

2

Project Planning and Capital Budgeting

Learning Objectives

After going through the chapter student shall be able to understand:

- Study of feasibility of any investment under the following heads:
 - (a) Market Feasibility
 - (b) Technical Feasibility
 - (c) Financial Feasibility
- A brief study of the various aspects of Project Report including its specimen and Post Completion Audit
- Social Cost Benefit Analysis- Features, Techniques, Limitations etc.
- Capital Budgeting under Risk and Uncertainty
 - (1) Risk Adjusted Discount Rate Method
 - (2) Certainty Equivalent Approach (CE Approach)
 - (3) Other Methods
 - (a) Sensitivity Analysis
 - (b) Scenario Analysis
 - (c) Simulation Analysis (Monte Carlo)
 - (d) Decision Tree Analysis
- Capital Budgeting under Capital Rationing
- Capital Budgeting under Inflation
- Capital Asset Pricing Model Approach to Capital Budgeting
- Replacement Decision
- Real Option in Capital Budgeting - Valuation and Types

1. Feasibility Study

Project feasibility is a test by which an investment is evaluated. There are three types of feasibilities evaluated for a project viz. 1) market feasibility 2) technical feasibility and 3) financial feasibility. For projects evaluated by government, economic and social feasibility is also considered.

1.1. Market Feasibility: Products having high sales potential are less risky to invest in. For conducting market feasibility study, the type of proposed product is important. Indicators of buyer behavior in response to a new product have to be taken into account for estimating the potential demand. A proposed product, if new in a country, but successfully marketed in other countries, then its market feasibility is assessed through comparison of some broad economic and cultural indicators in both the countries. Each country will experience an identical buying pattern and preference for products, if the economic indicators are comparable. Cultural differences should be adjusted so as to draw conclusions about the demand, per-capita incomes, income disparity levels, pattern indicating shifts in consumption, literacy level and other economic factors indicating the potential demand for a particular product.

A proposed project for an addition to the existing capacity, the task of market feasibility study shall be different. Historical data analysis and study of factors influencing consumption trends become essential. The market feasibility study for a product already selling in the market consists of:

- (a) Economic Indicators – A change in demand and a change in one or some economic indicators may take place simultaneously.
- (b) Demand Estimation – Projection of demand is most important step in project feasibility study. These include:
 - End-user profile
 - Study of influencing factors
 - Regional, national and export market potential
 - Infra-structure facilities facilitating or continuing demand
 - Demand forecasting
- (c) End-user profile – A product may have different uses and end-users. Total demand is made up of different end-users. Different market segments may not be interlinked. Demand for cement is divided into two categories, housing/ maintenance and infrastructure viz. irrigation, canal, railways, road and ports. The end-users are also classified into government and non-government demand, urban and rural demand.
- (d) Influencing Factors – Demand for a product is a derived demand. Demand for fertilizer sales is dependent on monsoons while sale of steel and industrial growth are associated with each other.
- (e) Market Potential – Regional, national and export market potential of a product may be different. Study of national demand may not be adequate due to regional imbalances

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caused by several constraints. Assessment of export potential is another important exercise. Economic distance to which a product can be exported must be evaluated. Importing countries must be identified, and countries that have no exportable surplus. Cost and quality aspects of goods must be compared with other potentially exporting countries. International relations, import and export barriers in countries, and other factors need to be understood.

