UNIT 6 INVESTMENT APPRAISAL METHODS

Objectives

The objectives of this unit are to:

- Appreciate the need for proper Investment Appraisal.
- Explain the different Factors affecting Investment Decisions
- Discuss the different methods of Appraising Capital Projects, and their relative merits and demerits.
- Describe the limitations of Appraisal Techniques

Structure

6.1 INTRODUCTION

A proper decision-making in capital investment is one of the most crucial areas of financial management. The successful running of any business firm is dependent on the allocation of resources in such a way that benefits or the highest feasible returns are realized. The capital budgeting is the word used in financial management to describe the investment decision.In the corporate world, investment decisions and capital budgeting are not regarded separate acts. As a result, investment decisions are driven by the question of whether increasing capital assets today will boost revenues enough to cover costs in the future. As a result, investment decisions include commitments of money resources at various times in the hope of future economic rewards.

An evaluation of each investment project is required to verify that the resources invested will yield the anticipated results in the future. If financial resources were plentiful, it would be conceivable to accept a number of

investment ideas that met the approval or acceptability criteria. Since resources are limited, a decision must be taken by weighing the pros and cons of alternative investment options. This would make it easier to identify comparably superior alternatives while keeping in mind the limited resources available. It is obvious that certain procedures should be used while evaluating investment bids. We will describe the various appraisal methods and their relative benefits in this Unit.

Capital Budgeting Vs. Current Expenditure.

A capital investment project can be distinguished from current expenditure by two features:

a) The capital budgeting projects are relatively large.

b) A significant period (more than one year) elapses between the investment outlay and the receipt of the benefits.

As a result, most large and medium-sized businesses have created unique protocols and methods for dealing with these issues. A methodical approach to capital budgeting entails the following:

a) The formulation of long-term goals

b) The creative search for and identification of new investment opportunities

c) Classification of projects and recognition of economically dependent proposals

d) The estimation and forecasting of current and future cash flows

e) The controlling of expenditures and careful monitoring of crucial aspects of project execution

f) A set of decision rules which can differentiate acceptable from unacceptable alternatives is required.

6.2 NEED FOR INVESTMENT DECISIONS

The necessity for investment decisions arises in order to achieve the firm's long-term goals, such as; survival or expansion, maintaining market share, and maintaining leadership in a specific area of economic activity. As a result, the company may wish to make an investment decision in order to take advantage of economic opportunities that may develop due to the following factors:

i) Expansion of the manufacturing process to fulfil current excessive demand in the local market, as well as to take advantage of international markets and economies of scale.

ii) In order to take advantage of technical breakthroughs, reduce product costs, and improve labour efficiency, it may be essential to replace a current asset, plant, machinery, or facility.

iii) Another essential aspect that establishes the necessity for investment decisions is whether to buy, rent, or lease a specific item.

6.3 FACTORS AFFECTING INVESTMENT DECISIONS

Ezra Solomon claims that the following three types of data are needed to make the best investing decisions:

i) Calculate the proposed project's capital outlay and projected earnings.

ii) Capital availability and cost-cutting considerations, and

iii) A proper set of criteria for selecting projects for execution in order to maximise the return.

i) Estimation of Capital Outlays and Future Earnings:

When estimating future cash flows emanating from current investment decisions, the management of the firm is led by a number of factors. If the time horizon over which the benefits accrue is more than one year, the resources committed are referred to as capital investment, and the money spent is referred to as capital expenditure. (i) advance spending, (ii) land and site expenditure, (iii) building costs, (iv) machines and tools, (v) erection of equipment, (vi) training expenditure, (vii) franchise cost, (viii) inventory cost are some of the most common sorts of such expenditures. These expenses are related to establishing a facility and determining whether it is ready to operate. Further, it requires certain amount of money to meet the operating costs. The broad categories of such costs are as follows:

a) Labour cost,

b) Repairing charges and maintenance cost,

c) Rent and royalty payments,

d) Insurance charges,

e) Stationery cost,

f) Payment of tax and duties, and

g) Fuel and power costs.

In addition to the aforementioned kinds of costs, the depreciation provision and interest charges are two further types of annual expenditure. Financing decisions are linked to investment decisions. Acceptance of investment proposals will be contingent on how they will be funded.

ii) Sources of Capital:

The sources of capital can be divided into the following categories:

a) ***Internal Capital:*** It is generated by the firm itself, which includes retained profit, depreciation provision, taxation provision and other reserves.

b) ***External Capital:*** If the firm is in the need of more capital that is a variable from the internal sources, it may raise the capital from external sources; the external capital can be further classified as:

- ***Short-term Capital:*** It is needed to meet day to day expenses of the business operations (working capital).Usually this capital is meant for uses of less than one year duration.
- ***Long-term Capital:*** It is needed to meet the requirements of fixed capital formation. This capital is used for the purpose fo more than one year requirements.

iii) Selection of Projects:

It is critical for the proper running of any firm that funds be invested in such a way that advantages or the greatest potential returns or maximum returns are realized. The profitability of an investment is a critical aspect in making investment decisions.

6.4 TYPES OF INVESTMENT PROPOSALS

The terms 'investment choice,' 'investment projects,' and 'investment proposal,' according to financial management language, are often connected with the deployment of long-term resources. What exactly is a "long term"? There is no hard and fast rule to define it, but it is defined by common practice and in compliance with financial institutions' financing policies, practices, and regulations and banks a period of ten years and above is generally treated as long term.

Long-term financial investments may be required for the following reasons:

- Expansion of operation
- Diversification in operations
- Replacement/Modernization of plant and machinery
- Research and Development

a) ***Expansion:*** Currently, a manufacturing plant can produce one lakh units per year. If it plans to expand output to satisfy demand, it will certainly require more capital. As a result, the total variable cost will rise, and the current assets will rise as well. As a result, working capital financial resources will have to be raised. If the current production is less than the capacity, no new investment is required. If the present infrastructure, plant and machinery, and other permanent or fixed assets are insufficient, the proposal to increase production will necessitate a long-term investment of capital.

b) ***Diversification:*** The management of a company, such as the Indian Tobacco Company (ITC), opted to diversify its output into other lines of business by adding a new field of hoteliering to its core business. Philips, best known for its radios and light bulbs, has expanded its product line to include additional electrical appliances and television sets. This

diversification process would necessitate the employment of substantial capital resources for long-term investment.

c) ***Replacement:*** The machinery that are utilised in production may wear out or become obsolete as a result of new technology. The enterprise's productive capacity as well as its competitiveness may be harmed. Some money may be required for the modernization of a certain class of machines, as well as the renovation of the entire plant or structure, among other things. Modernization and renovation will be used instead of total replacement to make them more efficient and productive. As a result, cash will be invested for the long-term, and money will be required for replacement if renovation/modernization is not desirable or practical.

d) ***Research and Development:*** There has been a growing recognition that applying new and more complex production and management approaches can improve the efficiency of production and overall operations.

