Capital Budgeting

Lesson 13

KEY CONCEPTS

■ Time Value of Money ■ Capital Budgeting ■ Internal Rate of Return ■ Net Present Value

Learning Objectives

To understand:

- Need and importance of Capital Budgeting
- Capital Budgeting Process
- Scope of Capital Budgeting Decisions
- Factors influencing investment decisions
- Capital Budgeting Techniques
- Capital Rationing
- Various methods of Capital Budgeting
- Risk and Uncertainties in Capital Budgeting

Lesson Outline

- Meaning of Capital Budgeting
- Capital Budgeting Process
- Techniques of Capital Budgeting- Discounted and Non-Discounted Cash Flow Methods, Modified NPV (MNPV), Modified IRR (MIRR), Unequal lives of projects
- Choice of Methods
- Capital Rationing
- Risk Evaluation and Sensitivity Analysis
- Analysis of Capital Budgeting, Decisions-Some case studies
- Lesson Round-Up
- Glossary
- Test Yourself
- List of Further Readings

There are two types of expenditures generally made in a business viz. Capital Expenditure and Revenue expenditure. Revenue expenditure is required for day to day operating requirements whereas Capital expenditure is incurred in making investment in fixed assets. Following are some of its important definitions:

1. "Capital budgeting is long-term planning for making and financing proposed capital outlays."

— Charles T. Horngren

2. "Capital budgeting involves the planning of expenditures for assets the returns from which will be realized in future time periods."

— Milton H. Spencer

3. "Capital budgeting consists in planning the development of available capital for the purpose of maximizing the long-term profitability (return on investment) of the firm."

— R. M. Lynch

In general we can say that capital budgeting is the decisions regarding the investment of funds in the fixed assets.

IMPORTANCE OF CAPITAL BUDGETING

Capital budgeting is important not only because of high investment cost of capital projects, their irreversible nature and permanent commitment and their long-run effects on the profitability of the concern, it is important because of the following reasons also:

1. Capital budgeting highlights the possibilities of expansion of production facilities to cover up the additional demand shown in projected sales budget.

2. It shows comparative position of available different alternative assets for the replacement of old or obsolete assets.

3. It helps in long-term planning and formulation of policy. Appropriate time of purchase of assets and of improvement in the quality of purchased assets is known by proper capital budgeting.

4. It helps in estimating the total requirement of capital with its break-up over the years. This analysis helps in timely arrangement of funds required for the purpose.

5. It also helps in planning capital structure because the net surplus of a project depends on the cost of capital, which in its turn depends upon the capital structure of the firm.

6. Capital budgeting provides necessary information for cash forecasts and budget.

7. It helps in preparing a sound policy for depreciation and replacement of assets.

8. The firm can plan its dividend policy, which is in keeping with profit and wealth maximization objective of the firm as well as the necessary internal resource generation for further business expansion.

9. It can prove beneficial for considering the methods and measures to minimize cost. It can thus help in planning modernization of existing production facilities.

10. It highlights the desirability of replacement of men by machines.

CAPITAL BUDGETING PROCESS

A capital budgeting process may involve a number of steps depending upon the size of the concern, nature of projects, complexities and diversities. Following steps are necessary for a comprehensive capital budgeting process:

Fig 2.2 Capital Budgeting Process

1. **Project Generation:**

   First of all capital expenditure requirements should be forecasted. Capital expenditure proposals may originate at any level, i.e., from top management's level to operative's level. To facilitate the origination of such ideas a periodic review and comparison of earnings, costs, procedures and product-line should be made by the management on a continuous basis.

2. **Project Evaluation:**

   This step involves:

   (i) Estimating the costs and benefits in terms of cash flows, and

   (ii) Selecting an appropriate criterion for judging the desirability of the projects.

   (iii) Project evaluation based on selection with techniques.

   For project evaluation, different techniques (as discussed later on in this chapter) may be used.

3. **Project Selection:**

   This step relates to the screening and selecting of the projects according to the criterion of the firm. This is done either by the financial manager or by a capital expenditure planning committee. After selecting the projects, priorities should be established of the accepted projects. It facilitates their execution and avoids delays and serious cost overruns. It also helps in capital rationing and better utilization of funds. The selected projects with details are submitted to top management for final approval.

4. **Project Execution:**

   After selecting the best proposals and taking final approval of top management, funds are allocated for them. It is the duty of the executive committee to ensure that funds are spent in accordance with allocation made in the capital budgets. Periodical reports should be prepared and submitted to the controller to exercise control over such expenditures.

5. **Follow-Up:**

   This step involves evaluation of the programme after its implementation. This involves comparison of actual performance with the budgeted data. Such follow up comparison will ensure better forecasting for the future. It has also the advantage of forcing the departmental heads to be more realistic in their approach and careful in actual execution of the projects.

SCOPE OF CAPITAL BUDGETING DECISIONS

Broadly speaking, capital budgeting decisions are long-term investment decisions. They include the following:

(1) Expansion Decisions:

Decisions on the matters such as acquisition of new machinery of building, addition of building and machinery etc. are taken on the basis of cost of investment and expected profits from goods produced.

(2) Replacement Decisions:

A company may have to replace its existing old or obsolete machinery by new and latest model machinery.

The use of new machinery may bring down operating costs and increase the volume of output. Decisions on such matters are taken on the basis of saving on account of decrease in operating costs and profits from additional volume produced by new plant.

(3) Buy or Lease Decisions:

The management may have to take decision on acquiring a fixed asset by purchase it from the market or by arranging it on lease basis. Such decisions are taken by comparing the cost of funds required for the purchase of asset with the amount payable on lease.

(4) Choice of Equipment:

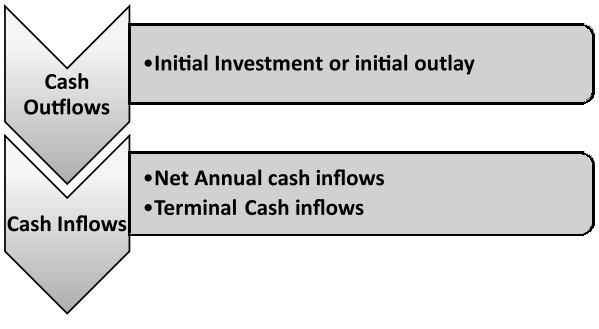
The management may have to select the best machine out of available several alternative machines. Decisions on such matters are taken by comparing the cost of different assets with their respective profitability.

(5) Product of Process Improvement:

This concern with decision on matters related to cost reduction or improvement in the quality of product by change in production processes. Decision on such matters is taken on the basis of a comparative study of cost of change and possible additional income or saving as a result of change.

COST AND BENEFITS OF PROJECT (CAPITAL BUDGETING DECISION)

For a capital budgeting decision, it is required to identify the cost and benefits involved in a project. These cost and benefits are termed as cash flows (both inflow and outflow). We can justify such cash flows in terms of cost and benefits as follows:



Initial Investment / Outlay

When a new project is launched, there are so many expenditures are made to acquire that. Hence all the expenditures incurred in zero time period (at initial stage) on an fixed assets (project) are called initial investment. It includes:

- Cost of the project (Asset)
- Opportunity cost of the Asset
- Additional Working Capital involved.

Salvage Value or any scrap or wastage will be subtracted from the value said above. We can compute the value of initial investment as follows:

Computing Initial outlay (Initial Investment / Cash outflows)

Cost of Fixed Asset (purchasing Price)	****
(+) Installation Cost	****
(+) Insurance, Freight	****
(+) Increase in Working Capital	****
(-) Salvage Value of scrap or wastage	****
(-) Decrease in Working Capital	****
Initial Investment	****

Net Annual Cash Inflows

An investment is made with a specific purpose of getting satisfied return especially in term of cash inflows. When cash inflows from a project regularly with same amount throughout the life of the project (with variation year to year), is called net annual cash inflows. This is net income of the firm before charging depreciation and after tax. This may be computed as follows:

Computing Net Cash Inflows (Operating Cash flows)

Annual Sale Income (revenue)	****
(-) Operating Expenses (with depreciation)	****
Income before Tax	****
(-) Income Tax	****
Net income after Tax	****
(+) Depreciation	****
Net Cash Inflows	****

The Net cash inflows may also be calculated as:

Estimated Savings in Direct Wages	****
(+) Estimated Savings in Direct Wages	****
(-) Estimated Additional Cost (Operating exp.)	****
Total Cost	****
(-) Income Tax	****
Net income after Tax	****
(+) Depreciation	****
Net Cash Inflows	****

Terminal Cash Inflows

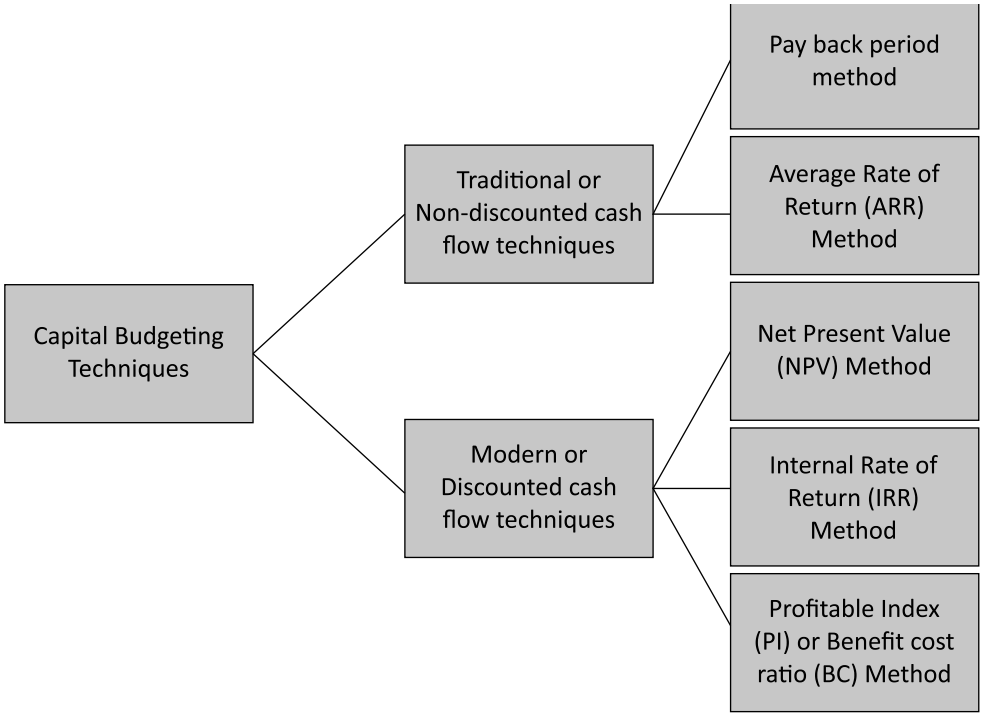
When in addition to annual cash inflows, the cash inflow of previous term (generally previous year) is also

included in the following terminal cash inflows; it is called terminal cash inflows. This cash inflow may be calculated as follows:

Estimated Salvage Value of Scrap	****
(+) Any Working Capital released	****
(-) Any Estimated Additional Cost	****
Net Cash Inflows	****

CAPITAL BUDGETING TECHNIQUES

The ultimate objective of the capital budgeting process is to achieve maximum benefit from the project. For this purpose, there are various techniques of capital budgeting which are as follows:



PAYBACK PERIOD METHOD

When one invests an amount in any type of investment, he/she always worries about the length of time for getting invested money back, same happens in a firm too. When a firm goes to invest an amount in purchasing any fixed asset, it explores the alternatives available which may provide cash back soon.

In this process, the payback period is most identified and popular method of capital budgeting to evaluate the proposals for the purpose of capital expenditure. *Payback period is that time period in which net cash inflow from investment recovers the cost of investment.*

The payback period is the duration to recover the initial cost of the project.

Under this method, the proposal is to be selected which are time conscious i.e. the project which will take least time to pay back the amount invested will be preferred. If numbers of proposals are available then these will be ranked on the basis of their estimated time consumption and selected accordingly.

Advantages or Merits of Payback Method

1. It is simple to calculate and easy to understand, apply and interpret.
2. It is realistic in approach as businessmen want speedy recovery of their money in capital assets.
3. It weights early returns heavily and ignores distant returns and thus short payback period acts as a hedge against a boon decision.
4. It is safe since it avoids incalculable risk and uncertainty in the long run.

Limitations or Demerits of Payback Method

Major shortcomings of this method are as follows:

1. This method is a 'crude rule of thumb' and over-emphasizes early recovery of invested funds. Of course, liquidity in itself is an important factor but ignoring 'profitability of investment' and concentrating, only on 'liquidity of investment' can in no way be justified in most of the situations.
2. It concentrates only on the 'recovering of the cost of investment' and does not consider the earnings after the payback period.
3. It considers only the payback period of the project and not its whole life.
4. This method ignores the risk factor in investments. Hence, projects with higher risk but lower payback period will be accepted as compared to a project with lower risk and higher payback period.
5. This method does not consider the 'cost of capital' which is an important base of sound investment decisions.
6. This method ignores the time value of money. It fails to consider varying cash flow patterns. All cash flows are treated and weighted equally, regardless of the time period of their occurrence.
7. This method ignores the salvage value of the asset.
8. It is not possible to calculate rate of return by this method.