- (f) Infrastructure Facility – It needs to be assessed properly. Exportability depends more on high cost of transportation.
- (g) Demand Forecasting – It is an important step in the assessment of demand potential. Growth in demand in past can be indicative of future demand. There are various methods of demand forecasting. Some factors influencing consumption behaviour in the past will continue to influence the future, others provide for adjustment of some economic indicators likely to be different in the future.
- (h) Supply Estimation – Past trends of supply of goods can be studied and further extrapolated. Projections so made need to be adjusted with additional information, projects undertaken in the economy, import possibility as governed by import policy, import tariff and international prices. Information regarding entry barrier is necessary. A long gestation period and a high capital to labour ratio may create a natural entry barrier. Government licensing policy, availability of required input like materials and skilled labour also cause entry on barrier. A product whose entry barrier is high is unlikely to find a sudden spur in supply, offering more comfortable position to existing players.
- (i) Identification of Critical Success Factors – For choice of location and to find the risk of a project, it is necessary to identify critical factors, which determine the success of project. Availability of raw material supply and cost of power, transportation facilities, supply of skilled manpower or other variables could be the critical success factors. They are product and region specific. The right choice of location may reduce the cost of a project and the uncertainty regarding the availability of resources. If some crucial factors are subject to volatile changes, then the impact of their variability on the net profitability of a project has to be separately evaluated.
- (j) Estimation of the Demand-Supply Gap – Demand and supply estimates have to be fine-tuned with new or changed factors and then compared with each other for determining the gap. The demand-supply gap is fruitful for a geographical territory. The forecast of demand and supply may not be a single point forecast. A multiple point forecast gives the most adverse, most likely and most favourable forecast of demand and supply.

To find Demand Supply Gap,

Demand Surplus : Minimum = Min demand – Max supply

Likely = Likely demand – Likely supply

Maximum = Max demand – Likely supply.

To summarize, deriving answers to the following queries will form the major part of Marketing Feasibility analysis:-

1. What is the product/service and what customer need does it/they address?
2. What is the market size?
3. Demand-Supply gap for the product/service?
4. Is it intermediary product or end-user product?
5. Whether any market research/survey has been conducted and, if so, the results of the survey?
6. Domestic market overview and overseas market potential
7. Is customer segmentation possible? If yes, what are the various segments?
8. What is the sale process?
9. What is the initial market share and growth in market share projected?
10. Who are the competitors and the competitive forces in the industry?
11. Price and income elasticity for the product(s)?
12. Imports, exports, import/export restrictions and tariff protection to the product
13. In the case of B2C, the following additional factors are required:-
 - a. Demographic factors, such as age, sex, family status, education, income, class, occupation, education; and, if relevant, religion and race.
 - b. Behavioural factors such as frequency of product purchase, shopping behavior, etc.
14. What are the barriers to entry into industry and exit?
15. What are the larger forces that define the market – eg. cultural changes, government policies, innovation
16. Possibility to reverse engineer the product by competition
17. What is the proposed channel and distribution policy?
18. What is the proposed pricing policy and comparison of prices with competition?
19. What is the sales promotion budget made in financial projections?
20. What is the overall marketing and sales strategy?
21. What are the strategic distribution alliances proposed?
22. If significant part of the output is proposed to be exported, what are the selling arrangements?
23. What are the gross profit and net profit margins and how do they compare with competition?
24. How much commission is proposed to be offered to the channel?

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- 25. Payment terms
- 26. Product standards, specifications and certifications

If the project has collaborators, how to leverage on collaborator brand value

1.2 Technical Feasibility: The technical feasibility analysis of a project can vary with the size and complexity involved in setting up the project. Establishing a large scale project for manufacturing of a product (eg., automobile, chemicals, steel or cement) will require an analyst to evaluate many of the points listed below:-

- (1) Plant location and site access
 - a. by road,
 - b. by rail and
 - c. by Telecom
- (2) Issues related to 'Seismic zone'
- (3) Soil structure analysis
- (4) Program for preparation of construction site
- (5) Civil engineering and construction capabilities i.e. piling, roads, ports, pipelines, transmission, etc.
- (6) Receipt of equipment
- (7) Facilities for erection and/or assembly of machinery
- (8) Raw material availability
 - a. Quality
 - b. Quantity
- (9) Component availability – vendor capabilities
- (10) Utilities availability
 - a. Power (back-up)
 - b. Water (quality and quantity)
 - c. Sanitation and sewerage services
- (11) Proposed technology versus available alternative technologies
- (12) Whether the chosen technology is already in operation, if yes, where?
- (13) Ease of technology absorption; learning curve analysis
- (14) Details of Technical collaboration, if any. If yes, details of collaborator
- (15) Technical Collaboration agreement review
- (16) Support from collaborators – Supply vs. Supply, installation and commissioning?
- (17) The technical specifications of plant and equipments
- (18) Plant design and layout
- (19) Product mix and implications on capacity utilisation