6.5 INVESTMENT APPRAISAL PROCESS

Investment appraisal is significant for since it is a type of fundamental analysis that can reveal a whether or not a fund investment has long-term potential. You have probably noticed that the investment proposals: (i) entail huge sums of money; (ii) entail a higher level of risk due to unforeseen circumstances; and (iii) frequently imply irreversibility once an investment decision is made. In light of these considerations, the work of evaluating investment proposals is critical in financial management. The following need to be considered before appraisal is taken up:

- The amount and timing of initial investment outlays
- The amount and timing of subsequent investment outlays
- The economic life of the project
- Salvage value at the end of the project
- The amount and timing of cash inflows

i) ***Initial Investment Outlay:***

This is the total amount of money required to carry out the proposal. It comprises design, survey, and consultant expenses, as well as working capital costs like stock maintenance and contingency reserves. The availability of credit from suppliers will reduce the amount of additional working capital necessary.

ii) ***Subsequent Investment Outlay:***

Maintenance, replacement, and upgrading costs should be recognised as outflows within the time frame in which they are scheduled to occur.

iv) ***Economic Life of a Project:***

A project's economic life must be distinguished from the life of a single asset. A building's lifespan may be sixty years, a plant's lifespan could be fifteen years, and certain equipment's lifespan may be as little as five years. The duration of the 'earnings flow' created by the project determines the project's economic life.

The economic life may end:

a) When the cost of replacement or remodeling becomes unfeasible in comparison to the expected advantages.

b) When the viability of the project is adversely affected due to obsolescence,

c) When rising maintenance costs exceed the estimated disposal value; and

d) When the development of new technology necessitates new investment.

iv) ***Salvage Value:***

Some equipment may have some value for the company at the conclusion of the project's life cycle, or it may have a projected sale value. At the end of the project's existence, this sum will be treated as an inflow.

v) ***Operating Cash Flows:***

Three main areas are to be considered here:

a) ***Sales Revenue:*** It is determined by the number of units sold and the unit selling price. Any underestimate of sales revenue might have a significant impact on an investment proposal's evaluation. The additional or incremental revenues created by every investment opportunity must be considered while evaluating it. It is also possible to invest in order to lower operating costs. For example, an older plant and machinery or equipment could be replaced with a modern one that is more cost-effective to operate. The new equipment may be more efficient (or productive), or it may require less electricity usage or maintenance expenditures, for example. It should be highlighted that the final impact of cost-cutting equipment is the same as that of new equipment for expanding capacity, namely, an increase in overall revenue.

b) ***Production Costs:*** The distinction between fixed and variable costs will be extremely useful in predicting cost behaviour. Only incremental costs must be taken into account.

c) ***Other Direct Costs:*** These expenses will cover selling and promotion costs, as well as additional rent and other expenses. By allocating the aforementioned things period-by-period, the net inflow/outflow of cash can be calculated. It may appear that determining the net cash flow, or the difference between total outflow (amount to be invested) and inflow (net of Sales Revenue Expenditure + Salvage Value), is all that is

required to assess the financial viability of an investment project or to choose between two offers.

Illustration-6.1

(Rs. in thousands)

Year	Net Cash Flows	
	Plan A	***Plan B***
0	40	-360
1	150	200
2	200	300
3	220	400
4	230	450
5	370	600
Total	**1210**	**1590**

Only plan 'B' creates a total cash flow of Rs. 15,90,000, but proposal 'A' only generates Rs. 12,10,000, as shown in the above illustration. This alone will not assist us in making an informed decision unless we know the total investment required for each of the plans, as well as the time value of money and the desired acceptable rate of return on investment. Hence it will be useful to examine a few methods of assessing the return on investment.

6.6 INVESTMENT APPRAISAL METHODS

The investment appraisal methods or techniques for evaluation of investment proposals will help the company to decide the desirability of an investment proposal, depending upon their relative income generating capacity and rank them in order of their desirability. These methods provide the company a set of norms on the basis of which, either it has to accept or reject the investment proposal. Therefore, a sound appraisal method should enable the company to measure the real worth of the investment proposal. The appraisal methods should possess several good characteristics, which are mentioned as under:

Characteristics of a Sound Appraisal Method:

i) It should help the company to rank the investment proposals in order of their desirability.

ii) It should provide a technique for distinguishing between an acceptable and non-acceptable project.

iii) It should provide a criterion to solve the problem of choosing among alternative projects.

iv) It should recognise the importance of time value of money; i.e., bigger benefits are preferable to smaller ones and early benefits are preferable to later benefits.

v) It should provide the criteria for the selection of investment proposals.

vi) It should consider the pattern of cash flows.

Different methods of appraisal of investment proposals are grouped into two types:

i) Traditional Methods:
   - Pay Back Period
   - Accounting Rate of Return

ii) Discounted Cash Flow Methods:
   - Net Present Value
   - Internal Rate of Return
   - Profitability Index

6.6.1 Traditional Methods

a) ***Pay Back Period***

Payback period method refers to the amount of time it will take for the complete amount invested to be recovered through net cash flow (after tax). Let us say you have invested Rs. 5 lakhs in a project with the following predicted net cash flows:

Illustration-6.2

	Incremental Cash Flow (Rs. in thousands)	
Year	Annual	Annual Cumulative
	(-) 500	(-) 500
1	185	(-) 315
2	125	(-) 190
3	140	(-) 50
4	170	120
5	180	300

The entire amount invested is evidently Rs. 5 lakhs. During the fourth year, this may be recovered. According to the calculations below, the payback period is 3.29 years (about three years and three and a half months):

$$P = E + B/C$$

Where,

P stands for payback period.

E stands for number of years immediately preceding the year of final recovery.

B stands for the balance amount still to the recovered.

C stands for cash flow during the year of final recovery.

The shorter the term, the better is the project. Early and certain results are preferable over longer-term forecasts that are more uncertain and questionable.