The payback period is calculated as follows:

(A) In the Case of Even Cash Inflows:

If cash inflows from investment are uniform throughout the life of investment, payback period is calculated by dividing the cost of investment with the amount of annual cash inflow. As per formula:

$$PBP = \frac{\text{Initial Investment}}{\text{New Annual Cash flow}}$$

For example, a project with an initial outlay of Rs. 20,000 yields annual cash inflow of Rs. 5,000 for seven years, the payback period of the project will be:

$$= \frac{20,000}{5,000} \text{ 4 Years}$$

Illustration 1:

A project costs Rs. 3,00,000 and yields annually a profit of Rs. 80,000 after depreciation @ 12% p.a. but before tax of 50%. Calculate the payback period.

Solution:

Profitability Statement

	Rs.
Profit before tax	80,000
Less Tax @ 50%	40,000
Profit after tax	40,000
Add back Depreciation @ 12% on Rs. 5,00,000	60,000
Annual Cash inflow or Cash Earnings	1,00,000

$$\text{Rate of Return} = \frac{\text{Cost of Product}}{\text{Annual Cash flow}} = \frac{300000}{100000} = 3 \text{ Years}$$

(B) In the Case of Uneven Cash Inflows:

If cash inflows from investment are not uniform each year, payback period will be calculated by taking cumulative total of each year's cash inflows and the exact payback period will be calculated by interpolation. Pay back period will be calculated as:

$$\text{PBP} = E + \frac{B}{C}$$

Where, E = number of years immediately preceding the year of final recovery

B = the balance amount still to be recovered

C = cash flow during the year of final recovery

Illustration 2:

A project with an outlay of Rs. 12,000 yields Rs. 2,000, Rs. 3,000, Rs. 4,000 and Rs. 6,000 respectively in the first, second, third and fourth year, the payback period will be calculated as thus:

Year	***Cash-inflow***	***Cumulative Cash-in-flow***
1	2,000	2,000
2	3,000	5,000
3	4,000	9,000
4	6,000	15,000

Solution:

$$PB.P = E + \frac{B}{C}$$

$$= 3 \text{ years} + \frac{12000-9000}{6000} \times 12 = 3 \text{ Years and 6 months}$$

(3 Years are taken from the highlighted row which is showing the at least fully completed years to be taken by the project)

Post Payback Profitability (P.P.B. Profit)

A major weakness of the traditional payback period method is that it ignores the profitability of post-payback period. Hence, it remains the test of liquidity and not of profitability of investments. Therefore, experts have suggested that post-payback profitability should also be calculated and compared to evaluate the relative profitability of various capital projects.

It is calculated as follows:

Post Payback Profitability = Annual Cash Inflows (Working Life – Payback Period)

Alternatively,

Note: Salvage value of asset will be included in the earnings of last year.

Post Payback Profitability = Total Cash Inflows – Investment Outlay

Other things being equal, the project with highest post-payback profitability will be the best. Higher the post-payback profitability, more attractive will be the project. If cost of various projects differs substantially, post payback profitability index may be calculated to assess the relative profitability of the projects.

It is calculated as thus :

$$\textbf{Post Payback Profitability Index} = \frac{\text{PPB Profits}}{\text{Investments}} \times 100$$

Illustration 3:

The following are the details relating to two projects:

	Project X (Rs.)	***Project Y (Rs.)***
Cost of Project	1,60,000	2,00,000
Estimated Scrap	16,000	24,000
Estimated Savings:		
1st year	20,000	40,000
2nd year	30,000	60,000

3rd year	50,000	60,000
4th year	50,000	60,000
5th year	40,000	30,000
6th year	30,000	20,000
7th year	10,000	-

Calculate Payback Period and consider which project is better.

Solution:

Table Showing Cumulative Cash Flow of Projects

Year	*Project X*		*Project Y*	
	Cash Flow	*Cumulative Cash Flow*	*Cash Flow*	*Cumulative Cash Flow*
	Rs.	*Rs.*	*Rs.*	*Rs.*
1	20,000	20,000	40,000	40,000
2	30,000	50,000	60,000	1,00,000
3	50,000	1,00,000	60,000	1,60,000
4	50,000	1,50,000	60,000	2,20,000
5	40,000	1,90,000	30,000	2,50,000
6	30,000	2,20,000	44,000*	2,94,000
7	26,000*	2,46,000	-	-

* *Including the estimated scrap.*

Calculation of Payback Period

	Project X	*Project Y*
P.B.P. =	= 4 years and 3 months	= 3 year and 8 months
Post Payback Profitability = Total Cash Flows – Investment Outlay	2,46,000 – 1,60,000	2,94,000 – 2,00,000
(Post-Payback) Profitability Index	= Rs. 86,000	= Rs. 94,000
$= \frac{\text{P.P.B. Profits}}{\text{Investments}} \times 100$	$\frac{86,000}{1,60,000} \times 100 = 53.75\%$	$\frac{94,000}{2,00,000} \times 100 = 47\%$

Comment: Project Y is better because of its shorter payback period and larger post-payback profitability.

DISCOUNTED PAYBACK PERIOD

An important weakness of payback method is that it ignores the time factor of cash inflows from investment. To overcome this weakness, discounted payback period may be calculated. Under this method at first the annual cash inflows are discounted at the required earnings rate (or cut off rate) and then these discounted cash inflows are cumulated and payback period is calculated with the help of these figures.

Illustration 4:

Calculate discounted payback period from the information given below:

Cost of Project Rs. 10,00,000

Life 5 years

Annual Cash inflow Rs. 4,00,000

Cut-off Rate 10%.

Solution:

Year	*Annual Cash Inflow Rs.*	*P.V. Factor at 10%*	*Discounted Cash Flow Rs.*	*Cumulative D.C.F. Rs.*
1	4,00,000	0.909	3,63,600	3,63,600
2	4,00,000	0.826	3,30,400	6,94,000
3	4,00,000	0.751	3,00,400	9,94,400
4	4,00,000	0.683	2,73,200	12,67,600
5	4,00,000	0.621	2,48,400	15,16,000

Discounted Payback Period = $= 3 \text{ years} + \frac{1000000 - 994400}{273200} \times 365$

= 3 years and 8 days

Accounting Rate of Return Method (ARR Method)

This method is also known as ***unadjusted rate of return*** method or ***Financial Statement Method*** because the main figures used in the calculation are derived from accounting statements. Under this method, percentage rate of return of the annual net profit on investment is calculated. If it is calculated on initial investment, it is called Return on Investment (ROI) and if it is calculated on average investment, it is called as Average Rate of Return. Usually, it is calculated on average investment in the project. If annual net income fluctuates then average annual net income is used into the calculation. Thus, the formula for calculating this return is as follows:

$$AAR = \frac{\text{Average Annual Net Income (Savings)}}{\text{Average Investment}} \times 100$$

If annual cash inflows are given, then the formula will be adapted as follows:

$$AAR = \frac{\text{Average Annual Cash flow} - \text{Annual Depreciation}}{\text{Average Investment}} \times 100$$

$$\text{When, Average Investment} = \frac{\textit{Initial Investment + Scrap Value}}{2}$$

Evaluation of Project under ARR method:

Rate of return calculated as above is compared with the cutoff or the pre-specified rate of return. If the return is more than the cut-off rate, the project would be accepted, if not, it would be rejected. In the evaluation of mutually exclusive projects, only such projects are considered, whose accounting rates of returns are more than the cut-off rate and the project with the highest rate is selected. The larger is the rate, better is the project.

Advantages or Merits of Unadjusted Rate of Return Method

1. It is simple to compute and easy to understand and interpret.
2. It takes into consideration the total earnings from the project during the its entire economic life.
3. This method gives due weight to the profitability of the project.
4. This method duly recognizes the concept of net earnings, *i.e.,* earnings after providing for depreciation on capital asset. In fact, this is the correct way of income determination.
5. This method ignores the life of the project for determining the cost of investment. Hence, the amount of initial investment and average investment remain the same.

Limitations or Demerits of Unadjusted Rate of Return Method

1. It is simply an averaging technique, which does not take into account the impact of various external factors on overall profits of the firm.
2. It ignores the life of the project and differentiates against the projects of lower economic life.
3. It ignores the time value of earnings. In other words, this method does not discount the future earnings to present value.
4. The method does not determine the fair rate of return on investments. It is left at the discretion of management.
5. This method does not give consideration to the risk factor in respect of each project. Risk analysis should be the integral part of a project evaluation technique.

Illustration 5:

A company is considering the purchase of a machine. Management does not want to purchase a machine if its payback period is more than 3 years and its rate of return of investment is less than 20%.

Two machines – X and Y are under consideration. Cost of each machine is Rs. 10,000 and working life is 4 years. Scrap value is Rs. 1,200 and Rs. 400 respectively. Annual cash inflows are as under:

Year	***Machine X***	***Machine Y***
	Rs.	***Rs.***
First	2,000	3,000
Second	3,000	4,000
Third	4,000	5,000
Fourth	8,000	5,000

Evaluate the two proposals and suggest as to which machine should be purchased?

Solution:

Table Showing Cumulative Cash Inflows:

Year	*Machine X*		*Machine Y*	
	Cash Flow	*Cumulative Cash Flow*	*Cash Flow*	*Cumulative Cash Flow*
	Rs.	Rs.	Rs.	Rs.
First	2,000	2,000	3,000	3,000
Second	3,000	5,000	4,000	7,000
Third	4,000	9,000	5,000	12,000
Fourth	8,000	17,000	5,000	17,000
	1,200	18,200	400	17,400

(1) Payback Method:		
	Machine X	*Machine Y*
P.B.P = $E + \frac{B}{C}$	$3 + \frac{10,000 - 9,000}{8,000} \times 12$	$2 + \frac{10,000 - 7,000}{5,000} \times 12$
	= 3 years and 1.5 months	= 2 years and 7.2 months
Post Payback Profitability	18,200 – 10,000 = Rs. 8,200	17,400 - 10,000 = Rs. 7,400

(2) Rate of Return Method:		
	Machine X	*Machine Y*
a) Average Annual Cash Inflow	$\frac{2,000+3,000+4,000+8,000}{4}$	$\frac{3,000+4,000+5,000+5,000}{4}$
	= Rs. 4,250	= Rs. 4,250
b) Annual Depreciation	$\frac{10,000 - 1,200}{4}$ = Rs. 2,200	$\frac{10,000 - 400}{4}$ = Rs. 2,400
c) Average Annual Net Income	4,250 – 2,200 = Rs. 2,050	4,250 – 2,400 = Rs. 1,850
d) Average Investment	$\frac{10,000 + 1,200}{2}$ = Rs. 5,600	$\frac{10,000 + 400}{2}$ = Rs. 5,200
e) Return on Investment	$\frac{2,050}{5,600} \times 100$ = 36.61%	$\frac{1,850}{5,200} \times 100$ = 35.58%

Conclusion:

Though ROI of Machine X is more than 20% its payback period is more than 3 years, hence this machine will be rejected. Machine Y will be selected because of its payback being less than 3 years and ROI more than 20%.

PRESENT VALUE METHOD

This is the method which follows the concept of real time factor. It involves the value of time in transactions. This method is popularly known as '**discounted cash flow method**' because in this method all future cash flows (inflows and outflows both) of an investment project which occur at different times are discounted at a given rate to bring them at a common denominator and make them comparable.

Discounting is a procedure of bringing future inflows and outflows of cash to their present values. In general, money received today is valued more than money receivable tomorrow. "A bird in hand is worth more than the two in the bush" is rightly applicable to the management of capital. Therefore, in this technique, all future inflows and outflows a cash of an investment project are brought to technique, all future inflows and outflows of cash of an investment project are brought to their present values by applying a discounting rate (i.e., cost of capital or interest rate).

What you have today is more worthy than what will you have in future

Calculating Present Value:

The present value of future cash flows is found out with the help of the following algebraic formula:

$$\text{Present Value (P)} = \frac{S}{(1+i)^n}$$

Where, P = Value of a future sum of money

S = Future value of a sum of money

i = Rate of interest

n = number of years

PRESENT VALUE METHODS

There are three methods of appraising the profitability of capital investment projects by present value technique:

(A) Net Present Value Method (NPV Method)

This is also known as Excess Present Value Method or Net Gain Method. This method is used when the management has prescribed minimum (or target) rate of return or cut-off rate. Following steps are involved in this method:

(i) Determine the present value of all cash inflows from investments at different periods at required earnings rate. The formula is:

Present Value = Annual Cash Inflow x Present Value Factor

Note:

It should be remembered that salvage value and working capital released at the end of the project's life are considered as cash inflows of the last year and are duly discounted to present values.

(ii) Determine the present value of all cash outflows at different periods at the same earnings rate. Cash outflows at zero period of time (initial investment including working capital needed, if any) are not discounted. For this amount, the present value factor is taken as 1. However, cash outflows at subsequent periods are discounted by the relevant present value factor.

(iii) Find out the present value. For this, total of present values of all cash inflows is compared with the total of present values of all cash outflows. As per formula:

Net Present Value = Total Present Value of Cash Inflows - Total Present Value of Cash Outflows

DECISION RULE

(i) If NPV is positive, project is accepted.

(ii) If NPV is zero, the project is accepted or rejected on non-economic considerations.

(iii) If NPV is negative, the project is rejected.

Higher the NPV, more attractive will be the project. Hence, in mutually exclusive projects, (if cost of investment is similar), the project which gives the higher positive NPV will be preferred.