- (20) Scale of operations and line balancing
- (21) Production bottlenecks
- (22) Flexibility in production lines
- (23) Effluents and disposal of effluents
- (24) Selection process for supply of Plant and equipments
- (25) Support from Plant & Equipment suppliers in case of downtime
 - a. availability of Service Level Agreements (SLAs)
 - b. availability and cost of machinery spare parts
- (26) Localization programme (PMP – Phased Manufacturing Program)
- (27) By-products, use and disposal
- (28) Present installed capacity, future capacity build-up – possibilities and constraints
- (29) Type of buildings (Class 1, 2 or 3) and appropriateness of the buildings
- (30) Availability of right labour for the technology selected – Adequacy of training/skilling of manpower by collaborators at their workplace
- (31) Lead times for delivery of Plant and equipments
- (32) Back to back liability (Liquidate Damages (LD)) clauses with suppliers of equipments
- (33) Availability of Patent licences to use certain external processes
- (34) Sewing the insurance load factors into plant layout
- (35) Research & development – inputs and capability
- (36) Process losses and possibilities to arrest the losses
- (37) Possibilities for future manufacturing/operating cost reduction
- (38) Project monitoring systems are in place?
- (39) Technical obsolescence possibilities
- (40) Safety standards, workplace hazards
- (41) Evacuation in case of disaster
- (42) Disaster recovery possibilities and back-up options
- (43) Technical Drawings, Blueprints

The commercial side of technical details has to be studied along with the technical aspects so that commercial viability of the technology can be evaluated.

1.3 Financial Feasibility: Demand and price estimates are determined from the market feasibility study. Project costs along with operating costs are derived from technical feasibility study. The estimates have to be made from (a) tax implications of the prevailing tax laws, (b) financial costs involved from financing alternatives for the project. Financial feasibility study requires detailed financial analysis based on certain assumptions, workings and calculations such as:

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- (1) Projections for prices of products, cost of various resources for manufacturing goods, capacity utilization. The actual data of comparable projects are included in the estimates.
- (2) Period of estimation is determined on the basis of product life cycle, business cycle; period of debt funds etc. and the value of the project at the terminal period of estimation are forecasted.
- (3) Financing alternatives are considered and a choice of financing mix made with regard to cost of funds and repayment schedules.
- (4) Basic workings in different schedules like Interest and repayment schedule, working capital schedule, working capital loan, interest and repayment schedule, depreciation schedule for income tax purposes, depreciation schedule for the purpose of reporting under Companies Act, 1956 (if policy is different from income tax rules).
- (5) Financial statements prepared in the project feasibility report viz. profit and loss account, balance sheet and cash flow statements for the proposed project.
- (6) Financial indicators calculated from data available in various financial statements. Basic financial parameters used for judging the viability of the project are Interest Coverage Ratio, Debt-Service Coverage Ratio (DSCR), Net Present Value (NPV) or internal rate of return (IRR). Some firms use payback period interest coverage ratio, net present value (NPV), as alternate additional tools.
- (7) When a project is set up with debt, especially with loans from Banks and Financial Institutions, it is necessary to take into account the specific requirements of such Institutions.

1.3.1 Risk Assessment: Basic indicators of financial viability use profit and cash flow estimates subject to risk or uncertainty. Evaluation of risk is necessary through the adoption of various analysis.

1.3.2 Financial Projections: In assessing the financial viability of a project it is necessary to look at the forecasts of financial condition and flows viz.

- Projected Balance Sheet
- Projected Cash Flow Statement

1.4 Projected Balance Sheet: The balance sheet, showing the balance in various asset and liability accounts, reflects the financial condition of the firm at a given point of time.