Calculating the payback technique is simple and straightforward. The

method's biggest flaw is that it disregards the timing and the amount of all cash inflows. The cash flows following the payback period are not considered. As a result, this method is ineffective for both absolute and comparative evaluation. Consider the following two projects as an example to illustrate this point:

Illustration-6.3

(Rs. in thousands)

	Project A		Project B	
Years	Cash Flow	Cumulative cashflow	Cashflow	Cumulative cashflow
0	(-)700	(-) 700	(-) 700	(-) 700
1	100	(-) 600	400	(-) 300
2	200	(-) 400	300	(-) 0
3	300	(-) 100	200	(-) 200
4	400	300	100	300
5	500	800	–	
Payback period		3.25 years	2 years	

The investment in both the projects is Rs. 7 lakhs, which results in a negative cash flow in the zero year. The payback period for project B is clearly shorter, and as a result, it may be preferred. Project A is likely to be rejected because of its slow cash flow start. This strategy, as previously stated, disregards the entire benefits or cash inflows created by the projects. In the above illustration, Project A generates cash flows for a longer duration than Project B. Project B generates returns over a shorter period of time and at a faster rate. As a result, the payback technique focuses just on the liquidity component of the business, ignoring the project's total profitability. It is not advisable to rely only on this strategy due to its simplicity. Because this method has some use, it may be awarded the rank of a secondary or subsidiary criterion rather than being completely rejected. In this case, a maximum payback term may be established, and projects that surpass this timeframe may be rejected.

b) Accounting Rate of Return

This method of calculating the rate of return on investment is based on the company's financial accounting methods for calculating annual earnings. After depreciation and taxes, the net annual profits are calculated. The average of annual earnings so obtained is calculated based on the project's life cycle (number of years). The accounting rate of return also called the average rate of return is defined as

$$\frac{Profit\ after\ tax}{Book\ value\ of\ the\ investment}$$

Illustration-6.4

(Amount in Rupees)

Years	Cash Flow (After tax)	Depreciation	Interest
1	13,000	6,000	400
2	11,000	6,000	400
3	9,000	6,000	400
4	6,400	6,000	400
5	6,000	6,000	400
Total	**45,800**	**30,000**	**2,000**

The investment is Rs. 30,000. Accounting rate of return will be equal to the average of net cash flow (after depreciation, taxes, and interest) as a percentage of investment.

$$\frac{(45,800 - 30,000 - 2,000) \times 1/5}{30,000} = 9.2\%$$

The return is calculated in the following using the original (initial) investment in the project, which is Rs. 30,000.Because the investment in this illustration is a depreciable asset with a five-year useful life and no salvage value, it could be argued that the investment base for calculating ARR should be the average investment, which is one-half of the initial investment, in this case Rs. 30,000/2 = 15,000. Based on an average investment, the ARR would be:

$$\frac{(45,800\text{-}30,000\text{-}2,000) \times 1/5}{15,000} = 18.4 \text{ Per cent}$$

The rate of return will be double the rate calculated on the original investment if there is no salvage value and the average investment is one-half the original investment.

This technique, like the Payback Method, overlooks the time value of cash flows because it does not account for the timing of revenue creation (first year, second year, etc.). Cash flow timing is an important factor to consider when making investment decisions. Higher earnings in the early years and lower earnings later in life cannot be compared to lower earnings in the early years and higher earnings later in life. As a result, the ARR technique has a fundamental flaw in that it ignores the quality or pattern of benefits as well as the time value of money. Further, it does not consider the scrap value of an asset (or project) at the end of its useful life. Finally, the calculation of profit is subject to varying practices. The attempts at window dressing and manipulation of accounting data have a distorting influence on the calculation of profit and consequently on the ARR. All these factors make ARR a less reliable method.

6.6.2 Discounted Cash Flow Methods

The Discounted Cash Flow (DCF) methods provide a more objective basis for evaluating and selecting an investment project. These methods consider

the magnitude and timing of cashflows in each period of a project's life. Thus, the discounted cashflow methods enable us to isolate the differences in the timing of cashflows of the project by discounting them to know the present value. The present value can be analyzed to determine the desirability of the project. These techniques adjust the cashflows over the life of a project for the time value of money. This principle underpins two methodologies for valuing investment projects. There are three different DCF methods. There are three different DCF methods. They are Net Present Value approach, the Internal Rate of Return approach and, the Profitability Index.

i) ***Net Present Value Method:***

Understanding the compound rate of interest or the general compounding formula will help you calculate the net present value of future income. Assume that an amount of Rs. 100 (P) is invested for one year at a rate of interest (r) of 10% per annum. The investment at the end of one year will be equal to:

$$P\left(1+\frac{r}{100}\right)^{n}$$

$$= 100\left(1+\frac{10}{100}\right)^{n}$$

$$= 100\left(1+\frac{11}{100}\right)^{n=1}$$

$$= 110$$

It is also possible to say that what was worth Rs. 110 a year ago is now only worth Rs. 100.

When the compounding formula is used to calculate the present value (PV) of a future stream of income over a number of years, the formula is reconstructed as

$$PV = \frac{P}{\frac{(1+r)^{n}}{100}}$$

Where,

P is the amount to be received in the future (number of years = n), and r denotes the annual interest rate. Let us say we want to know the PV of a cash flow of Rs. 500 that would be received at the end of five years at a 10% interest rate. The PV will be as follows:

$$= \frac{P=500}{(1+r=1.10)^{n=5}} \quad = \frac{500}{(1+.10)^{5}} \qquad = \quad \text{Rs. } 310.5$$

Rather than wasting time with computations, look at Table-1 (at the end of this block), which shows the discount factor for 10% over a 5-year period in terms of the present value of one rupee. The value is 0.621. By multiplying it by Rs. 500 in predicted future earnings This income's PV will be 500 x 0.621= Rs. 310.5.If a person receives a series of similar amounts over a five-

year period, say Rs. 1,000 each year, the present value of these receipts can be calculated as follows:

Years	Amount (Rs.)	Present Value Factor @10%	Present Value (Rs.)
1	1,000	.909	909
2	1,000	.826	826
3	1,000	.751	751
4	1,000	.683	683
5	1,000	.621	621
			3790

Discounting is the practice of decreasing future values according to the parameters provided in order to determine the present value. Table-2 provides a straightforward technique of computing the present value when the annual cash flows to be received over a period of time are equal in amount, as in the aforementioned situation.

In Table-2, you may discover a factor of 3.790 in the 10% column for the line for 5 years using the aforementioned example. When you multiply it by 1,000, the present value is the same, which is Rs. 3,790, as estimated using the longer technique using Table-I. Table-2 contains factors that reflect the yearly present value of Rupees received for a particular number of years (this form of cash flows is commonly known as an annuity).

You will notice that by discounting the predicted yearly returns for each year the project has been evaluated, rather than a few years' return as covered under the Payback Method. We may calculate the PV of the aggregate inflows by adding the PV of the annual cash inflows for each year of the project's estimated life. This is easily comparable to the cash outflow required for investment today. If the total PV of cash inflow exceeds the current outflow, the investment plan can be acceptable. With the net present value method, the decision to accept or reject a proposal or to accept the superior one (with greater PV for the same investment) out of two or more proposals can be made more rationally. We may illustrate the method by comparing two projects.