Merits of NPV Method

1. The NPV method recognizes the time value of money and takes into consideration the cost of capital.
2. It is very easy to calculate and simple to understand and interpret.
3. It takes care of the entire life of the project and its entire earnings including salvage of asset.
4. It can be applied to both types of cash inflow patterns – even and uneven cash inflows.
5. The economists generally prefer this method as it is consistent with the objective of maximizing owners' wealth.

Limitation or Demerits of NPV Method

1. Compared to payback or accounting rate of return methods, NPV method is difficult and complicated.
2. The greatest problem of this method is determination of desired rate of return. Due to difference in the state of risk and uncertainty of different business, no uniform rate can be used.
3. Keeping in view time-span of different projects and difference of risk inherent in them, use of a common discounting rate is not correct.
4. It may also not give satisfactory results where the projects under competition have different lives. NPV method favors long-lived projects.
5. It assumes that intermediate cash inflows are reinvested at the firm's cost of capital, which is always not true.
6. The results from this method may contradict those under internal rate of return method, even in the case of alternative proposals, which are mutually exclusive.
7. Net present value is sensitive to discount rates. With a change in rate, a desirable project may turn into an undesirable one and vice-versa.

Illustration 6:

ABC & SK Co. Ltd. is considering the purchase of a machine. Two machines, X and Y, are available each costing Rs. 50,000 and salvage is estimated at Rs. 3,000 and Rs. 2,000 respectively. Earnings after taxation are expected to be as follows:

Year	*Cash Flow*	
	Machine X	*Machine Y*
1	Rs. 15,000	Rs. 5,000
2	20,000	15,000
3	25,000	20,000
4	15,000	30,000
5	10,000	20,000

Evaluate the two alternatives according to:

a) The payback method;

b) Unadjusted Rate of Return Method;

c) Net Present value Method. A discount rate of 10% is to be used.

Solution:

a) Payback Method:

Table Showing Cumulative Cash Flow of Projects

Year	*Project X*		*Project Y*	
	Cash Flow	*Cumulative Cash Flow*	*Cash Flow*	*Cumulative Cash Flow*
	Rs.	**Rs.**	**Rs.**	**Rs.**
1	15,000	15,000	5,000	5,000
2	20,000	35,000	15,000	20,000
3	25,000	60,000	20,000	40,000
4	15,000	75,000	30,000	70,000
5	13,000*	88,000	22,000*	92,000

* Including salvage value.

(i) Payback Period = $E + \frac{B}{C}$

Machine X: $2+ \frac{50,000 - 35,000}{25,000} = 2\frac{3}{5}$ years

Machine Y: $3+ \frac{50,000 - 40,000}{30,000} = 3\frac{1}{3}$ years

(ii) Post Payback Profitability = Total Cash Flows – Investment Outlay

Machine X: 88,000 - 50,000 = Rs. 38,000

Machine Y: 92,000 – 50,000 = Rs. 42,000

b) Unadjusted Rate of Return Method:

(i) $\text{Annual Depreciation} = \frac{\text{Cost – Scrap Value}}{\text{Working Life}}$

Machine X: $\frac{50,000 - 3,000}{5} = \text{Rs. } 9,400$

Machine Y: $\frac{50,000 - 2,000}{5} = \text{Rs. } 9,600$

(ii) $\text{Average Annual Cash Flow} = \frac{\text{Total Cash Earnings}}{\text{No. of Years}}$

Machine X: $\frac{15,000 + 20,000 + 25,000 + 15,000 + 10,000}{5} = \text{Rs. } 17,000$

Machine Y: $\frac{5,000 + 15,000 + 20,000 + 30,000 + 20,000}{5} = \text{Rs. } 18,000$

(iii) $\text{Unadjusted Rate of Return} = \frac{\text{Average Annual Cash Earnings – Annual Depreciation}}{\text{Average Investment}} \times 100$

Machine X: $\frac{17,000 - 9,400}{(50,000 + 3,000) \div 2} \times 100 = \frac{7,600}{26,500} \times 100 = 28.68\%$

Machine Y: $\frac{18,000 - 9,600}{(50,000 + 2,000) \div 2} \times 100 = \frac{8,400}{26,000} \times 100 = 32.31\%$

c) Net Present Value Method:

Calculation of Present Value of Cash Inflows

Year	***Discount***	***Project X***		***Project Y***	
	Factor	***Cash Flow***	***Present Value***	***Cash Flow***	***Present Value***
	(at 10%)	***Rs.***	***Rs.***	***Rs.***	***Rs.***
1	.909	15,000	13,635	5,000	4,545
1	.826	20,000	16,520	15,000	12,390
3	.751	25,000	18,775	20,000	15,020
4	.683	15,000	10,245	30,000	20,490
5	.621	13,000	8,073	22,000	13,662
Total		**88,000**	**67,248**	**92,000**	**66,107**

Net Present Value = Total Present Value – Investment

Machine X: Rs. 67,248 – Rs. 50,000 = Rs. 17,248

Machine Y: Rs. 66,107 – Rs. 50,000 = Rs. 16,107

(B) Profitability Index Method or Present Value Index Method

The Profitability index method is a variant of NPV method and is called benefit-cost ratio. It is preferable to the NPV method where capital costs of mutually exclusive projects differ substantially. It expresses the relationship between present values of cash inflows and the present value of cash outflows (i.e., cost of investment). The formula is:

$$\text{P.V. Index (on Re. 1)} = \frac{\textit{Present Value of Cash Inflows}}{\textit{Present Value of Cash Outflows}}$$

$$\text{P.V. Index (percentage)} = \frac{\textit{Present Value of Cash Inflows}}{\textit{Present Value of Cash Outflows}} \textit{ X 100}$$

The main object of the use of present value index is to provide ready comparability between investment proposals of different magnitude. A proposal can be accepted only if profitability index is greater than or at least equal to unity. Higher the index, more desirable is the investment. The proposal is rejected if its profitability index is less than one. But, it is to be noted that profitability index of less than one does not indicate loss. It simply means that the firm's cost of capital exceeds the rate of return making it imperative for the proposal to be rejected.

The only difference between NPV method and PV index method is that while the former indicates absolute figures, the latter indicates the relative figures.

Illustration 7:

Rank the following investment proposals for A&G pvt. Ltd. in order of their profitability using (a) Payback period method, (b) Accounting rate of return method and (c) Present value index method (cost of capital – 10%):

Project	*Initial Outlay*	*Annual Cash Flow*	*Life*
	Rs.	*Rs.*	*(in years)*
A	96,000	15,000	12
B	48,000	10,000	8
C	80,000	14,000	10
D	40,000	9,000	8

Solution:

(a) Ranking of the Projects under Payback Period Method

Project	*Initial Outlay*	*Annual Cash Flow*	*Payback Period*	*Rank*
A	96,000	15,000	6.4	4

B	48,000	10,000	4.8	2
C	80,000	14,000	5.7	3
D	40,000	9,000	4.4	1

(b) Ranking of the Projects under Accounting Rate of Return Method

Project	*Initial Outlay Rs.*	*Average Outlay Rs.*	*Annual Cash Flow Rs*	*Life*	*Annual Depreciation*	*Net Income Ra.*	*Return Average Outlay %*	*Rank*
A	96,000	48,000	15,000	12	8,000	7,000	14.58	4
B	48,000	24,000	10,000	8	6,000	4,000	16.67	2
C	80,000	40,000	14,000	10	8,000	6,000	15	3
D	40,000	20,000	9,000	8	5,000	4,000	20	1

(c) Ranking of the Projects under the Present Value Index Method

Project	*Initial Outlay Rs.*	*Annual Cash Flow Rs*	*Life*	*P.V. Factor (at 10%)*	*P.V. of Cash Flows Years*	*P.V. Index of Rs.1*	*Rank*
A	96,000	15,000	12	6.814	1,02,210	1.06	4
B	48,000	10,000	8	5.335	53, 350	1.11	2
C	80,000	14,000	10	6.145	86, 030	1.08	3
D	40,000	9,000	8	5.335	48, 015	1.20	1

(C) TIME ADJUSTED RATE OF RETURN METHOD (TAR Method) or INTERNAL RATE OF RETURN METHOD (IRR Method)

This rate is also known as '***Marginal Efficiency of Investment'***, **'Internal Rate of Project'** and **'Breakeven Rate'**. It follows the discounted cash flow technique, which takes into account the time value of money. This is why, this rate is called as time adjusted rate. This method is used when the management does not prescribe desirable rate of return.

Under this method, such a rate of return (or discounting rate) is derived at which the aggregate of the present values of all future cash inflows from investment equals the present value of cash outflows for the proposal (*i.e.,* initial investment outlay). In other words, IRR is the maximum rate of interest that could be paid for the capital employed over the life on an investment without loss on the project. It is the rate of discount at which net present value is zero. **Higher the IRR, more attractive is the proposal**. A proposal is accepted only when IRR is higher than the required rate of return (cut-off rate). If it is lower, the proposal is rejected; if it is just equal decision is taken on the basis of other considerations. In case of mutually exclusive projects, project with highest IRR is selected.

Computation of IRR

A) In the case of even cash Inflows:

If cash inflows are uniform each year, the computation of IRR involves the following two steps:

(i) Calculate Present Value Factor (or Payback Reciprocal):

The following formula is applied for this purpose:

$$\text{P.V. Factor} = \frac{\text{Investment}}{\text{Annual Cash Inflows}}$$

(ii) Finding Rate of Return:

Locate the factor closest to the factor calculated in (i) in the compound present value table (Table 2) in the row of year corresponding the life span of investment in years. The interest rate of the column of that factor will be the required IRR. For example, if an investment outlay of Rs. 10,432 yields cash earnings of Rs. 2,000 each year for 10 years, IRR is calculated as follows:

$$\text{P.V. Factor} = \frac{\text{Investment}}{\text{Annual Cash Inflows}} = \frac{10{,}432}{2{,}000} = 5.216$$

Locating this factor in the compound P.V. Table in the row corresponding to the life span of investment in years (i.e., tenth year), the factor is an interest rate of 14%s. Hence, IRR in this case is 14%.

Note:

It is always not possible that the same factor as calculated in (i) above is there in the present value table. It may exist between any two factors in the table. In such a case, IRR is determined on the basis of closest factor. The actual rate can, however, be calculated by applying interpolation technique, although such accuracy is usually not required in the appraisal of the projects.

The formula for interpolation is:

$$r = r_1 + \frac{V_1 - V}{V_1 - V_2}(r_2 - r_1)$$

where, r = rate of return to be determined

r_1 = lower rate of return

r_2 = higher rate of return

V_1 = the p.v. factor at lower rate of return

V_2 = the p.v. factor at higher rate of return

V = the p.v. factor for which r is to be interpolated.

B) In the Case of Uneven Cash Inflows:

The calculation of IRR under such circumstances is a little bit difficult. In this case, 'trial and error' procedure is followed to find out IRR. Here also the object is the same. We have to determine the rate at which the total present value of irregular and uneven cash inflows equals the cost of investment (or total present value of cash outflows), i.e., where NPV is zero. The following procedure may be followed in such a case:

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

(ii) Determine 'fake payback factor' by dividing the initial outlay with the average annual cash inflows.

(iii) Locate the factor in compound P.V. Table closest to the fake present value factor in the same manner as in the case of annuity and determine the fake IRR.

(iv) Calculate present value of cash inflows at the fake rate determined above in (iii) and compare the total present value of cash inflows with the cost of investment. If NPV is positive, a higher rate should be tried to calculate NPV. Conversely, if NPV is negative, a lower rate should be tried. The procedure will go on till we find the rate at which NPV is zero.

Alternatively, two discounting rates may be selected in such a way that the NPV result of the lower rate of discount is a positive amount and the NPV result of the higher discounting rate is a negative amount. Then the interpolation technique should be applied to arrive at the correct IRR.

Merits of TAR or IRR Method

1. Like NPV, IRR method takes into consideration time value of money and also the total cash inflows and outflows over the entire life of the project.
2. The pre-determination of earnings rate is not a pre-condition for the use of this method.
3. For a manager, it is easier to understand and interpret the 'rate' than an absolute amount.

Demerits of TAR or IRR Method

1. Its computation is difficult. IRR requires tedious calculations based on trial and error procedure or interpolation.
2. The assumption that cash flows are reinvested for the remaining life of the project at the IRR is unrealistic. In some cases, it remains idle in the business.
3. This method requires the determination of minimum required rate of return to know the acceptability of IRR, which is a difficult task.
4. If cash inflows in any years are negative then it may give more than one solution.
5. This method does not differentiate satisfactorily between projects of different lives.

Illustration 8:

A project costs Rs. 10,000 and cash inflows in the first, second, third and fourth years respectively is Rs. 2,000, Rs. 3,000, Rs. 5,000 and Rs. 6,000. Calculate time adjusted rate of return for the project.

Solution:

Total Cash Inflows of 4 years = Rs. 16,000

Average Annual Cash Inflow = Rs. 4,000

$$\text{P.V. Factor} = \frac{10000}{40000} = 2.5$$

Locating this factor in cumulative P.V. Table on the line corresponding to the 4th year, TAR is found to be about 22%. Now, we have to verify this TAR as follows:

Year	*Cash Inflow*	*P.V. Factor at 22%*	*Present Value*
	Rs.		*Rs.*
1	2,000	0.820	1,640

2	3,000	0.672	2,016
3	5,000	0.551	2,755
4	6,000	0.451	2,706
			9,117

As the total present value of cash-inflows at 22% is less than the cost of investment, the TAR must be below 22%. Because the difference between these two figures is quite large, so we take out next trial at 16%.