Format of Balance Sheet

Liabilities	Assets
Share capital	Fixed assets
Reserves and surplus	Investments
Secured loans	Current assets, loans and advances
Unsecured loans	Miscellaneous expenditure and losses
Current liabilities and Provisions	

Liabilities side of the balance sheet shows the sources of finance employed by the business. Assets side of the balance sheet shows how funds have been used in the business.

For preparing the projected balance sheet at the end of year n+1, information about the following is required:

- Balance Sheet at the end of year n
- Projected Income statement and the distribution of earnings for year n+1
- Sources of external financing proposed to be tapped in year n+1
- Expected changes in current liabilities in year n+1
- Proposed repayment of debt capital during year n+1
- Outlays on and the disposal of fixed assets during year n+1
- Changes in level of current assets during year n+1
- Changes in assets and certain outlays pre-operative and preliminary expenses during year n+1

Illustration 1

The Balance Sheet of X Ltd. at the end of year n is as follows:

<i>Liabilities</i>	₹	<i>Assets</i>	₹
<i>Share capital</i>	100	<i>Fixed assets</i>	180
<i>Reserves and surplus</i>	20	<i>Current assets</i>	
<i>Secured loans</i>	80	<i>Cash</i>	20
<i>Unsecured loans</i>	50	<i>Receivables</i>	80
<i>Current liabilities</i>	90	<i>Inventories</i>	<u>80</u>
<i>Provisions</i>	20		180
<i>Total</i>	<u>360</u>	<i>Total</i>	<u>360</u>

₹ in Crores

The projected income statement and distribution of earnings for year n+1

	(₹ in Cr)
<i>Sales</i>	400
<i>Cost of goods sold</i>	300
<i>Depreciation</i>	20
<i>Earnings before interest and taxes</i>	80
<i>Interest</i>	20
<i>Profit before tax</i>	60
<i>Tax at 35%</i>	21
<i>Profit after tax</i>	39
<i>Dividends</i>	10
<i>Retained earnings</i>	29

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During year $n+1$ firm plans to raise secured term loan of ₹ 20 crores repay previous term loan to the extent of ₹ 5, increase unsecured loans by ₹ 10. Current liabilities and provisions expected to remain unchanged. Firm plans to acquire fixed assets worth ₹ 30, increase its inventories by ₹ 10, Receivables expected to increase by ₹ 15, other assets remain unchanged, except cash. Level of cash to be the balancing amount in the projected balance sheet.

Required: Projected Balance Sheet of X Ltd. for the year ended $n+1$.

Solution

Projected balances in various assets/liabilities are worked out as follows.

Projected Balances in Assets & Liabilities

₹ in Cr.				
Account Category	Opening Balance	Changes during the year		Closing Balance
<i>Liabilities</i>				
Share capital	100			100
Reserved and surplus	20	+29 (Retained earnings)		49
Secured loan	80	+20 (Additional term loan)		
		-5 (Repayment)		95
Unsecured loans	50	+10 (Proposed increased)		60
Current liabilities	90			90
Provisions	20			<u>20</u>
		Total		<u>414</u>
<i>Fixed Assets</i>				
Fixed Assets	180			
Investments		+30 (Additional outlay)		
		<u>-20 (Depreciation)</u>		190
Current assets	180			
Cash	20	+19 (Bal. Fig)	39 (Bal. fig)	
Inventories	80	+10 (Proposed increase)	90	
Receivables	80	+15 (Expected increase)	95	<u>224</u>
		Total		<u>414</u>

Projected Balance sheet

₹ in Crores

Liabilities		Assets	
Share Capital	100	Fixed Assets	190
Reserve surplus	49	Current Assets	
Secured Loan	95	Cash	39
Unsecured Loan	60	Receivables	90
Current Liabilities	90	Inventories	<u>95</u>
Provisions	20		224
	414		414

1.5 Projected Cash Flow Statement

Cash flow statement shows the sources and disposition of cash and the net change in cash balance.