Illustration-6.1

(Rs. in thousand)

Project	Initial Outlay	Net Cash Income (before depreciation but after Tax)							
		Year							
	Rs.	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
A	20,000	4	4	4	8	2	-	-	-
B	20,000	8	6	2	2	2	2	2	2

Assume a discount rate of 7%.

The firm can be assured of a surplus if the current value of the stream of net cash flow exceeds the capital expenditures. When comparing alternative projects, the one with the highest net present value (or positive net present value) will be chosen.

Year	Project A			Project B		
	Net Cash Income (Rs.)	Discount Factor*	PV (Rs.)	Net Cash Income (Rs.)	Discount Factor*	PV (Rs.)
1	4000	0.935	3,740	8000	0.935	7,480
2	4000	0.873	3,492	6000	0.873	5,238
3	4000	0.816	3,264	2000	0.816	1.632
4	8000	0.763	6,104	2000	0.763	1.526
5	2000	0.713	1,426	2000	0.713	1.426
6	-	-	-	2000	0.666	1.332
7	-	-	-	2000	0.623	1.246
8	-	-	-	2000	0.582	1.164
Total Present Value(Rs.)			18,026	21,044		
Initial Cost(Rs.)			20,000	20,000		
Net Present Value (Rs.)			(1,974)	1,044		

* Refer to Present Value Table

We utilised a discounting rate, often known as the 'cutoff' rate, 'hurdle' rate, or ‘required rate of return', to calculate the NPV. When more than one investment proposal is to be evaluated and the funds available for investment are insufficient to accommodate all of the proposals, the discounting rate is very important. Is the discounting rate chosen at random or is there any rationale behind it? Should it be the present rate of return on capital employed, or the rate at which the firm would borrow or lend money? A business may set a target rate of return for valuing an investment that is not less than the cost (or interest rate) of the funds required for the investment.

However, it should be noted that monetary interest rates do not reflect the additional risks that a company may face. As a result, logically, the corporation should choose the rate of interest that best represents the project's risk, i.e., a rate that is likely to be close to, if not exactly equal to, the overall rate of return on capital employed. The NPV technique, in addition to assessing the time value of money, examines the total benefits of a proposed project over its lifetime. This strategy is very beneficial for choosing tasks that are mutually exclusive. Acceptance of proposals with positive net present values is anticipated to have a favourable impact on stock market prices.

The NPV approach is harder to compute and understand than the payback or ARR approaches. It can be challenging to decide which discounting rate to apply when computing present values. The choice of a discounting rate has a significant impact on a project's attractiveness. An attractive project can

become an unattractive one if the rate changes, and vice versa. The NPV approach may not provide reliable findings for projects with varying outlays. It is also possible that it will not produce good results if the projects in the competition have various lifespans. If all other factors are equal, a project with a shorter payback period would be preferable.

Activity-6.1

a) How much money would you have to put into a savings account today to have Rs. 4,000 at the end of five years assuming the bank offers a 5% half-yearly return? How much would you need to put down if you desired Rs.10,000 in five years?

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b) If you deposit Rs. 1,000 today and the bank pays an annual interest rate of 11%, how much money would you have in a Fixed Deposit Account after seven years? If you deposited Rs.4,500 today, how much would you have after seven years?

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c) Suppose you have won a prize in a lottery; you have the opportunity to pick one of the two prizes?

Prize A: Rs. 50,000 a year for the next ten years, paid on December 31 of each year.

Prize B: Rs. 2,50,000 cash paid today, 'January 1.

Which award would you choose if both rewards were tax-free, and you could earn a 6% annual interest rate on your money (also tax-free)?

Which prize would you choose if you could double your money's value? At what interest rate do you think the two rewards are worth the same to you?

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ii) ***Internal Rate of Return:***

The Internal Rate of Return is another way for evaluating investment ideas that falls within the Discounted Cash Flow methods. Using this method, we can calculate the discounting rate at which the sum of all future cash inflow PVs equals the proposal's current cash outflows. The illustration below will help you understand this method:

Illustration-6.6

Year	Net Cashflow	Present Value of Net Cash Flow			
		At Discount Rate	20%	At Discount Rate	10%
		Discount Factor	Rs.	Discount Factor	Rs.
0	-100	1.000	- 100.00	1.000	(-) 100.00
1	40	0.833	33.30	0.909	36.40
2	35	0.694	24.30	0.826	28.90
3	30	0.579	17.40	0.751	22.50
4	25	0.482	12.10	0.683	17.30
5	20	0.402	0.621	12.40	
			(-)4.90		17.30

You can see that at a discount rate of 20%, the PVs (Rs. 95.10) of future cash inflows are Rs. 4.90 less than the current outflow of an investment of Rs. 100. At a 10% discount rate, the total PVs of future cash inflows are Rs. 17.30 higher than the original cash outlay. The rate of discount will be found by interpolating between the two aforementioned rates of 20% and 10% in order to equalize the inflows and outflows. This can be accomplished in the manner outlined below:

$$IRR = LRD + \frac{(NPVL)}{PV} \times R$$

Where,

IRR is the Internal Rate of Return

LRD is the Lower rate of discount.

NPVL is the Net Present Value at a lower rate of discount (i.e., differences between present values of cash inflows and present value of cash outlay or outflows).

PV is the difference in present values at lower and higher discount rates.

R is the difference between two rates of discount.

Substituting the values, we get:

$$IRR = 10 + \frac{(17.30)}{(22.20)} \times 10 = 17.8$$

If a discount rate of 17.8 percent is used, the two inflows will be equal. Clearly, if this discount rate is larger than the target rate or the interest rate used to calculate the cost of funds, the cost of funds will be higher, the investment project should be acceptable.

IRR through Payback Reciprocal:

The IRR is calculated by a rigorous and time-consuming trial-and-error approach. The reciprocal of payback, which is a good approximation of the IRR, can be used to solve this problem. The concept can be applied to situations where a fixed cash flow is obtained over the asset's lifetime as well as situations where fluctuating cash flows are obtained.

Where cash inflows are constant (or the same) every year (called annuity):

The procedure to calculate IRR is as under:

i) Determine the payback period of the proposed project.

ii) Look for the factor closest to the payback period in the year row of the present value of annuity table. The relevant year for the purpose would be equivalent to the life period of the project.