Year	*Cash Inflow*	*P.V. Factor at 16%*	*Present Value*
	Rs.		*Rs.*
1	2,000	0.862	1,724
2	3,000	0.743	2,229
3	5,000	0.641	3,205
4	6,000	0.552	3,312
			10,470

As it is clear from the above, the total present value of cash inflows at 16% is more than the cost of investment, so the TAR is some where between 16% and 22% and the exact rate can be found out by interpolation as follows:

$$r = r_1 + \frac{V_1 - V}{V_1 - V_2} (r_2 - r_1)$$

$$r = 16 + \frac{10,470 - 10,000}{10,470 - 9,117} (22 - 16)$$

$$= 18.08\%$$

Modified IRR

The limitation of IRR is that reinvestment rate in case of IRR is IRR itself. This can be overcome changing the reinvestment rate incorporating the expected reinvestment rate for future periods over the life of the projects and using such expected reinvestment rate for calculating the terminal value of the cash inflows for different years of the life of the project. Thereafter, MIRR is determined with present value of such terminal value of thecash inflows and present value of the cash outflows. In other words, the MIRR is the discount rate which will make present / discounted value of terminal value of cash inflows equal to present/discounted value of cash outflow.

The procedure for calculating MIRR is as follows:

Step 1: Calculated the present Value of the costs (PVC) associated with the project, using the cost of capital (r) as the discount rate:

$$PVC = \sum_{t=0}^{n} \frac{\text{Cash outflow}_t}{(1+r)^t}$$

Step 2: Calculate the terminal Value (TV) of the cash inflow expected from the project:

$$TV = \sum_{t=0}^{n} \text{Cash Inflow}^{t} (1+ r)^{n-t}$$

Step 3: Obtain MIRR by solving the following equation:

$$PVC = \sum_{t=0}^{n} \frac{TV}{(1+ MIRR)^{n}}$$

To illustrate the calculation of MIRR let us consider an example. Srivastava Limited is evaluating a project that has the following cash flow stream associated with it:

Year	0	1	2	3	4	5	6
Cash Flow	-120	-80	20	60	80	100	120

The cost of capital is 15 percent. The percent value of costs will be : 120 + 80 / 1.15 = 189.6

1.15

The terminal value of cash inflow is:

$20(1.15)^{4} + 60(1.15)^{3} + 80 (1.15)^{2} + 100(1.15) + 120$

= 34.98 +91.26 + 105.76 + 115+120 = 467

The MIRR is obtained as follows:

$$189.6 = \frac{467}{(1+MIRR)^{6}}$$

$(1+MIRR)^{6} = 2.463$

$1+ MIRR= 2.463^{1/6} = 1.162$

MIRR= 1.162 or 16.2 percent

Modified NPV or Modified IRR may be used to resolve the conflict in ranking of the alternative projects under NPV and IRR methods arising out of differences in timing of cash flows, i.e., in one project, the cash inflows in the initial years may be more than the other or vice versa.

In case of mutually exclusive projects, financial appraisal using NPV & IRR methods may provide conflicting results. The reasons for such conflicts may be attributed to (i) Difference in timing / pattern of cash inflows of the alternative proposals (Time Disparity), (ii) difference in their amount of investment (Size Disparity) and (iii) difference in the life of the alternative proposals (Life Disparity).

TIME DISPARITY: Main source of conflict is the different re-investment rate assumption. Such conflicts may be resolved using modified version of NPV and IRR using expected / defined reinvestment rate applicable to the firm.

For modified NPV and IRR, at first Terminal Value (TV) is calculated using the specified reinvestment rate. TV= "$CF(1+r^{*})^{n-t}$ MNPV = {TV ÷ (1+K)n}-IMIRR=$(TV÷I)1^{/n}$-1

Where, r*t = reinvestment rate

Example:

	Project I	***Project II***
Investment	220000	220000
Year 1	62000	142000
Year 2	80000	80000
Yera 3	100000	82000
Year 4	140000	40000
Cost of capital: 10%		
Solution:		
	I	II
NPV()	73226	62628
IRR (appx.)	22%	25%

According to NPV, Project I is better but according to IRR, Project II is better. So, there is conflicting results. The primary reason for such conflict is the difference in timing of cash inflows. In case of Project II, more cash inflows occur in the initial years while in case of Project I more cash flows occur towards the end of the project. Such conflict may be resolved using Modified version of NPV or IRR (MNPV or MIRR) as follows.

Using reinvestment rate of 14%,

$TV1 = 62000 (1 + .14)^3 + 80000 (1 + .14)^2 + 100000 (1 + .14)^1 + 140000 (1 + .14)^0 = 449822$

$TV2 = 142000 (1 + .14)^3 + 80000 (1 + .14)^2 + 82000 (1 + .14)^1 + 40000 (1 + .14)^0 = 447822$

MNPVI= {449822 ÷ (1 +.10)4} – 220000 = 87228

MNPVII = {447822 ÷ (1 +.10)4} – 220000 = 85862

MIRRI = (449822 ÷220000)1/4 – 1 = 19.57%

MIRRII = (447822 ÷220000)1/4 – 1 = 19.32%

Both the MIRR and MNPV show that Project I should be accepted.

SIZE DISPARITY:

Conflict may arise due to disparity in the size of initial investment /outlays. Such conflict may be resolved using incremental approach.

Steps :

- Find out the differential cash flows between the two proposals
- Calculate the IRR of the incremental cash flows
- If the IRR of the differential cash flows exceeds the required rate of return (usually cost of capital), the project having greater non-discounted net cash flows should be selected.

Example:

	Project A (r)	*Project B (r)*
Investment	5000000	7500000
Net Cash Inflow K = 10%	6250000	9150000

Solution: At first, NPV and IRR of the projects are calculated and it has been found that,NPVA<NPVB IRRA> IRRB

The above results indicate that there is a conflict in ranking of the projects under NPV and IRR. Such conflict is mainly due to the difference in the initial investment of the projects and it can be resolved using incremental approach as follows.

Differential Cash Outflows = r 2500000, Differential Net Cash Inflows = r2900000

We know that IRR is the discount rate at which Present Value of Cash Inflows are equal to the Present Value of Cash Outflows.

So, 25, 00,000 = 29, 00,000 / $(1+ r)^1$

Or, 1 + r = 29,00,000/25,00,000 Or, r = 1.16 – 1 = 0.16

IRR (r) of the differential cash flows = 16%, which is greater than Cost of Capital (k). Therefore, Project with higher non- discounted cash inflows, i.e., Project B would be selected.

Advantages and Disadvantages of the MIRR Method

The modified internal rate of return resolves two problems inherent to the IRR.

All cash inflows are reinvested at the reinvestment rate, which is more realistic than reinvesting at the IRR.

The method of calculation eliminates the problem of multiple IRR for projects with abnormal cash flows.

The main disadvantage of the MIRR method is the potential conflict with the NPV method. The reason may be due to a difference in project scale or in the timing of cash flows (the problem was discussed in "NPV vs IRR method"). Furthermore, if the reinvestment rate is lower than the cost of capital, there is a conflict with the basic assumption of the NPV method, which is that all expected cash inflows are reinvested at the cost of capital (discount rate).Thus, the project can simultaneously have positive NPV and MIRR lower than the cost of capital. That is the reason why some academic studies recommend using the reinvestment rate equal to the cost of capital raised for a project.

Unequal lives of the Projects or LIFE DISPARITY

In some cases, the mutually exclusive alternatives with different/ unequal lives may lead to conflict in ranking. To resolve such conflict, one approach is to compare the alternatives on the basis of their Equivalent Annual Benefit (EAB) or Equivalent Annual Cost (EAC) and select the alternative with the higher EAB or lower EAC.

EAB = NPV x Capital Recovery Factor or NPV ÷ PVIFAk,n

Capital Recovery Factor = the inverse of PVIFA = $k (1+k)^n \div (1+k)^n - 1$

EAC = PV of Cost ÷ PVIFAk.n

Another approach is to evaluate the alternatives over an equal time frame using the lowest common multiple (LCM) of the lives of the alternatives under consideration. This method is referred to as LCM method. For example, life of Proposal A is 3 Years and that of B is 5 years. Lowest common multiple period is 15 years, during which

period, it may be assumed that Machine A will be replaced 5 times and Machine B will be replaced 3 times. Cash Flows are extended to this period and computations made. The final results would then be on equal platform i.e. equal years, and hence would be comparable.

Example:

	P	***Q***
Investment (Rs.):	5000000	5000000
Cash Inflows (Rs.):		
Year 1	7500000	2000000
Year 2		2000000
Year 3		7000000
K = 12%		
Solution.		
	P	Q
NPV (Rs.)	1696400	3362800
IRR	50%	40%

From the above, it is found that there is conflict in ranking of the projects under NPV and IRR. The reason may be attributed primarily to the unequal lives, i.e., life disparity. In such situation, EAB approach may be followed as follows.

	P	***Q***
Capital Rec. Factor	1.12	416*
		*1 ÷ (.893+.797+.712)
EAB (Rs.)	1900000	1398900

Based on EAB, Project P is better.

CAPITAL RATIONING

One important aspect of control device is to match the demand schedule for the capital for the company and the supply of capital from different sources. Demand comes for capital from all departments and it is at this level control could be exercised to keep the demand at the bare minimum required for the objective inherent in capital investment decisions. Supply of capital, on the other hand, is a scarce commodity and the company has to incur expenditure for availing it. This necessitates for the finance manager to exercise economy in capital expenditure so that optimum benefit could be obtained with the use of scarce capital sources. This establishes the need for capital rationing to impose constraints on capital expenditure under prevailing market conditions and place self-imposed constraints to check the funds being raised from outside agencies like borrowings. Thus, the device of capital rationing is adopted to control capital expenditure.

The firm may put a limit to the maximum amount that can be invested during a given period of time, such as a year. Such a firm is then said to be resorting to capital rationing. A firm with capital rationing constraint attempts to select the combination of investment projects that will be within the specified limits of investments to be made during a given period of time and at the same time provide greatest profitability.

Capital rationing may be effected through budget ceiling. A firm may resort to capital rationing when it follows

the policy of financing investment proposals only by ploughing back its retained earnings. In that case, capital expenditure in a given period cannot exceed the amount of retained earnings available for reinvestment. Management may also introduce capital rationing when a department is authorised to make investments upto a limit beyond which investment decisions will be made by higher level management.

Capital rationing may result in accepting several small investment proposals then accepting a few large investment proposals so that there may be full utilisation of budget ceiling. This may result in accepting relatively less profitable investment proposals if full utilization of budget is a primary consideration. Similarly, capital rationing also means that the firm foregoes the next most profitable investment falling after the budget ceiling even though it is estimated to yield a rate of return much higher than the required rate of return. Thus, capital rationing does not lead optimum results.

Types of capital rationing

1. "hard" or external
2. "soft" or internal

Hard capital rationing occurs when external factors force a company to cut expenses, including capital expenditures. For example, creditors may include provisions in an agreement limiting borrowers' spending to reduce the risk of default. Many companies are also forced to reduce spending when they are going to raise additional capital by issuing new debt or equity. The objective of such a strategy is to increase the free cash flow and therefore make a company more attractive to investors. As we can see, external factors may cause severe constraints on the capital budget.

Soft capital rationing is caused by internal factors. For example, to reduce overall risk, the board of directors may set a minimum internal rate (IRR) of return for capital projects. All projects having a lower IRR will be rejected even though they have a positive net present value. Dividend policy can also cause soft rationing. For example, if a company declares paying a fixed dividend per share, any failure will be negatively perceived by the market and will most likely result in a decrease in the stock price. That is why company management would prefer to cut capital expenditures than dividends.

A company has a budget constraint of 3 lakh for Capital expenditure and is considering five projects using the net present value method. The particulars are:

Project	*Project cost (r)*	*Net Present value (r)*
A	1,80,000	75,000
B	1,50,000	60,000
C	1,20,000	50,000
D	75,000	36,000
E	60,000	30,000

Assuming that project B and C are mutually exclusive and all other project are independent, select the combination which all maximise the net present value.

Solution

Under condition of Capital Rationing, raking of the project is done under the profitability index as follow:

Profitability Project for under PI

Project	*Project Cost (r)*	*NVP (r)*	*Total PV (r)*	*PI(PV÷PC)*	*Rank*
A	1,80,000	75,000	2,55,000	1.42	3
B	1,50,000	60,000	2,10,000	1.40	4
C	1,20,000	50,000	1,70,000	1.42	3
D	75,000	36,000	1.11,000	1.48	2
E	60,000	30,000	90,000	1.50	1

On the basis raking for other factors, three possible combinations along with their net present value are arrived at as follow:

Profitability of Combined Project

Project	*Project Cost (r)*	*NVP (r)*	*Project*	*Project Cost (r)*	*NVP (r)*	*Project*	*Project Cost (r)*	*NVP (r)*
E	60,000	30,000	E	60,000	30,000	C	1,20,000	50,000
D	75,000	36,000	D	75,000	36,000	A	1,80,000	75,000
C	1,20,000	50,000	B	1,50,000	60,000			
	2,55,000	1,16,000		2,85,000	1,26,000		3,00,000	1,25,000
Rank		3			1			2

Combination II, which produces the maximum possible net present value within the overall budget limit of 3,00,000 of the project cost is recommended.

Note: Since B and C are mutually project, they cannot be considered simultaneously.