Projected Cash Flow statement

(A) Sources of Funds

- Share issue
- Profit before taxation with interest added back
- Depreciation provision for the year
- Specific Reserves
- Increase in secured medium and long-term borrowings for the project
- Other medium/long term loans
- Increase in unsecured loans and deposits
- Increase in bank borrowings for working capital
- Increase in liabilities for deferred payment (including interest)
- Sale of fixed assets
- Sale of investments
- Other income
- Total (A)

(B) Disposition of Funds

- Capital expenditures for the project
- Other capital expenditures
- Increase in working capital
- Decrease in secured medium and long-term borrowings – Financial institutions/Banks
- Decrease in unsecured loans and deposits
- Decrease in bank borrowings for working capital

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Decrease in liabilities for deferred payments (including interest) to machinery	
Increase in investments in other companies	
Interest on term loans	
Interest on bank borrowings for working capital	
Taxation	
Dividends – Equity/Preference	
Other expenditures	_____
Total (B)	_____
Opening balance of cash in hand and at bank	
Net surplus/deficit (A - B)	_____
Closing balance of cash in hand/at bank	_____

Projected Cash Flow Statement

		₹ (Cr.)
(A)	Sources of Funds	
	Profit before tax with interest added back	80.00
	Depreciation	20.00
	Increase in secured loans	15.00
	Increase in unsecured loans	10.00
	Total	125.00
(B)	Disposition of Funds	
	Capital expenditure	30.00
	Increase in working capital	25.00
	Interest	20.00
	Taxation	21.00
	Dividends- equity	10.00
	Total	106.00
	Opening balance of cash in hand and at bank	20.00
	Net surplus/deficit (A) – (B)	19.00
	Closing balance of cash in hand and at bank	39.00

1.6 Combined Multi-Year Projections

Let us take up an illustration showing combined projection of balance sheet, sources and uses of funds statement, and cash flow statement over several years.

Illustration 2

The expected outlays and proposed financing during the construction of A Ltd. and the first two operating years are given hereunder:

Proposed Outlays and Financing (₹ in Cr)

	<i>Construction Period</i>	<i>1st Operating Year</i>	<i>2nd Operating Year</i>
<i>Outlays</i>			
<i>Preliminary and Pre-operative Expenses</i>	20	-	-
<i>Fixed assets</i>	200	200	100
<i>Current assets (Other than cash)</i>	-	200	100
<i>Financing</i>			
<i>Share capital</i>	100	150	-
<i>Long Term loan</i>	150	150	75
<i>Short-term bank Borrowing</i>		120	60

The projected revenues and costs for the first two operating years are given below.

Projected Revenues and Costs

(₹ in Cr.)

	<i>1st Operating Year</i>	<i>2nd Operating Year</i>
<i>Sales</i>	300	600
<i>Cost of sales (excluding interest and depreciation)</i>	300	400
<i>Interest</i>	48	64
<i>Depreciation</i>	20	28

With following additional assumptions you are required to prepare Projected Cash Flow Statement of A Ltd.

- (i) The tax rate will be 35 percent,
- (ii) no deductions (relief's) are available
- (iii) preliminary and preoperative expenses will not be written off during the first two operating years, and
- (iv) no dividend will be paid in the first two operating years.

Solution

Projected Statements: The projected income statement (profit and loss statement) is prepared in the following way:

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Projected Income Statement

(₹ In Cr.)

	1st Operating Year	2nd Operating Year
Sales	300	600
Cost of sales (excluding depreciation and interest)	300	400
Interest	48	64
Depreciation	20	28
Losses (absorbed)	-	68
Profit before tax	(68)	40
Tax	-	14
Profit after tax	(68)	26

From the given information, the projected balance sheets and the projected cash flow statements shall be prepared as follows:

Projected Balance Sheet

(₹ in Cr.)

Liabilities	End of Constn. Period	End of 1 st Operating Year	End of 2 nd Operating year	Assets	End of Constn. Period	End of 1 st Operating year	End of 2 nd Operating year
Share Capital	100	250	250	Fixed assets	200	380	452
Reserves and Surplus			26	Current Assets			
Long Term Loan	150	300	375	Cash (Bal. Fig.)	30	2	59
				Others	--	200	300
Short term Bank borrowing	-	120	180	Miscellaneous Current Assets			
				Preliminary and Pre-operative expense	20	20	20
				Profit and Loss account	--	68	---
	250	670	831	Balance	250	670	831

Projected Cash Flow Statement

(₹ in Cr.)