For instance, if the life of the project is 6 years and its payback period is 4 years, then we have to look for the factor closest to 4.000 for the year 6 in Table. According to Table the factors closest to 4.0 for 6 years are 3.998 (13 % rate of interest) and 4.111 (12 % discount rate). The value closest to 4.0 is 3.998. Therefore, the actual value lies between 12 and 13 per cent, tilting on the side of 12 per cent. This value can be calculated by interpolation as shown in Illustration-6.6.

Where the stream of cash flows is of varying nature:

The calculation of IRR under such circumstances is a little more difficult. The way to simplify the process is to use a `fake annuity' as a starting point.

The following procedures may be followed:

i) Calculate the average annual cash flows to get a fake annuity.

ii) Determine `fake payback period' by dividing the initial outlay with the average annual cash flows after taxes (CFAT) as calculated in step (i).

iii) Look for the factor in the annuity Table closest to the fake payback period in the same manner as in the case of annuity.

iv) Adjust the IRR derived in step (iii) by comparing the average annual cash flow pattern from step-I to the actual variable stream of cash flows. Adjust the IRR a few percentage points upward if the real cash flow stream is higher in the early years of the project's existence than the average stream. Conversely, if in the early years the actual cash flow is below the average, adjust the IRR a few percentage points downward.

v) Find out the present value of the uneven cash flows, taking the IRR as the discount rate as estimated in step (iv) by using present value Table.

vi) If the PV of CFAT equals the original outlays by accident, you have arrived at the correct IRR. Otherwise, if you have not found the proper IRR rate yet, repeat step-(v). It is possible that the net present value will be positive or negative. If it is positive, try working for a different rate (i.e., a higher rate) to make it negative. If the NPV is negative, find a different rate (i.e., a lower rate) that will make it positive. When two consecutive discount rates are discovered, one of which causes the NPV to be positive and the other causing it to be negative, the true IRR can be calculated using the interpolation method, as shown in Illustration-6.6.

In brief, whether the cash inflows of a project are the same or change each year, you should choose two discounting rates such that the NPV result of the lower discounting rate is a positive amount and the NPV result of the higher discounting rate is a negative amount. The interpolation formula can then be used to calculate the accurate IRR. You do not need to worry about what is indicated point 2 above if your intuition is strong enough and you can estimate the two consecutive discounting rates with a little effort (viz., when the stream of cash flows is of varying nature).

IRR, like NPV, considers the time value of money as well as total cash inflows and outflows across the project's whole life cycle (asset). It is easier to understand for managers because the computation is always a percentage rather than an absolute number, as with the Net Present Value method. It also has the advantage of not requiring a discounted rate. A rate of return is provided by the technique itself. If projects are chosen with IRRs that are higher than the required rate of return, the strategy will achieve the goal of maximum of shareholder wealth.

However, as you may have noticed, IRR necessitates time-consuming calculations (based on trial-and-error or interpolation). Cash flows are supposed to be reinvested at the same rate as IRR in the IRR technique. This also means that if the IRR of two projects is, say, 16% and 20%, the cash flows generated by these two projects will be reinvested at their respective rates, i.e., 16% and 20%. It may appear unreasonable to reinvest cash flows at two different rates inside the same organisation. Several factors may influence whether project cash flows are reinvested in the company or used for other purposes. The cash earned may or may not be used internally in various circumstances.

Net Present Value Vs. Internal Rate of Return (IRR):

In many ways, the NPV and IRR approaches are similar. In some circumstances, they would make the same accept or reject decision, but in others, they would make a different conclusion. Let us see the similarities and differences between these two methods:

i) Similarities:

In certain cases, the two methodologies would produce consistent outcomes in terms of investment proposal acceptance or rejection. Both approaches will tell whether or not a project is sound. Both techniques

will suggest that the project should be rejected if it does not meet the criteria for acceptance.

***Conventional and Independent Projects*:**

Both the NPV and IRR approaches will yield the same accept-reject conclusion in the case of conventional and independent projects. A traditional project has a cash flow pattern that starts with a capital investment and ends with a cash inflow. Capital outflows are limited to the initial period, i.e., at the start.

The term "independent initiatives" refers to investment ideas that do not preclude the adoption of another profitable project. If finances are available, all profitable applications will be approved. Accepting all profitable proposals has no further limits. Both the NPV and IRR techniques would imply that the same projects are profitable. If the NPV approach is utilised, all projects with a positive net present value (NPV) will be allowed; if the IRR technique is used, all projects with an IRR greater than the needed rate of return will be allowed. The last project that is allowed under NPV is one that has zero net present value; however, this project will have an IRR equal to the needed rate of return if utilizing the IRR approach.

The internal rate of return on the projects with positive net present values would be higher than the required rate of return. Only when the marginal or last project's internal rate of return equals the necessary rate of return will it have zero net present value. In terms of accepting or rejecting conventional and independent initiatives, the NPV and IRR techniques are comparable.

Decision Rule:

Accept a project	If, NPV is greater than zero (NPV >0)
	If, IRR is greater than required rate of return (IRR > k)
May accept/	If, NPV is equal to zero (NPV =: 0)
Reject a project	If, IRR is equal to required rate of return (IRR = K) .
Reject a project	If NPV is Negative or less than zero (NPV <0)
	If, IRR is less than required rate of return (IRR <K)

Projects which have positive NPV will also have an IRR higher than the required rate of return. Projects which have negative NPV will also have an IRR lower than the required rate of return. Projects which have zero NPV will also have an IRR equal to the required rate of return.

ii) Differences:

The NPV and IRR approaches will yield the same outcome in the case of independent and conventional projects. In some cases, however, they will produce contradicting responses. For example, if the NPV approach considers one plan acceptable, IRR prefers another. This occurs when two projects are mutually exclusive.

Mutually Exclusive projects:

Projects that are mutually exclusive are ones in which the acceptance of one proposal results in the rejection of another. If there are multiple options for action, only one can be chosen; these options are mutually exclusive.

For example, a corporation may choose to set up its own sales organisation or hire an outside distributor to market its products. Out of the two options, the more profitable one will be chosen. When initiatives are mutually exclusive, ranking them becomes critical. Because the NPV and IRR standards can result in projects being ranked in a different order. When the ranking provided by the NPV and IRR approaches differs for mutually exclusive projects, it is preferable to employ the NPV technique, which is compatible with the goal of maximising shareholder wealth.

Non - Conventional Investments:

Non-conventional investments are those that do not guarantee a steady stream of cash inflows. In addition, funding may be necessary in order to utilize the project. During the project's lifespan, it may be necessary to invest more money.The purchase of an asset creates cash inflows for a number of years, is overhauled, and creates a stream of cash inflows for a number of years is a typical example of a non-conventional investment pattern.For Rs. l,00,000, a machine can be acquired that generates cash inflows of Rs.25,000 per year for seven years. The machine will require a Rs.40,000 outlay (investment) in the eighth year to be overhauled, following which it would yield cash inflows of Rs.25,000 each year for the next seven years.