CONSIDERATION OTHER THAN PROFITABILITY IN MANAGERIAL DECISIONS

Managerial decision on capital projects is very difficult and complicated problem. Though profitability of the proposal is the crucial factor that influences the capital expenditure decisions this cannot be the sole determinant for these decisions. In practice there are many other factors which make the profitability base subsidiary or less important. These factors are as follows:

1. Urgency of the Project:

Sometimes an investment is made due to urgency to avoid heavy losses. For example, on breakdown of machinery, management may decide to replace it by any available machine suitable for the work without proper evaluation of its cost and benefits so as to avoid heavy losses due to stoppage of production process. In such a case, the basis of managerial decision is urgency and not the profitability.

2. Funds Available:

The availability of funds is an important factor that influences the capital budgeting decisions. Sometimes, a more profitable project is not taken up for want of sufficient funds and a lesser profitable project of lower payback period is approved, if the firm is short of funds.

3. Available Technical Know-how and Managerial Capability:

Before approving a project, the management will have to consider whether their firm has got the necessary technical know-how and managerial capability to implement that project and if not, whether it could be acquired.

4. Availability of Additional Funds:

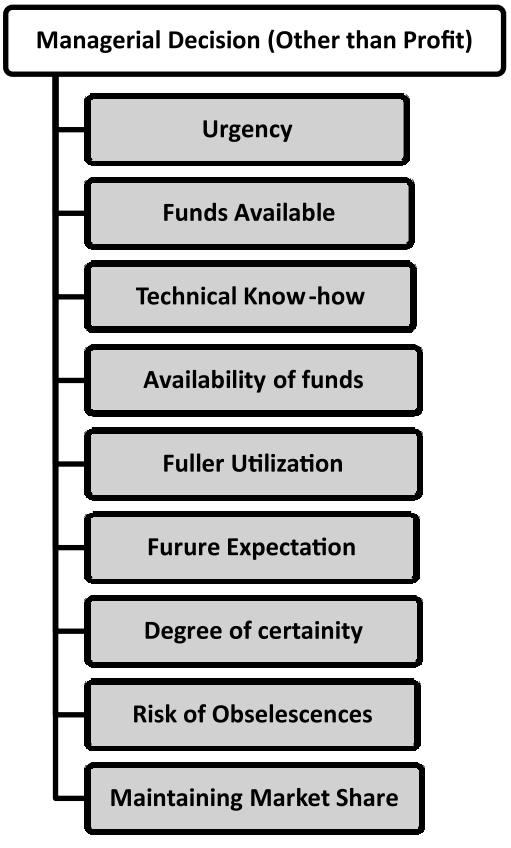
If the management is capable of arranging additional funds in future, then all the funds available at present may be utilized for the capital projects; if not, working capital needs will have to be arranged out of the funds available with the firm.

5. Fuller Utilization of Funds:

The ultimate goal of managerial policy is to maximize the owner's wealth. Hence, if the firm has ample funds for investment then a project yielding highest rate of return and requiring lesser outlay may not be approved by the management if no other profitable investment of spare funds is possible. In such a situation, it may be better to select the next best project if total funds of the concern could be invested in the project, so that total profits of the firm are maximized.

6. Future Expectations of Earnings:

Expected earnings on future investments may also influence current capital investment decisions. If more profitable investments are possible in future, then at present management would select the project of lower useful life so that the funds invested may be taken back early and could be invested in future in more profitable projects. On the contrary, if there is possibility of rate of return on investment to go down then long economic life projects would be better even if rate of return on this project is lower to a short live project.



7. Degree of Certainty of Net Income:

Certainty of income on project also influences the selection of the project. Although future business operations are uncertain, even then the management may select a lower income project in place of a higher but uncertain income project.

8. Risk of Obsolescence:

In case of rapid technological development, the project with a lesser payback period may be preferred in comparison to one which may have higher profitability but still longer payback period.

9. Maintaining Market Share:

Sometimes, the management may take a decision in favor of a project though yielding a lower return but necessary to maintain earning capacity and existing market share of the firm.

RISK AND UNCERTAINTY IN CAPITAL BUDGETING

The cash flows from an investment are estimated when the proposal is evaluated; however, the returns are not known until the cash flow actually occurs. The uncertainty of returns from the moment the funds are invested until management and investor know how much the projects has earned, is a primary determinant of a proposal's risk. The owners of a firm are ordinarily concerned with the riskiness of their capital, and management must therefore, take risk into account in evaluation of capital budgeting proposals.

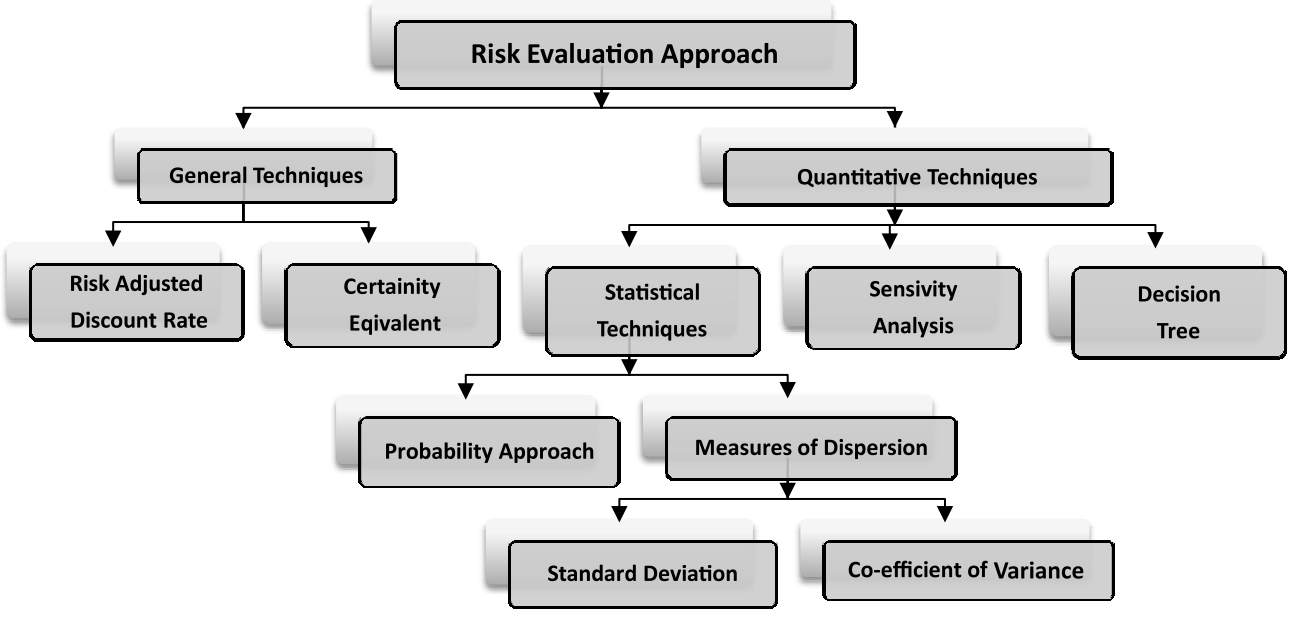
In case, the cash flows associated with a proposal are known with certainty then the techniques such as NPV,

IRR or any other may be used to evaluate the desirability of the proposal. However, when the cash flows are not known with certainty a measure of risk of the proposal should also be brought into the evaluation system. Such resultant capital budgeting decisions criterion will then evaluate the proposals by considering both the risk and return associated with the proposal.

MEASURES OF RISK / RISK EVALUATION

Measurements cannot be assured of cent per cent accuracy because risk is caused by numerous factors such as social, political, economic and managerial efficiency. Measurement provides an approximate quantification of risk.

The following techniques can be applied to evaluate the risk presented in the chart given below:



F-1.6 Risk Evaluation

1. Risk Adjusted Discount Rate (RADR)

This discount rate is applicable to a risky investment and is the sum of risk free rate and a risk premium relating to that investment. It is also known as ***"Varying Discount Rate Method".*** Under this method the discount rate is adjusted in accordance with the degree of risk.

RADR = Risk Free Rate of Retun + Risk Premium Rate

This is a simplest method of accounting for risk in capital budgeting is to increase the cut-off rate or the discount factor by certain percentage on account of risk. The projects which are more risky and which have greater variability in expected returns should be discounted at a higher rate as compared to the projects which are less risky and are expected to have lesser variability in returns.

Illustration 9:

SK & ABC Company Ltd. is considering the purchase of a new investment. Two alternative investments are available (A and B) each costing Rs. 1,00,000. Cash inflows are expected to be as follows:

Cash Inflows	Investments A	Investment B
Years	Rs.	Rs.
1	40,000	50,000
2	35,000	40,000
3	25,000	30,000
4	20,000	30,000

The company has a target return on capital of 10%. Risk premium rates are 2% and 8% respectively for investments A and B. Which investment should be preferred?

Solution:

The profitability of the two investments can be compared on the basic of net present values cash inflows adjusted for risk premium rates as follows:

	Investment A			*Investment B*		
Year	*Discount Factor @*	*Cash Inflow*	*Present Value*	*Discount Factor @*	*Cash Inflows*	*Payment Value*
	10%+2%=12%	*Rs.*	*Rs.*	*10%+8%=18%*	*Rs.*	*Rs.*
1	0.893	40,000	35,720	0.847	50,000	42,350
2	0.797	35,000	27,895	0.718	40,000	28,720
3	0.712	25,000	17,800	0.609	30,000	18,270
4	0.635	20,000	12,700	0.516	30,000	15,480
			94,115			1,04,820

Investment A

Net Present value = Rs, 94,115 – 1,00,000

= Rs. (-) 5,885

Investment B

Net Present value = Rs. 1,04,820 – 1,00,000

= Rs. 4,820

As even at a higher discount rate investment B gives a higher net present value, investment B should be preferred.

2. Certainty Equivalent Technique

In this method, Cash flows are corrected and reduced to conservative levels by multiplying them by certainty equivalent co-efficient (or correction factor).

$$\textit{Certainty Equivalent Co-efficient} = \frac{\text{Riskless Cash Flows}}{\text{Risky Cash Flows}}$$

This is another simple method of accounting for risk in capital budgeting is to reduce expected cash flows by certain amounts. It can be employed by multiplying the expected cash flows by certainly equivalent co-efficient as to convert the uncertain cash flows to certain cash flows.

Illustration 10:

There are two projects X and Y. each involves an investment of Rs. 40,000. The expected cash inflows and the certainly coefficients are as under:

Year	*Project X*		*Project Y*	
	Cash Inflow	*Certainty Coefficient*	*Cash Inflow*	*Certainty Coefficient*
	Rs.		*Rs.*	
1	25,000	0.8	20,000	0.9
2	20,000	0.7	30,000	0.8
3	20,000	0.9	20,000	0.7

Risk-free cut-off rate is 10%. Suggest which of the two projects should be preferred.

Solution:

Calculations of Cash Inflows with Certainty

Year	*Project X*			*Project Y*		
	Cash Inflow	*Certainty Coefficient*	*Certain Cash Inflow*	*Cash Inflow*	*Certainty Coefficient Cash Inflow*	*Certain*
	Rs.		*Rs.*	*Rs.*		*Rs.*
1	25,000	0.8	20,000	20,000	0.9	18,000
2	20,000	0.7	14,000	30,000	0.8	24,000
3	20,000	0.9	18,000	20,000	0.7	14,000

Calculations of Present Values of Cash Inflows

Year	*Discount*	*Project X*		*Project Y*	
	Factor	*Cash*	*Present*	*Cash*	*Present*
	@ 10%	*Inflows*	*Values*	*Inflows*	*Value*
1	0.909	20,000	18,180	18,000	16,362
2	0.826	14,000	11,564	24,000	19,824
3	0.751	18,000	13,518	14,000	10,514
			43,262		46,700

	Project X	**Project Y**
Net Present Value	= Rs. 43,262-40,000	46,700-40,000
	= Rs. 3,262	Rs. 6,700

As the net present value of present Y is more than that of Project X, Project Y should be preferred.

3. PROBABILITY TECHNIQUE

Probability is the at most chances of happening of a certain event. The probability lies between ***0 and 1***. If any chance is sure to be happened then it will carry probability 1 (which mean no probability at all but certainty). Under this method, the cash inflows estimates are multiplied by the probability assigned to them. The result

would be expected monetary values. Then these expected monetary values will be discounted at a discount rate available for present value.

A probability is the relative frequency with which an event may occur in the future. When future estimates of cash inflows have different probabilities the expected monetary values may be computed by multiplying cash inflow with the probability assigned. The monetary values of the inflows may further be discounted to find out the present values. The project that gives higher net present value may be accepted.

Illustration-11:

Two mutually exclusive investment proposals are being considered. The following information is available:

	Project A (Rs.)		**Project B (Rs.)**	
Cost	6,000		6,000	
	Cash Inflow			
Year	***Rs.***	***Probability***	***Rs.***	***Probability***
1	4,000	0.2	7,000	0.2
2	8,000	0.6	8,000	0.6
3	12,000	0.2	9,000	0.2

Assuming cost of capital at 10%, advice for the selection of the project.