	Construction Period	1st Operating Year	2 nd Operating year
Sources of Funds			
Share issue	100	150	
Profit before taxation and Interest		(20)	172
Depreciation provision for the year		20	28
Increase in long-term borrowings for the project	150	150	75
Increase in bank borrowings for working capital	-	120	60
Total (A)	250	420	335
Disposition of Funds			
Capital expenditure for the Project	200	200	100
Increase in current assets	--	200	100
Interest	--	48	64
Other expenditure (Preliminary and Pre-operative expenses)	20	-	-
Taxes	-	-	14
Total (B)	220	448	278
Opening balance of cash in hand and cash at bank	-	30	2
Net surplus/deficit (A-B)	<u>30</u>	<u>(28)</u>	<u>57</u>
Closing balance of cash in hand and at bank	30	2	59

2. Contents of a Project Report

The following aspects need to be taken into account for a Project Report -

1. **Promoters:** Their experience, past records of performance form the key to their selection for the project under study.
2. **Industry Analysis:** The environment outside and within the country is vital for determining the type of project one should opt for.
3. **Economic Analysis:** The demand and supply position of a particular type of product under consideration, competitor's share of the market along with their marketing strategies, export potential of the product, consumer preferences are matters requiring proper attention in such type of analysis.
4. **Cost of Project:** Cost of land, site development, buildings, plant and machinery, utilities e.g. power, fuel, water, vehicles, technical know how together with working capital margins, preliminary/pre-operative expenses, provision for contingencies determine the total value of the project.

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5. **Inputs:** Availability of raw materials within and outside the home country, reliability of suppliers cost escalations, transportation charges, manpower requirements together with effluent disposal mechanisms are points to be noted.
6. **Technical Analysis:** Technical know-how, plant layout, production process, installed and operating capacity of plant and machinery form the core of such analysis.
7. **Financial Analysis:** Estimates of production costs, revenue, tax liabilities profitability and sensitivity of profits to different elements of costs and revenue, financial position and cash flows, working capital requirements, return on investment, promoters contribution together with debt and equity financing are items which need to be looked into for financial viability.
8. **Social Cost Benefit Analysis:** Ecological matters, value additions, technology absorptions, level of import substitution form the basis of such analysis.
9. **SWOT Analysis:** Liquidity/Fund constraints in capital market, limit of resources available with promoters, business/financial risks, micro/macro economic considerations subject to government restrictions, role of Banks/Financial Institutions in project assistance, cost of equity and debt capital in the financial plan for the project are factors which require careful examinations while carrying out SWOT analysis.
10. **Project Implementation Schedule:** Date of commencement, duration of the project, trial runs, cushion for cost and time over runs and date of completion of the project through Network Analysis have all to be properly adhered to in order to make the project feasible.

2.1 Specimen of Project Feasibility Report: Submitted to Board of Directors of XYZ & Co. Ltd., a project feasibility report on the introduction of a new product 'α' in the paint market by Chief Finance Officer.

To

The Board of Directors,

XYZ & Co. Ltd.

From:

The Chief Finance Officer

Re: In depth study of a product 'α' being introduced in the market proposed

The Company proposes to introduce a new product 'α' in the paint Market at Delhi. The present study is an effort to see whether the project under consideration should be taken up or not.

Commercial Viability (Market)

Aim in Market Share: The in depth market study and research reveals the following facts:

Total Demand of the product 'α' type	- 1,00,000 tonnes p.a.
Installed Capacity	- 90,000 tonnes p.a.
Production	- 80,000 tonnes p.a.
Potential Demand Gap	- 20,000 tonnes p.a.

The company proposes to manufacture 10,000 tonnes of 'α' thus aiming at 10% share of the market or 50% of unfulfilled demand.