In this instance, the NPV and IRR approaches will rank the projects in a different order. Because IRR approaches produce multiple rates of return. The number of different rates of return is determined by the number of times the cash flow stream's sign changes. To address this issue, it is recommended that non-conventional investment projects be chosen using the NPV technique.

NPV and IRR choice of the Methods:

Both approaches, NPV and IRR, produce the same conclusions in the case of conventional and independent projects. However, the NPV and IRR techniques produce inconsistent conclusions in the case of mutually incompatible projects and projects involving non-traditional investments. Then, due to its advantage over IRR, the NPV approach should be used. Moreover, the NPV method is consistent with the objective of maximising the wealth of the shareholders.

iii) Profitability Index:

When using the Internal Rate of Return approach, a proposal may be rejected if the IRR is lower than that of the other, yet the former may not be a terrible proposal if the NPV is calculated using the target rate of discount.

Project	Cash outflow in year 0	Cash inflow per annum for 5 years (Rs.)	IPR%	NPV at 10% Rs.	NPV at 15% Rs.
A	50,000	15,000	15.4	6,865	280
B	68,000	20,000	14.4	7,820	960

If the organisation must pick between the two projects, and the IRR criterion is used, Project B will be rejected because it has a lower IRR. Project B, on the other hand, will be chosen if the - goal rate is set to 10% since it has a greater NPV. However, if a 15% target rate is applied, Project A will be chosen since it appears to be more appealing. You can calculate the figures and verify the results on your own.

The investment plan is good if the PV of aggregate future cash inflows is higher than the current cash outflow by way of investment, as stated earlier. If we had to select between two options, the one with a bigger excess of discounted cash inflows over cash outflows will be the superior option.

Illustration-6.8

Proposal	PV of total inflows (Rs.)	Outflows (Rs.)	Surplus (Rs.)
A	4,50,000	4,00,000	50,000
B	1,20,000	1,00,000	20,000

Proposal A appears to be more appealing because the net surplus over cash outflows is higher than in Proposal B. Please note that we are overlooking a very important factor: the rate of return on investment. The size of the inflow is meaningless unless it is compared to the entire amount of investment. Now, using a simple way of determining rate of return, we can see that the return on investment in the case of 'A' is:

$$\frac{50{,}000 \times 100}{4{,}00{,}000} = 12.5\ \%,$$

Whereas, in case of 'B' it is,

$$\frac{20{,}000 \times 100}{1{,}00{,}000} = 20\ \%.$$

Now it can be rationally stated that proposal 'B' is superior to 'A'.

The Profitability Index (PI) represents the connection between the present values of net cash inflows and outflows. It can be calculated in both unitary and percentage terms. The formula is as follows:

$$\text{Profitability Index} = \frac{\text{Present Value of Cash inflows}}{\text{Present Value of Cash outflows}}$$

If we apply this formula to the Illustration, we find that profitability index for each of the two proposals is:

A 4,50,000 ÷ 4,00,000 = 1.125 or 112.5%

B 1,20,000 ÷ 1,00,000 = 1.20 or 120%

You will find that the result is identical as per the rate of return on investment calculated earlier. Proposal B, therefore, is superior.

A question may now be posed. Why have two procedures if the result is the same under each of them? Please keep in mind that if Management has set a 'cut off rate' for accepting investment ideas, a proposal will not be authorized if the rate of return falls below the 'cut off rate' or the minimum projected rate of return. In the lack of a cut-off rate, the profitability index may appear to be meaningless. If two or more investment projects pass these criteria, however, due to resource restrictions, a decision may have to be taken amongst them. As a result, a plan with a high profitability index may be approved for approval. If there is no basic cut-off rate, the profitability index can be used once again be regarded as a good guide for choice making.

Net Present Value Vs. Profitability Index:

The NPV and PI as investment criteria, in most cases, provide the same accept or reject result. Both strategies are closely related to one another. The investment proposal will be accepted using the PI technique if the PI is bigger than one. The PI will be bigger than one if the investment proposal has a positive net present value. When the investment proposal has a negative NPV, PI will be less than one. These approaches may produce different rankings in the case of mutually exclusive investment offers. This is demonstrated in the following example.

Year	Project A Rs.	Project B Rs.
0 (outflows)	-5,000	-3,500
1 (inflows)	4,000	3,000
2 (inflows)	4,000	3,000
Present value of cash inflows @ 10%	6,944	5,208
(-) Less cash outflows	5,000	3,500
NPV	**1,944**	**1,708**

Profitability Index = $\frac{6,944}{5,000} = 1.39$ $\frac{5,208}{3,500} = 1.49$

As a result, project "A" is acceptable using the NPV technique, and project "B" is acceptable using the PI technique. Which project should the firm take on? As previously stated, the NPV method is preferable, hence project 'A' should be approved. The best project is one that adds the most value to the shareholders' wealth among the available options. As a result, the NPV technique provides a better mutually exclusive choice than the PI technique and ensures the selection of the best choices.

6.7 DEPRECIATION, TAX, AND INFLOWS

It is important to note that depreciation is not included in Discounted Cash Flow (DCF) calculations. A common mistake is to discount cash flows after depreciation has been deducted. This type of inaccuracy, in fact, demonstrates a lack of comprehension of the DCF's essential concept. The DCF approach is fundamentally based on inflows and outflows of cash and not on the accrual concept of revenues and expenses. Depreciation does not involve any cash flow. It is merely a book entry to allocate the cost of the asset over its useful life. It has of course the effect of reducing disposable income.

The initial cost of an asset is commonly seen as a lump sum outflow of cash at time zero in the DCF technique. In our examples, cash inflows are assumed to be after income taxes. As mentioned, depreciation is not considered when using discounted cash flow approaches. Nonetheless, because of its relationship with income tax, depreciation has some impact on annual cash flows. You are probably aware that depreciation is deductible as a regular company expense when calculating your taxable income.

Illustration-6.9

A piece of automatic equipment with an original cost of Rs. 12,000 is available for acquisition by the New Look Company. Calculate cash inflow after taxes using the following assumptions: annual cash savings of Rs. 5,600 before taxes, depreciation (straight line) of Rs.2,400 (based on the initial cost of Rs. 12,000), no salvage value, five-year life, and a tax rate of 50%.