Solution:

Calculation of the Net Present Values of the Two Projects

			Project X	***Project Y***					
Year	***P.V. Factor***	***Cash Inflows***	***Probability***	***Monetary Value***	***Present Value***	***Cash Inflows***	***Probability***	***Monetary Value***	***Present Value***
	@ 10%	***Rs.***		***Rs.***	***Rs.***	***Rs.***		***Rs.***	***Rs.***
1	0.909	4,000	0.2	800	727	7,000	0.2	1.400	1,273
2	0.826	8,000	0.6	4,800	3,965	8,000	0.6	4,800	3,965
3	0.751	12,000	0.2	2,400	1,802	9,000	0.2	1,800	1,352

Total Present Value	6,494	6,590
Total Present value	6,494	6,590
Less: Cost of Investment	6,000	6,000
Net Present Value	**494**	**590**

As net present value of Project Y is more than that of Project X after taking into consideration those probabilities of cash inflows, Project Y is more profitable.

4. STANDARD DEVIATION

The statistical tool often used to measure and used as a proxy for risk is the standard deviation. It is measure of the values of the variables around its mean or it is the square root of the sum of the squared deviations from the mean divided by the number of observances. The arithmetic mean of the returns may be same for two companies but the returns may vary widely.

Standard Deviation is the measure of variability of cash flow from the expected cash flow.

Standard deviation in the probability distribution is as:

$$\textit{Standard Deviation } (\sigma) = \sqrt{\sum} \textit{ Pid}^2$$

Where d = Deviation of each of the cash flows

Pi = Associated probability

Advantages of Standard Deviation

The standard deviation and variance are conceptually equivalent quantitative measures of total risk. Standard deviation is preferred because of the following advantages:

1) Standard Deviation considers every possible event and assigns each event a weight equal to its probability.
2) Standard deviation is a very familiar concept and many calculators and computers are programmed to calculate it.
3) Standard deviation is a measure of dispersion around the expected (or average) value. This is in absolute consensus with the definition of risk as "variability of returns".
4) Standard deviation is obtained as the square root of the sum of squared differences multiplied by their probabilities. This facilitates comparison of risk as measured by standard deviation and expected returns as both are measured in the same costs. This is why standard deviation is preferred to variance as a measure of risk.

If two projects have the same cost and their net present value are also the same, standard deviations of the expected cash inflows of the two projects may be calculated to judge the comparative risk of the projects. The project having a higher standard deviation is said to be more risky as compared to the other.

Illustration-12:

From the following information, ascertain which project is more risky on the basis of standard deviation:

Project A		*Project B*	
Cash Inflow (Rs.)	*Probability*	*Cash Inflow*	*Probability (Rs.)*
2,000	.2	2,000	.1
4,000	.3	4,000	.4
6,000	.3	6,000	.4
8,000	.2	8,000	.1

Solution:

Calculation of Standard Deviation (Project A)

Cash Inflows (Rs.)	*Deviation from Mean (d) [5,000]*	*Square of Deviations*	*Probability (Pi)*	*Weighted Square Deviations (Pid²)*
2,000	-3,000	90,00,000	.2	18,00,000
4,000	-1,000	10,00,000	.3	3,00,000

6,000	+1,000	10,00,000	.3	3,00,000
8,000	+3,000	90,00,000	.2	18,00,000
			n = 1	(Pid^2) = 42,00,000

Standard Deviation = $\sqrt{\sum Pid^2} = \sqrt{4200000} = 2,050$

(Project B)

Cash Inflows (Rs.)	*Deviation from Mean (d) [5,000]*	*Square of Deviations*	*Probability*	*Weighted Square Deviations*
2,000	-3,000	90,00,000	.1	9,00,000
4,000	-1,000	10,00,000	.4	4,00,000
6,000	+1,000	10,00,000	.4	4,00,000
8,000	+3,000	90,00,000	.1	9,00,000
			n = 1	26,00,000

Standard Deviation = $\sqrt{\sum Pid^2} = \sqrt{2600000} = 1,612$

As the Standard Deviation of Project A is more than that of project B, A is more risky.

5. Co-Efficient of Variation

Investment proposals involve substantially varied cash outlays and Standard Deviation is not a suitable comparison criterion. To overcome such adverse situation, relative measure of dispersion or variability is used. This relative measure of dispersion based on standard deviation is called Co-efficient of Standard Deviation or Co-efficient of Variation.

Coefficient of variation is a relative measure of dispersion. If the projects have the same cost but different net present values, relative measure, i.e., coefficient of variation should be computed to judge the relative position of risk involved. It can be calculated as:

$$\textit{Certainty Equivalent Co-efficient} = \frac{\textit{Standard Deviation } (\sigma)}{\textit{Mean of expected Cash Flows}} \times 100$$

Illustration 13:

The management of SK & ABC Ltd. is considering which of the two mutually exclusive projects to select. Details of each project are as follows:

Project A		*Project B*	
Probability	*Profit (Rs. '000)*	*Probability*	*Profit (Rs. '000)*
0.3	300	0.2	(800)
0.3	400	0.6	600

0.4	500	0.1	800
		0.1	1600

Solution:

Project A			*Project B*		
Probability	***Profit (Rs.)***	***MV (Rs.)***	***Probability***	***Profit (Rs.)***	***MV (Rs.)***
0.3	300	90	0.2	(800)	(160)
0.3	400	120	0.6	600	360
0.4	500	200	0.1	800	60
		_.	0.1	1600	160
		410			**440**

On the basis of MVs above, it is observed that project B is marginally preferable to X, by Rs. 30,000. Project B is however is more risky, offering profit Rs. 16,00,000 but also loss to the extent Rs. 8,00,000.

Let us compute standard deviation of each project as follows:

(Project A)

Probability	***Profit (Rs. '000)***	***(d)***	$P_i d^2$
p	***x***		
0.3	300	(110)	3,630
0.3	400	(10)	30
0.4	500	90	3,240
	MV = 410		**6,900**

Here $\overline{X}$ = 410

Standard deviation = $\sqrt{\sum} Pid^2 = \sqrt{6,900}$ = Rs. 83.066

(Project B)

Probability	***Profit (Rs. '000)***	***(d)***	$P_i d^2$
p	***x***		
0.2	(800)	(1240)	3,07,520
0.6	600	160	15,360
0.1	800	360	12,960
0.1	1600	1160	134,560
	MV = 440		**4,70,400**

Standard deviation = $\sqrt{4,70,400}$ = 685.857

As the MV of the project differs, we have to find out coefficient of variation for each project, as follows:

		Project A	*Project B*
(a)	Standard deviation	Rs. 83.066	Rs. 685.857
(b)	Mean	410	440
	Coefficient of variation = $\frac{(a)}{(b)} \times 100$	20.26	155.88

Here, Project A is, less risky and should be selected.

6. Sensitivity Technique

Where cash inflows are very sensitive under different circumstances, more than one forecast of the future cash inflows may be made. These inflows may be regarded as 'Optimistic', 'Most Likely' and 'Pessimistic'. Further cash inflows may be discounted to find out the net present values under these three different situations. If the net present values under the three situations differ widely it implies that there is a great risk in the project and the investor's decision to accept or reject a project will depend upon his risk bearing abilities.

Illustration 14:

Mr. ABC, a risky investor is considering two mutually exclusive projects A and B. You are required to advise him about the acceptability of the project from the following information.

	Project A (Rs.)	*Project B (Rs.)*
Cost of the investment	50,000	50,000
Forecast cash flows per annum for 5 years		
Optimistic	30,000	40,000
Most likely	20,000	20,000
Pessimistic	15,000	5,000
(The cut-off rate may be assumed to be 15%)		

Solution:

Calculation of Net Present Value of Cash Inflows at a Discount Rate of 15%

(Annuity of Re. 1 For 5 Years)

	Project A				**Project B**			
	Annual Cash Inflow (Rs.)	**Discount Factor @15%**	**Present Value (Rs.)**	**Net Present Value (Rs.)**	**Annual Cash Inflow (Rs.)**	**Discount Factor @15%**	**Present Value (Rs.)**	**Net Present Value (Rs.)**
Optimistic	30,000	3.3522	1,00,566	50,566	40,000	3.3522	1,34,088	84,088
Most Likely	20,000	3.3522	67,014	17,044	20,000	3.3522	67,044	17,044
Pessimistic	15,000	3.3522	50,283	283	5,000	3.3522	16,761	(33,239)

The net present values as calculated above indicate that Project B is more risky as compared to Project A. but at the same time during favorable conditions, it is more profitable also. The acceptability of the project will depend upon Mr. ABC's attitude towards risk. If he could afford to take higher risk, project B may be more profitable.

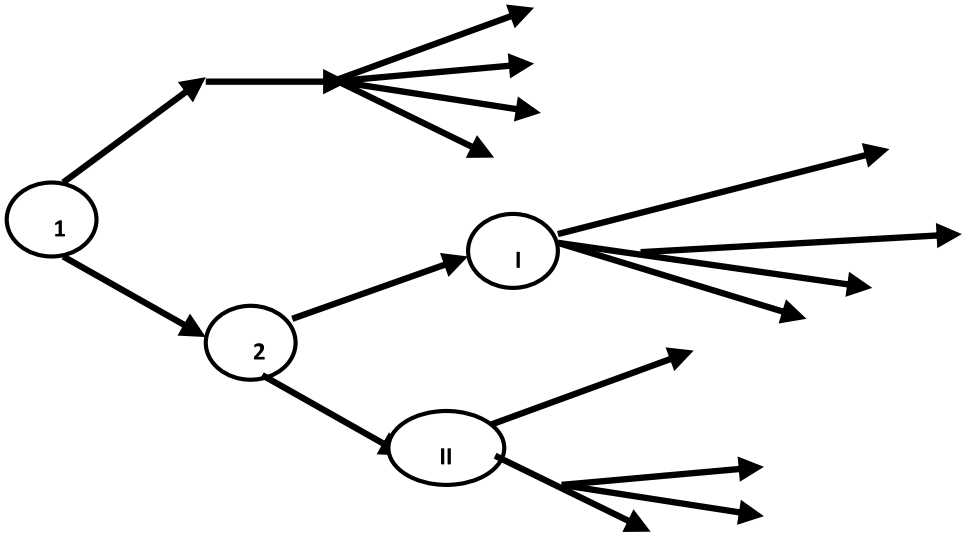
7. Decision Tree Technique

This technique is a graphical display of the relationship between a present decision and future events, future decisions and their consequences. In modern business there are complex investment decisions which involve a sequence of decisions over time. Such sequential decisions can be handled by plotting decisions trees.

A decision tree is a graphic representation of the relationship between a present decision and future events, future decisions and their consequences. The sequence of events is mapped out over time in a format resembling branches of a tree and hence the analysis is known as **decision tree analysis.**

The decision tree can be constructed with following five steps:

- **First:** Identification of the problem and defining the Proposal
- **Second:** Identifying maximum alternatives
- **Third:** Graphing the Decision Tree indicating the decision points, chance events, and other relevant data
- **Fourth:** Forecasting Cash Flow and specification of probabilities
- **Fifth:** Result Evaluation (Analysis of the alternatives)



F-1.7 A Decision Tree

For example, a company 'X' has an opportunity to invest in equivalent schemes that will last for two years and will cost r 1,00,000 initially. Cost of capital is 15%. It has the following estimated possible cash flow after tax (CFAT)

Year

One: 30% chance that (CFAT) will be r 40,000/-40% chance that (CFAT) will be r 60,000/- 30%

chance that (CFAT) will be r 80,000

Two: CFAT are conditional to those of year one.

The estimated conditional CFAT's and probabilities are as under:

If 1st year CFAT = r 40,000		If 1st year CFAT = r 60,000		If 1st year CFAT = r 80,000	
2nd year CFAT	**Probability**	**2nd year CFAT**	**Probability**	**2nd year CFAT**	**Probability**
20,000	0.2	70,000	0.3	80,000	0.1
50,000	0.6	80,000	0.4	1,00,000	0.8
80,000	0.2	90,000	0.3	1,20,000	0.1

From the above data we may plan the decision as under:

					Decision Tree			*Expected*
	Prob-ability	***CFAT Year 1 (r)***	***Probability***	***CFAT Year 2(r)***	***PV of CFAT at 15% (PV of CFAT at yr1 + PV of CFAT at yr2)***	***(a) NPVat 15% r***	***(b) Joint Probability***	***NPV a x b(r)***
	0.3	40,000	0.2	20,000	49,920	- 50,080	0.06	- 3,005
			0.6	50,000	72,600	- 27,400	0.18	- 4,932
			0.2	80,000	95,280	- 4,720	0.06	- 283
Cash outlay 1,00,000	0.4	60,000	0.3	70,000	1,05,120	5,120	0.12	614
			0.4	80,000	1,12,680	12,680	0.16	2,029
			0.3	90,000	1,20,240	20,240	0.12	2,428
	0.3	80,000	0.1	80,000	1,30,080	30,080	0.03	902
			0.8	1,00,000	1,45,200	45,200	0.24	10,848
			0.1	1,20,000	1,60,320	60,320	0.03	1,810
							1.00	10,411

Note: Present value of cash inflows are worked out on the basis of three decimal points.