Market Leader & Competition: The market leader of this group of products has a share of 40% and rest of market is shared by a number of small manufacturers. Thus company expects little competition from the market leader.

Availability of Inputs

Raw Materials: Raw Materials constitute a major portion of the total cost of output. In fact, 70% of value added output cost is raw material. About 5% of petroleum by-products are used as additives and these are subject to price fluctuations due to change in international prices. Such increases are passed on to the consumers in the shape of increased prices thereby keeping contribution margin intact. As government is the sole supplier of additives there is a fear that company may have to stop production if supply is discontinued.

Power: As the project will require very little power it is expected that power shortage will not create a very big hazard.

Disposal of Waste/Effluents/Pollution Control: The production process is such that it will release very little waste & effluents and so disposal is not a very great problem. Public health is thus not endangered. No special measures are required to be undertaken for pollution control.

Technical Feasibility

Knowhow: As the total investment in Plant & Machinery is ₹6 lakhs and it is presumed that complex technical know how is not required.

Right Plant & Machinery: The company being the market leader in paints it has been able to select the right kind of plant & Machinery at optimum cost. As per market quotations, the cost of Plant & Machinery, seems to be reasonable.

Storage Tanks: The cost that will incur if storage tanks are erected is estimated at ₹ 2 lakhs and the expense has been considered very much necessary for the purpose.

New Factory/(Industrial Estate New Co.): The company is proposing to set up a factory nearer to the existing one where locational facilities are available (Nearness to market, transport facilities, Tax Holiday Benefits, Availability of skilled labour, free trade zone etc.)

Plant layout, Blue Print: A plant layout, blue print as per engineer's and technician's report has been attached with the schedule.

Financial Feasibility

<i>Capital cost of the Project</i>	<i>₹ (lakhs)</i>
(1) Land & Building	5.00
(2) Plant & Machinery	6.00
(3) Other Fixed Assets including Tanks	4.00
(4) Pre Operative Expenses	1.00

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(5) Margin Money for Working Capital	2.00
(6) Provision for contingencies	<u>2.00</u>
	<u>20.00</u>

Financial Plan - ₹ (lakhs)

(1) Equity Shares	5.00
(2) Retained Earnings	5.00
(3) Term Loans	<u>10.00</u>
	<u>20.00</u>

Repayment Schedule

A loan repayment schedule (Subject to negotiation) is being given herewith.

<i>Years</i>	<i>Repayment (₹ in Lakhs)</i>
1	-
2	2
3	2
4	2
5	2
6	<u>2</u>
Total	<u>10</u>

Projected Profitability and Cash Flow Statement

₹ (Lakhs)

Year	Profit after Tax	Depreciation	Cash Flow
1	8.00	1.50	9.50
2	5.00	1.50	6.50
3	5.00	1.50	6.50
4	5.00	1.50	6.50
5	5.00	1.50	6.50
6	5.00	1.50	6.50
7	4.00	1.50	5.50
8	4.00	1.50	5.50
9	4.00	1.50	5.50
10	5.00	1.50	6.50
Total	50.00	15.00	65.00

The cash flow of ₹ 65 lakhs when discounted at the company's cost of capital rate gives net cash flow of ₹ 30 lakhs. Hence net present value of ₹10 lakhs is available [Net Cash Flow – Capital Cost]. *Thus the project seems to be feasible.*

S/d

Dated 30 August 20XX

Chief Finance Officer

2.2 Post Completion Audit: Post-completion audit evaluates actual performance with projected performance. It verifies both revenues and costs. The advantages of conducting a post completion audit are:

1. The experience gained is highly valuable for future decision making since it can highlight mistakes that can be avoided and areas of improvements brought about.
2. Identify individuals with superior abilities in planning and forecasting.
3. It helps in discovering biases in judgment.
4. It induces healthy caution among the sponsors of projects as projects sponsors make over-optimistic projections for their proposals.
5. It serves as a useful training ground for promising executives needing experience and exposure into a wide range of factors like market behaviour, pricing, cost structure, input availability, productivity, regulatory environment, financial system and industrial relations.