	Tax Purpose Rs.	**Cash inflow** Rs.
Gross annual cash cost savings	5,600	5,600
Less: Depreciation	2,400	
Net incremental income subject to tax	3,200	
Income tax at 50% (payment in cash)	1,600	1,600
Net cash inflow after taxes		4,000

The income tax on Rs.5,600 would have been Rs.2,800 if depreciation had not been deducted, and the net incremental cash inflow would have been Rs. 2,800. As it stands, Rs. 1,200 of cash flow is kept; the tax rate (50%) applied to the depreciation deduction (Rs. 2,400) is thus considered a "tax shield."

6.8 LIMITATIONS OF APPRAISAL TECHNIQUES

The methods for valuing investments appear to be precise. However, it must be understood that an investment proposal's genuine worth can only be approximated. The final findings are based on estimated factors, which must be kept in mind at all times. The degree of impartiality and reliability of the input data would determine the outcomes' dependability to a considerable

extent. Constant inflation further confuses the picture. It's critical to factor in expected inflation when calculating cash flows.

The quantitative methodologies for investment appraisal essentially include three components: (i) capital investment, (ii) return or cash flows, and (iii) project or asset life. While capital investment can be calculated to a high degree of accuracy in some circumstances (e.g., the purchase price and installation cost of a piece of equipment), it cannot be done in all circumstances (e.g., development of a new product, opening a new sales territory), the amount can only be approximated.

The return factor, or cash inflows, is always subject to guesswork. And these estimations are based on the subjective probabilities (used in risk analysis) that are attributed to different outcomes. With so many unknowns in the future, forecasted cash flows may only be half-truths. The estimation of sales volume and price is the source of the majority of big errors. To calculate the amount of money saved from using labor-saving equipment, for example, an experienced engineer or production executive must evaluate the number of labour man hours saved, the rise or decrease in maintenance costs, the impacts on power consumption, and a variety of other factors.

Finally, estimating the usable or economic life of a project or asset is arguably the most difficult of all, as it is influenced by a variety of environmental, technological, and marketing factors. Only if the rate of technological change and obsolescence can be accurately assessed if an engineer's assumption about the usable life of a productive asset can be trusted. Customer acceptance and competitor reactions are both highly speculative events that determine whether a new product will be lucrative. Certain probability-based statistical techniques can help to reduce estimation mistakes when there is uncertainty, but they cannot completely eliminate uncertainty and thus inaccuracy.

The decision's soundness would thus be determined not only by the proper choice (or combination) of appraisal technique (or procedures), but also by the decision-makers' sound common sense and judgment.

6.9 SUMMARY

One of the most important ways for Management to attain the goal of wealth maximisation is through effective long-term capital deployment. Investment decisions influencing long-term capital projects or assets have a significant impact on the organization's future success. This unit focused on how to make more effective investment decisions that contribute to the firm's healthy growth. The management will be able to rank and choose among the proposals competing for essentially scarce long-term funds if proper analysis methods are used.

The Payback period, Accounting Rate of Return, and Discounted Cash Flow approaches, including; (i) Net Present Value, (ii) Internal Rate of Return, and (iii) Profitability Index, are the methodologies used for Capital Budgeting decisions. The Pay Back method is a quick way of determining how long it

will take to return the initial investment from the cash flow generated by the enterprise.

The Accounting Rate of Return method is simple to understand and calculate, but it has major drawbacks. It averages cash flows rather than distinguishing between projects with long and short lifespan, as well as those with irregular cash flows. This model is appropriate when a project's return clearly surpasses the needed rate or when the project is not in direct competition for money with other projects.

The Net Present Value and the Internal Rate of Return methods are the two most common discounted cash-flow approaches. When calculating the present value of cash inflows, the former uses a desired (or needed) rate of return as a discount factor. The investment should have a present value excess over the initial cost or investment at the targeted rate. The latter is the rate of return, which compares the cost of future cash flows to the cost of the initial investment that generates them. Both of these DCF strategies produce equal results in many situations. The Profitability Index is the third in this category, and it shows the percentage relationship between the present value of cash inflows discounted at the desired rate and the present value of the cash outflows discounted at the desired rate and the cost of the investment. This method offers ready comparability between projects of unlike size and duration.

Discounted cash flow approaches, in general, provide the most accurate evaluations of various investment plans. These methods are relatively straightforward to utilize because of the usage of present value tables. All capital budgeting appraisals are subject to certain constraints. However, the three fundamental components of quantitative analytical procedures - investment, return, and time - are all estimations to differing degrees. The key factor in investment appraisal is the assessment of future benefits. Certain methodologies have been developed, such as sensitivity analysis, to help reduce the margin of error of such estimates.

6.10 SELF ASSESSMENT QUESTIONS/ EXERCISES

1. Examine different types of capital projects and explain why they are often approached differently?
2. What is payback period? Why does this method enjoy a good deal of popularity? What are its limitations?
3. What is Internal Rate of Return? Are the Internal Rate and Payback related? Explain?
4. What are the essential limiting factors in the reliability of capital budgeting measurement techniques including discounted cash flow?
5. Discuss about `cost of capital' as a device for establishing a cut-off point for capital investment proposals.

6. The Western India Company is considering the replacement of one of its machines with a newer model, which supposedly will reduce operating costs considerably. The company has prepared the following analysis of costs:

	Old Machine Rs.	New Machine Rs.
Depreciation	10,000	18,000
Labour	12,000	6,000
Other Costs	10,000	4,000
Total Annual Costs	**32,000**	**28,000**

The old machine originally cost was Rs. 80,000 and has been operated for three years out of an estimated eight-year life. The new machine, which has an estimated life of five years, can be acquired for Rs. 90,000 less a trade-in allowance of Rs. 20,000 for the old machine. The other costs listed above consist of repairs, power to operate the machine, lubrication, and similar costs.

Which of the following statements is false?

a) Depreciation on the old machine is a sunk cost.

b) Depreciation on the old machine may be disregarded in deciding whether to replace the old machine.

c) Labour and other costs are out-of-pocket costs.

d) The payback period of the new machine is seven and one-half years.

7. The Greatways Company is considering replacing an old machine with a newer model having lower maintenance costs. The old machine has a current book value of Rs. 9,000 and a (straight line) depreciation charge of Rs. 3,000 per year for the remaining life of 3 years including the current year. It will have no salvage value. However, at present the machine can be sold in the market for Rs. 6,000. The existing machine requires annual maintenance costs of Rs. 3,000. The new machine will cost Rs. 12,000 and require an annual maintenance costs of Rs.600. Its expected useful life is 3 years with no salvage value.

   Assuming straight-line depreciation also for new machine and a tax rate of 50%, determine the incremental cash flows (both outflows and inflows) of the replacement decision.