The above decision tree shows possible CFAT outcomes in each year and the probabilities associated with these outcomes. The decision tree shows nine distinct paths, or combinations of outcomes that the project would take if accepted. One possibility is that one year's CFAT is Rs. 40,000 and the second year's CFAT is

Rs. 20,000. This is worst combination of outcomes that could occur. The company X would have paid Rs.1,00,000 for a CFAT stream of Rs. 40,000 and Rs. 20,000 in years one and two respectively. If the company X determined that an appropriate discountrate for this project is 15%, the NPV of the worst path is –Rs. 50,080. By looking at the decision tree figure, the best path for the firm is CFAT1 = Rs. 80,000 and CFAT2 = Rs. 1,20,000. The NPV at 15% of that path is Rs. 60,320. The decision tree shows NPV of each of the nine possible CFAT paths in the tree at discount rate of 15%. The expected net present value (NPV) of the problem depicted by the decision tree is the weighted average of net present values of all the paths:

$$NVP=\sum_{J=0}^{N}(Probj)\ (NPVj)$$

Where NPVj = net present value of the jth path

Probj = the probability of the jth path occurring N = number of possible paths

The probability of a path occurring is called its joint probability. It is equal to the product of the probabilities along with the path.

In the decision tree calculations the last column shows the calculation of expected NPV which is the weighted average of individual path NPVs where the weights are the path probabilities. NPV for example is Rs. 10,411 and project should be accepted.

For short period projects the above technique is good but for long period projects it becomes more complicated with the multiplication of paths, for the number of possibilities. In the above case, there had been 9 paths for 2 years, but for the 3 years these could be (3 × 3 × 3) = 27 paths and likewise the increase of path complicates the diagram and calculations.

CASE STUDIES

Question 1 - The Capital Budget Committee of SK company is making a preliminary screening of capital expenditure proposals. The following proposals are under consideration:

Proposal	*Investment*	*Annual Net Cash inflows (after tax but before depreciation)*	*Service Life (in years)*	*Present Value Factor at 20%*
	Rs.	*Rs.*		
A	31,300	6,000	10	4.192
B	97,400	20,000	20	4.870
C	98,075	25,000	10	4.192
D	27,200	4,000	15	4.675

a) Rank the proposals according to pay-back period. The period of pay-back should not exceed 6 years.

b) Rank the proposals according to the rate of return on investment (Discounted Cash Flow Method). The Company's cut-off rate is 20%.

Solution

a) Ranking According to Pay-back Period

Proposal (1)	*Investment (2)*	*Annual Net Cash inflows (3)*	*Pay-back Period (4)*	*Rank (5)*
	Rs.	Rs.	(2) / (3)	
A	31,300	6,000	5.22 years	3
B	97,400	20,000	4.97 years	2
C	98,075	25,000	3.81 years	1
D	27,200	4,000	6.80 years	4

Decision: - The pay-back period of the project D is more than 6 years; hence, it will be rejected. Remaining projects will be accepted as per ranks given.

b) Ranking According to Present Value Index Method DCF Method)

Proposal (1)	*Life in Years (2)*	*Annual Cash flows (3)*	*P.V. Factor at 20% (4)*	*P.V. of Total Cash Flows (5) = (3) x (4)*	*Initial Outlay (6)*	*Net Present Value Index (7) = (5) x (6)*	*Rank (8)*
		Rs.		Rs.	Rs		
A	10	6,.000	4.192	25.152	31,300	0.80	3
B	20	20,000	4.870	97,400	97,400	1.00	2
C	10	25,000	4.197	1,04,800	98,075	1.07	1
D	15	4,000	4.675	18,700	27,200	0.69	4

Decision: - Profitability index (PI) of the projects A and D is less than 1, hence, these will be rejected. Project C would be selected. The project B will be rejected due to its index being equal to one.

Question 2 - Calculate the 'pay-back period', 'average rate of return' and 'net present value' for a project which requires an initial outlay of Rs. 10,000 and generates year ending cash flows (after tax but before depreciation) of Rs. 6,000; Rs. 3,000; Rs. 2,000; Rs. 5000 and Rs. 5,000 from the end of the first year to the end of fifth year. The required rate of return is 10 percent and pays tax at 50 percent rate. The project has a life of five years and depreciated on straight line basis.

Year	1	2	3	4	5
Discount Rate at 10%	.909	.826	.751	.683	.620

Solution:

i) Pay-back Period Method

Year	*Initial Investment*	*Cash Inflows*	*Cumulative Cash Inflows*
	Rs.	*Rs.*	*Rs.*
1	10,000	6,000	6,000
2	-	3,000	9,000
3	-	2,000	11,000
4	-	5,000	16,000
5	-	5,000	21,000

Pay-back Period = 2 + (10,0000 – 9,000) / 2,000 = 2.5 years

ii) Average Rate of Return Method

ARR = (Average Annual Cash Inflows – Annual Depreciation)/Average Investment x 100

= (Rs. 4,200 – Rs. 2,000) / 5,000 x 100

= (Rs. 2,200 / Rs. 5,000) x 100 = 44%

Average Annual Cash Inflows = Total Cash Inflows / Life in Years = Rs. 21,000 / 5 = Rs.4,200

iii) Net Present Value Method

Year	*Cash inflows*	*P.V. Factor at 10%*	*Present Value*
	Rs.		*Rs.*
1	6,000	.909	5,454
2	3,000	.826	2,478
3	2,000	.751	1,502
4	5,000	.683	3,415
5	5,000	.621	3,105
		Total Present Value	**15,954**

Net Present Value = Present Value – Initial Investment

= Rs. 15,954 – Rs. 10,000

= Rs. 5,954

Question 3 - SK. Ltd. is considering the purchase of a new machine which will come out some operations which are at present performed by labour X and Y are alternative models. The following information's are available:

	Machine X	*Machine Y*
Cost of Machine	15,000	24,000
Estimated life of machine	5 years	6 years
Estimated saving in scrap p.a.	1,000	1,500

Estimated cost of indirect materials p.a.	600	800
Estimated savings in direct wages p.a.	9,000	12,000
Additional cost of maintenance p.a.	700	1,100
Additional cost of supervision p.a.	1,200	1,600

Depreciation will be charged on a straight-line basis. A tax rate of 50% is assumed.

a) The pay back method;

b) Unadjusted return on average investment method; and

c) Net present value index method (cost of capital 8 percent)

Note: - The present value of Re. 1 @ 8% per annum received annually for 5 years is 3,993 and for 6 years are 4.623.

Solution:

Profitability Statement

	Machine X	***Machine Y***
Savings per annum	***Rs.***	***Rs.***
Wages	9,000	12,000
Scrap	1,000	1,500
Gross Saving(A)	10,000	13,500
Additional Cash Cost per annum:		
Indirect material	600	800
Maintenance	700	1,100
Supervision	1,200	1,600
Total Cash Costs (B)	2,500	3,500
Cash Savings p.a. (A – B)	7,500	10,000
Less: Depreciation (straight line)	3,000	4,000
Annual Savings p.a. (before tax)	4,500	6,000
Less: Income tax @ 50 %	2,250	3,000
Annual Savings p.a. (after tax)	2,250	3,000
Add: Depreciation	3,000	4,000
Annual Cash Inflow	5,250	7,000

Evaluation of Projects

i) Pay-back Method:

a. Pay-back Period = Initial Investment / Annual Cash Inflows

Machine X = Rs. 15,000 / Rs. 5,250 = 2.86 years

Machine Y = Rs. 24,000 / Rs. 7,000 = 3.43 years

b. Post Pay-back Profitability = Annual Cash Inflows x (Whole life – Pay-back period)

Machine X = Rs. 5,250 x (5 – 2.86) = Rs. 11,235

Machine Y = Rs. 7,000 x (6 – 3.43) = Rs. 17,990

Decision: According to Pay-back period method, the machine X should be purchased, but if post pay-back profitability method is used, then machine Y should be purchased.

ii) Unadjusted Return on Average Investment Method:

Average Rate of Return = Average Annual Net Savings / Average Investment x100

Machine X = Rs. 2,250 / Rs. 7,500 x 100 = 30%

Machine Y = Rs. 3,000 / Rs. 12,000 x 100 = 25%

Average Investment = Initial Investment / 2

Decision: According to this method machine X should be purchased.

iii) Net Present Value Index Method:

Present Value = Annual Cash Inflows x P.V. Factor at 8%

Machine X = Rs. 5,250 x 3.993 = Rs. 20,963

Machine Y = Rs. 7,000 x 4.623 = Rs. 32,361

Net Present Value Index = Present Value / Investment

Machine X = Rs. 20,963 / Rs.15, 000 = 1.3975

Machine Y = Rs. 32,361 / Rs.24, 000 = 1.3484

Question 4 - The following details of SK & ABC Co. relate to the two machines X and Y:

	Machine X	***Machine Y***
Cost	Rs. 56,125	Rs. 56,125
Estimated Life	5 years	5 years
Estimated salvage value	Rs. 3,000	Rs. 3,000
Annual income after tax and depreciation:		
Year	Rs.	Rs.
I	3,375	11,375
II	5,375	9,375
III	7,375	7,375
IV	9,375	5,375
V	11,375	3,375

Overhauling charges at the end of third year Rs. 25,000 on machine Y. Depreciation has been charged at straight line method. Discount rate is 10%, P.V.F. at 10% for five years are 0.909, 0.826, 0.751, 0.683 and 0.621. Suggest which project should be accepted.

Solution:

i) Calculation of Present Value of Cash-outflows:

Year	*Investment*		*P.V. Factor at 10%*	*Present Value*	
	X	*Y*		*X*	*Y*
	Rs.	Rs.		Rs.	Rs.
0	56,125	56,125	1.000	56,125	56,125
III	-	25,000	0.751	-	18,775
				56,125	74,900

ii) Calculation of Cash Inflows:

Year	*Machine X*			*Machine Y*		
	Annual Income	*Depreciation*	*Cash Inflows*	*Annual Income*	*Depreciation*	*Cash Inflow*
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
I	3,375	10,625	14,000	11,375	10,625	22,000
II	5,375	10,625	16,000	9,375	10,625	20,000
III	7,375	10,625	18,000	7,375	10,625	18,000
IV	9,375	10,625	20,000	5,375	10,625	16,000
V	11,375	10,625	22,000	3,375	10,625	14,000

iii) Calculation of present Value of Cash Inflows:

Year	*Cash Inflows Machines*		*P.V. Factor at 10%*	*Present Value Machines*	
	X	*Y*		*X*	*Y*
	Rs.	Rs.		Rs.	Rs.
I	14,000	22,000	0.909	12,726	19,998
II	16,000	20,000	0.826	13,216	16,520
III	18,000	18,000	0.751	13,518	13,518
IV	20,000	16,000	0.683	13,660	10,928
V	22,000	14,000	0.621	15,525	10,557
	3,000*	3,000*			
	Total Present Value			68,645	71,521

*Salvage value at the end of life of the machines.

Net Present Value = P.V. of Cash Inflows – P.V. of Cash Outflows

Machine X = Rs. 68,645 – Rs. 56,125 = Rs. 12,520

Machine Y = Rs. 71,521 - Rs. 74,900 = Rs. (-) 13,379

Decision: Machine X should be selected.

Question 5 - ABC Ltd. is contemplating adding a new product line. The new product line would be marketable for only five years, after which time it would have to be discontinued. The costs and revenues that would be associated with the new line are:

Cost of equipments required	80,000
Working Capital needed	70,000
Salvage value of equipment in 5 years	10,000
Annual sales revenues	75,000
Annual out of pocket costs for salaries, advertising etc.	45,000
Overhaul of the equipment required in 4 years.	5,000

The company's cost of capital is 12%. Would you recommend that the new line be introduced? Ignore income tax.

The Present value of Re. 1 for 5 years at 12% discount factor is .893, .797, .636 and .567.

Solution:

Computation of Present Value of Cash Outflows

	Rs.
Cost of Equipment	80,000
Working Capital needed	70,000
Overhauling of Equipment in 4th year (Rs. 5,000 x 0.636)	3,180
	1,53,180

Computation of Present Value of Cash Inflows

Year	***Cash Inflows Rs.***	***P.V. Factor At 12%***	***Present Value Rs.***
1	30,000	.893	26,790
2	30,000	.797	23,910
3	30,000	.712	21,360
4	30,000	.636	19,080
5	1,10,000	.567	62,370
			1,53,510

*This includes Rs. 70,000 for released Working Capital and Rs. 10,000 for salvage value.

Net Present Value = Rs. 1, 53,510 – Rs. 1, 53,180 = Rs. 330

Net Present Value is Rs. 330; hence new line may be introduced.

Working Note:

i) Annual Cash Inflows

Annual Sales Revenues	75,000
Less: Annual out of pocket cash for salaries, adv. Etc	45,000
	30,000

ii) Income tax ignored in absence of information.

Question 6 - From the following information, ascertain which project is more risky on the basis of coefficient of variation:

Project A		***Project B***	
Cash Inflow (Rs.)	***Probability***	***Cash Inflow***	***Probability (Rs.)***
2,000	.2	2,000	.1
4,000	.3	4,000	.4
6,000	.3	6,000	.4
8,000	.2	8,000	.1

Solution:

Calculation of Standard Deviation (Project A)

Cash Inflows (Rs.)	***Deviation from Mean (d) [5,000]***	***Square of Deviations***	***Probability (Pi)***	***Weighted Square Deviations (Pid^2)***
2,000	-3,000	90,00,000	.2	18,00,000
4,000	-1,000	10,00,000	.3	3,00,000
6,000	+1,000	10,00,000	.3	3,00,000
8,000	+3,000	90,00,000	.2	18,00,000
			n = 1	$\sum Pid^2$= 42,00,000

Standard Deviation = $\sqrt{\sum Pid^2} = \sqrt{4200000} = 2050$

Coefficient of variation = $\frac{\textbf{Standard Deviation } (\sigma)}{\textbf{Mean of expected Cash Flows}} \times 100 \quad \frac{2050}{5000} \times 100 = 41\%$

(Project B)

Cash Inflows	***Deviation from***	***Square of***	***Probability***	***Weighted Square***
(Rs.)	***Mean (d) [5,000]***	***Deviations***		***Deviations***
2,000	-3,000	90,00,000	.1	9,00,000
4,000	-1,000	10,00,000	.4	4,00,000
6,000	+1,000	10,00,000	.4	4,00,000
8,000	+3,000	90,00,000	.1	9,00,000
			n = 1	= 26,00,000

Standard Deviation = $\sqrt{\sum} Pid^2 = \sqrt{2600000} = 1612$

Coefficient of variation = $\frac{\textbf{\textit{Standard Deviation (σ)}}}{\textbf{\textit{Mean of expected Cash Flows}}} \times 100 = \frac{1612}{5000} \times 100 = 32.24\%$

As the coefficient of variation of Project A is more than of B, Project A is more risky. Hence project B should be accepted.