8. Farewell Company has an investment opportunity costing Rs.30,000 with the following expected net cash flow (i.e., after taxes and before depreciation);

Year	Net Cash flow (Rs.)
1	4,000
2	4,000
3	4,000

4	4,000
5	4,000
6	7,000
7	9,000
8	12,000
9	9,000
10	2,000

Using 10% as the cost of capital (rate of discount), determine the following:

a) Payback period

b) Net present value at 10 % discounting factor

c) Profitability index at 10% discounting factor.

d) Internal rate of return with the help of 10 % discounting factor and 15 % discounting factor.

9. The Deccan Corporation, which has a 50% tax rate and a 20% after-tax cost of capital, is evaluating a project which will cost Rs. 1,25,000 and will require an increase in the level of inventories and receivables of Rs. 25,000 over its life. The project will generate additional sale of Rs. 1,00,000 and will require cash expenses of Rs. 25,000 in each of its 5-year life. It will be depreciated on a straight-line basis. What are the net present value and internal rate of return for the project?

10. The management of Maratha Udyog has two alternative projects under consideration. Project `A' requires a capital outlay of Rs. 3,00,000 but project `B' needs Rs. 4,20,000. Both are estimated to provide a cash flow for six years: A Rs. 80,000 per year and B Rs. 1,10,000 per year. The cost of capital is 12%. Show which of the two projects is preferable from the viewpoint of (i) Net Present Value and (ii) Internal Rate of Return.

11. Speedex Dry Cleaning Company is considering the purchase of new wash and dry equipment in order to expand its operations. Two types of options are available: a Low-Speed System (LSS) with a Rs. 40,000 initial cost and a High-Speed System (HSS) with Rs. 60,000 initial costs. Each system has a sixteen-year life and no salvage value. The net cash flows after taxes (CFAT) associated with each investment proposals are:

CEAT for year-1	Low Speed System (LSS	High Speed System (HSS)
through 16	Rs. 8,000)	Rs. 12,000

Which speed system should be chosen by Speedex, assuming 15 % cost of capital/rate of discount?

12. Space Age Printers, a large and profitable printing press, is faced with the prospect of replacing a large printing system. Two systems currently being marketed will do the job satisfactorily. The Superior system costs Rs. 1,50,000 and will require cash running expenses of Rs. 60,000 per year. The Matchless system costs Rs. 2,25,000 but running expenses are expected to be only Rs. 45,000 per year. Both machines have a ten-year

useful life with no salvage value and would be depreciated on a straight-line method.

a) If the company pays a 40 % tax and has a 11 % after-tax required rate of return, which machine should it purchase?

b) Would your answer be different if the required rate of return is 9% ?

13. Vishwa Bharti Company is examining two mutually exclusive proposals for new capital investment. The data on the proposals are as follows:

Proposal A	**Proposal B**	
Net cash outlay	Rs. 50,000	Rs. 60,000
Salvage value	2,000	NIL
Estimated life	5 years	6 years
Depreciation	Straight-line Method	Straight-line Method
Corporate income-tax	50%	50%
Cut-off rate used for appraisal	10%	10%
Earnings before Depreciation and taxes		
I year	Rs. 13,000	Rs. 12,000
II year	15,000	16,000
Ill year	18,000	18,000
IV year	22,000	24,000
V year	12,000	24,000
VI year	-	20,000

Using both (a) present value method and (b) D C F rate of return (internal rate of return) calculations, you are asked to advise which proposal would be financially preferable, (you may calculate depreciation on the original cost without taking salvage value into account. You may also ignore income tax on salvage value received).

14. Arunachal Limited has been having a job performed by a neighbouring company on a part used in its project at a cost of Rs.5 per part. The annual average, production of this part is expected to be 6,000 pieces.

The Arunachal Limited itself can perform this operation by bringing into operation two machines: spare lathe which has a net book value of Rs. 2,000 and a new machine which can be purchased at a price of Rs. 70,000.

The new machine is expected to last 7 years. The old machine has a remaining physical life of at least 10 years and could be sold now for approximately Rs. 15,000. The final salvage value of both machines is considered negligible.

In performing the operation, on its own, the Arunachal Limited will incur out-of-pocket costs for direct labour, power supply, etc. of Rs. 2 per part.

Prepare an analysis (including explanatory comments) which would help to determine whether it is profitable for the company to perform these operations itself. The company normally expects to earn a rate of return before taxes of about 15 % on its invested capital. Ignore income tax effect.

Answers to Questions/Exercises (6 through 12)

6. (d) The payback period is approximately five and five-sixth year. The required outlay is Rs. 70,000 (90,000-20,000). The annual savings in out-of-pocket costs are 22,000 (12,000 + 10,000) less Rs. 10,000 (6,000 + 4,000), or 12,000. The payback period is then Rs. 70,000 ÷ 12,000.

7. Cash inflow due to sale of machine Rs 7,500

   Net cash outflow Rs 4,500

   Total cash inflow each year with new machine Rs 1,700

8. a) Payback period = Six years and four months

   b) Net present value = Rs. 3,917

   c) Profitability Index = Rs. 1.131 (or 113.1%)

   d) Internal rate of Return = 12.75 (approx.)

9. NPV = Rs. 9,600

   IRR = 22.78 (try interpolation between 20% and 24%)

10.

	NPV	IRR
Project A	28,880	15.34
Project B	32,210	14.68

Project B is preferable as its NPV is more than that of A. Project A is preferable on the basis of IRR.

11.

	LSS	HSS
NPV	7,632	11,448

The High-Speed System should be chosen by the company as its NPV is greater than that of the Low Speed System. However, the profitability index of both the systems is the same, that is 119.08. per cent. On the basis of this criterion, the company could be indifferent between the two systems. The decision then would depend on other factors.

12. a) NPV = Rs. 4,332 (negative)

   Since the NPV is negative, Matchless system should not be acquired. The company should buy the Superior system.

   b) NPV = Rs. 2,016

   Since the NPV is positive at 9% rate of discount the company should purchase the Matchless system. Therefore, the answer is definitely different.

13.

		Proposal A	Proposal B
a)	NPV	(Rs.) -948	1,879
b)	Average cash flow	(Rs) 13,600	14,500
	Fake payback period	3.846	4.138
	IRR	9.274	11.024

Since the NPV and IRR of proposal B are higher than those of proposal A, proposal B would be financially preferable.

14. The present value of annual savings= Rs. 74,880

Investment required to produce the part (Rs. 70,000 + 15,000) = Rs. 85,000. As the present value of savings is less than the present value of investment required, the part should continue to be purchased.

6.11 FURTHER READINGS

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