LESSON ROUND-UP

- Capital Budgeting refers to long-term planning for proposed capital outlays and their financing. Capital Budgeting may also be defined as "the firms' decision to invest its current fund more efficiently in long- term activities in anticipation of an expected flow of future benefit over a series of years.
- Capital Rationing helps the firm to select the combination of investment projects that will be within the specified limits of investments to be made during a given period of time and at the same time provide greatest profitability.
- Pay Back technique estimates the time required by the project to recover, through cash inflows, the firm's initial outlay. Payback period = Initial Investment / Annual cash inflows
- Average Rate of Return method is designated to consider the relative profitability of different capital investment proposals as the basis for ranking them – the fact neglected by the payout period technique.
- Net Present Value: The cash outflows and inflows associated with each project are ascertained first and both are reduced to the present values at the rate of return acceptable to the management. The rate of return is either cost of capital of the firm or the opportunity cost of capital to be invested in the project.
- Internal Rate of Return: The internal rate of return refers to the rate which equates the present value of cash inflows and present value of cash outflows.
- Profitability Index (PI): Profitability Index is defined as the ratio of present value of the future cash benefits at the required rate of return to the initial cash outflow of the investment.

GLOSSARY

Internal Rate of Return: The internal rate of return calculation is used to determine whether a particular investment is worthwhile by assessing the interest that should be yielded over the course of a capital investment.

Net Present Value: Net present value (NPV) is used for the same purpose as the internal rate of return, analyzing the projected returns for a potential investment or project. The net present value represents the difference between the current value of money flowing into the project and the current value of money being spent. The value can be calculated as positive or negative, with a positive net present value implying that the earnings generated by a project or investment will exceed the expected costs of the venture and should be pursued.

Profitability Index: The profitability index is a capital budgeting tool designed to identify the relationship between the cost of a proposed investment and the benefits that could be produced if the venture was successful. The profitability index employs a ratio that consists of the present value of future cash flows over the initial investment. As this ratio increases beyond 1.0, the proposed investment becomes more desirable to companies. When this ratio does not exceed 1.0, the investment should be deferred, as the project's present value is less than the initial investment.

Accounting Rate of Return: The accounting rate of return is the projected return that an organization can expect from a proposed capital investment. To discover the accounting rate of return, finance professionals must divide the average profit by the initial investment. The accounting rate of return is a useful metric for quickly calculating the profitability of a company, and it is widely used for analysing the success rates of investments that feature multiple projects.

Payback Period: The payback period is a unique capital budgeting method. Specifically, the payback period is a financial analytical tool that defines the length of time necessary to earn back money that has been invested. A subcategory, price-to-earnings growth payback period, is used to define the time required for a company's earnings to find equivalence with the stock price paid by investors. The price-to-earnings growth payback period is also widely used to get a basic understanding of how risky an investment opportunity may be. Understanding the payback period of an investment limits the risks associated with taking on costly projects.

Equivalent Annuity: The equivalent annuity method expresses the NPV as an annualized cash flow by dividing it by the present value of the annuity factor. It is often used when comparing investment projects of unequal lifespans. For example, if project A has an expected lifetime of seven years, and project B has an expected lifetime of 11 years, it would be improper to simply compare the net present values (NPVs) of the two projects, unless the projects could not be repeated.

Real Options Analysis: The discounted cash flow methods essentially value projects as if they were risky bonds, with the promised cash flows known. But managers will have many choices of how to increase future cash inflows or to decrease future cash outflows. In other words, managers get to manage the projects, not simply accept or reject them. Real options analysis try to value the choices–the option value–that the managers will have in the future and adds these values to the NPV.

TEST YOURSELF

TRUE / FALSE

1.	The long term investment decisions are synonymous.	True
2.	Pay back period methods measure the true profitability of a project.	False
3.	Rate of return method does not take into account the time value of money.	True
4.	Is the Net present value method takes the earning over the entire life of the project?	True
5.	Time adjusted rate of return and internal rate of return are the same things.	True
6.	Discounted cash flow techniques takes into account time value of money.	True
7.	IRR and NPV both are discounting cash flow technique.	True
8.	Capital budgeting decisions are for short period	False

MULTIPLE CHOICE QUESTIONS

1. The payback method measures:

   (A) The cash flow from an investment

   (B) How quickly the investment may be recovered

   (C) The profitability of the project

   ANS – (B)

2. In the calculation of cash earnings:

   (A) Depreciation should be added to profit after tax

   (B) Depreciation should be added to profit before tax

   (C) Depreciation should be ignored

   ANS – (A)

3. Which of the following does not consider the time value of money?

   (A) Payback period (B) Profitability index (C) IRR

   ANS – (A)

4. Which of the following method does not consider the profitability of the whole life of the project?

   (A) Payback period method (B) Net present value method

   (C) Accounting rate of return method

   ANS - (A)

5. The result of NPV and IRR method:

   (A) Will always be same

   (B) Will always be conflicting

   (C) May or may not be same

   ANS – (C)

ESSAY TYPE QUESTIONS

1. What so you mean by capital budgeting? Also discuss its features and objectives.
2. Discuss the process of capital budgeting.
3. Discuss the need and importance of capital budgeting.
4. Explain the scope and limitation of capital budgeting.
5. Explain the concept of Payback Period. Why does this method enjoy such popularity among businessmen? What are its limitations?
6. What considerations other than profitability are made in managerial decisions about investment proposal?
7. Describe the decision tree approach.

8. Explain the various techniques of capital budgeting.
9. What are the various DCF Techniques being applied for capital budgeting decisions?

PRACTICAL TYPE QUESTIONS

Question 1. SK Co. is considering the purchase of a Machine. Model 'A' and Model 'B' are available for this purpose each costing Rs. 1,00,000. Estimated working life of each machine is 5 years and salvage value is Rs. 4,000 and Rs. 6,000 respectively. Estimated annual cash flows are estimated to be as under:

Year	Machine A (Rs.)	Machine B (Rs.)
First	60,000	20,000
Second	50,000	30,000
Third	40,000	40,000
Fourth	20,000	50,000
Fifth	20,000	60,000

Evaluate these proposals according to pay back period method.

Answer: P.B.P – $1\frac{4}{5}$ years; B: $3\frac{1}{5}$ years. Hence, A is better.

Question 2. From the followings details of SK Corporation relating to two projects, calculate the payback period and suggest which project is better:

	Project A	***Project B***
Cost of the Project	Rs. 1,80,000	2,00,000
Estimated Scrap Value	20,000	25,000
Estimated Savings:		
1st year	25,000	35,000
2nd year	30,000	50,000
3rd year	45,000	70,000
4th year	50,000	65,000
5th year	40,000	30,000
6th year	30,000	20,000
7th year	10,000	-

Answer: P.B.P. A – 4 years 9 months; B – 3 years 8 $\frac{4}{13}$ months. Project B is better.

Question 3. Cost of a Machine is Rs. 2,50,000 and its working life is estimated to be 5 year. Annual cash inflows are as under:

Year	*I*	*II*	*III*	*IV*	*V*
Annual Cash Inflows (Rs.)	60,000	70,000	60,000	90,000	50,000

Calculate:

A) Pay Back Period
B) Post Payback Period
C) Post Payback Profits
D) Index of Post Payback Profits

Answer: (A) 3 years 8 months, (B) 1 year 4 months, (C) Rs. 80,000, (D) 32%

Question 4. SK Ltd. is considering the purchase of a new machine. Two machines A and B are available, each costing Rs. 50,000. Earnings after taxation are expected to be as under:

	Cash Flow	
Year	***Machine A***	***Machine B***
	Rs.	**Rs.**
1	15,000	5,000
2	20,000	15,000
3	30,000	20,000
4	15,000	30,000
5	5,000	20,000

Evaluate the two alternatives according to (a) Payback Period Method (b) Return on Investment Method (c) Present Value Index Method. A discount rate of 10% is to be used.

Answer:

(a) P.B.P.: A – 2 years 6 months, B – 3 years 4 months,
P.P.B. Profitability: A – Rs. 35,000; B – Rs. 40,000;

(b) ROI: A – 28%, B – 32%, Machine A is better according to P.B.P.
According to P.P.B.P. and ROI, Machine B would be preferred.

(c) A – 1.345; B - 1.322

Question 5. SK Ltd. is considering the purchase of a machine. Two machine X and Y are available each costing Rs. 5,000. Earnings after taxation and depreciation on the basis of fixed installment system are expected to be as follows:

Year	*Machine X*	*Machine Y*
1	500	200
2	1,000	300
3	1,500	1,000
4	400	2,000
5	100	1,000

Evaluate the two alternatives according to:

(a) The payback period method, and

(b) Return on investment method.

Answer: (a) P.B.P.: X - $2\frac{3}{5}$ years; Y - $3\frac{1}{6}$ years, Machine X is better.

(b) ROI: X – 28%; Y – 36%, Machine Y is better

Question 6. Given data for ABC Ltd.:

Initial Investment	20,000
Net Cash Inflow:	
Ist year	2,000
IInd year	2,000
IIIrd to 10th year	2,500

Work out net present value with a discount rate at 10% and express whether the investment will be worthwhile. The P.V.F. @ 10% are as follows:

Year	1	2	3	4	5	6	7	8	9	10
P.V.F.	.909	.826	.751	.683	.621	.564	.513	.467	.424	.386

Answer: NPV = Rs. 5,507.50; Hence, investment is not worthwhile.

Question 7. ABC Ltd. has to purchase a machine. Two models A and B are available. You are to determine as to which machine should be purchased using

(i) Payback Period Method,

(ii) Unadjusted Rate of Return Method and

(iii) Present Value Index Method (Cost of Capital - 12%):

Particulars	***Machine A***	***Machine B***
Cost of Machine	Rs. 42,000	Rs. 54,000
Working Life	4 years	5 years
Scrap Value	Rs. 2,000	Rs. 4,000
Annual Savings after depreciation and tax:		
Ist year	Rs. 12,000	Rs. 12,000
IInd year	Rs. 16,000	Rs. 12,000
IIIrd year	Rs. 10,000	Rs. 12,000
IVth year	Rs. 8,000	Rs. 12,000
Vth year	-	Rs. 12,000

Answer: (i) PBP: A 1 year 281 days, B 2 years 166 days; (ii) ROI: A 52.27%, B 41.38%

(iii) PVI: A 1.603, B 1.51

[***Hint:*** Annual Cash Flow = Annual Savings + Depreciation]

Question 8. Rank the following investment proposals in order of their profitability according to:

(a) Payback period method,

(b) Unadjusted rate of return method and

(c) Present value index method. The cost of capital is 10%.

Project No.	*Initial Quality*	*Annual Cash Flow*	*Life*
	Rs.	*Rs.*	*(in years)*
A	60,000	8,000	15
B	25,000	3,000	10
C	3,000	1,000	5
D	2,150	1,000	3
E	20,000	4,000	10
F	40,000	8,000	8

Answer: (a) 4, 5, 2, 1, 3, 3; (b) 5, 6, 1, 2, 3, 4; (c) 5, Rejected, 1, 3, 2, 4

Question 9. Golden Brick Company has got up to Rs. 3,50,000 to invest. The following proposals are under consideration:

Proposal	*Initial outlay*	*Annual Cash Flow*	*Life (years)*
A	1,25,000	16,000	15
B	2,50,000	75,000	20
C	3,00,000	25,000	18
D	60,000	9,000	12
E	1,00,000	26,000	11

Cost of Capital is 10%.

Rank these projects according to (i) Payback period and (ii) Net present value index method. Which projects would you recommend?

Answer: (1) 4, 1, 5, 3, 2, (ii) Reject., 1, Reject., 3, 2 ; Hence, invest in B and E

Question 10. A project requires an initial outlay of Rs. 32,400. Its estimated economic life is 3 years. The cash streams generated by it are expected to be as follows:

Year	*Estimated Annual Cash Flows (Rs.)*
1	16,000
2	14,000
3	12,000

Compute its IRR. If the cost of capital to the firm is 12%, advise the management whether the project should be accepted or rejected.

Answer: IRR = 15%. The project must be accepted as its IRR exceeds the cost of the funds. The project will contribute 3% to the value of the firm.

LIST OF FURTHER READINGS

1. Business Finance—Theory and Management. New York: Macmillan
2. Financial Management for Decision Making. New York: Macmillan.
3. Financial Management: Theory and Practice. 8th ed. Florida: Dryden Press.
4. Capital Budgeting: Theory and Practice, Pamela P. Peterson, Frank J. Fabozzi