Post Completion Audit is the most neglected aspect of capital budgeting. The reasons are

- (a) It is difficult to isolate the cash flows attributable to individual investments from financial accounts compiled as a whole and based on accrual principle.
- (b) Apprehension that it may be used for punitive purposes.

First problem is overcome by using estimates and approximations where it is not possible to obtain accurate data. Second problem is overcome by making it clear to project sponsors that purpose of post audit is to promote learning as it provides feedback for future improvements.

Post-completion audit involves effort and cost. It is to be conducted for investments above a certain size.

Post-completion audit is conducted when project is commissioned or the operations of the project stabilizes or the project is terminated, or at any other time in the life of the project. If conducted earlier review data may not be meaningful and if conducted towards end of project life utility of the lessons drawn is not useful.

Post-completion audit should not be entrusted to the sponsoring group since the group has a bias in favour of the project. It should be performed by an independent group consisting of economists, engineers, accountants and executives requiring training in capital budgeting.

SOCIAL COST BENEFIT ANALYSIS

3. What it is?

Social cost benefits analysis is an approach for evaluation of projects. A technique for appraising isolated projects from the point of view of society as a whole. It assesses gains/losses to society as a whole from the acceptance of a particular project. Social gains/losses (quantifiable/measurable) regarded as additions to and subtractions from something that the society desires. UNIDO (United Nations Industrial Development Organisation) advocates aggregate consumption as unit of measurement. OED (Oxford English Dictionary) advocates, on the other hand, use of uncommitted social income in the hands of the government as yardstick of measurement since consumption has both time dimension (present/future) and distributional dimension (consumption by group/region of the country).

3.1 Features

- (1) It includes many economic activities having indirect effects on which there is no possibility of putting a market value. For example, a project may have beneficial effects on the rest of society viz. training imparted to workers quitting the project before/after completion and joining other projects where trained personnel are available without any extra payment or environmental pollution causing damage to property. These are regarded as external effects for which no market compensations are made.
- (2) If savings are inadequate; money going into investment is regarded more valuable than money going into current consumption.
- (3) Society values, given quantum of additional consumption going to different sections of the population differently. So distributional considerations are important.
- (4) For society, taxes are transferred from the project in hand to government and does not involve real cost.
- (5) Relative valuation placed on future consumption compared to current consumption is different for the society. Also effect of perceived uncertainties may be different.
- (6) Society may want to discourage consumption of certain goods and promote that of others.
- (7) External effects exist on consumption side e.g. person getting inoculation against infectious disease will be conferring some benefit to society by preventing the spreading over of the disease.
- (8) Output from large projects has significant impact on the market for the goods/services and neither pre project market price nor expected post project market price would be correct indicators of the social value of project output. Market prices are not true indicators of social gains/losses but can be suitably adjusted to reflect social valuations.

3.2 Technique of Social Cost Benefit Analysis: Estimation of shadow prices form the core of social cost benefit methodology. A shadow price reflects the social evaluation of the

input or output. This value may or may not be equal the market price. Since it does not have an existence apart from its use in social evaluation it is called social cost. Economic resources have been categorised into goods, services, labour, foreign exchange, shadow price of investment vis-à-vis consumption, shadow price of future consumption vis-à-vis present consumption viz. social rate of discount.

3.2.1 Goods & Services: Social gain/losses from outputs and inputs of a project are measured by the willingness of the consumers to pay for the goods. This is reflected by market price if:

- a. Perfect competition exists in all relevant markets.
- b. Project unable to make substantial additions to or withdrawals from existing supply of goods.

For consumer goods, absence of rationing/controls, condition a) as specified above is required. If rationing/control exists, market price understates willingness to pay and so upward adjustment is necessary. If condition b) as specified above is violated neither old nor new market price shall reflect the willingness to pay. However an average of the two may serve the purpose and the demand has to be estimated once again.

For producer goods in addition to absence of rationing/controls and condition b) as specified above, not only competitive conditions must prevail in the market for the goods itself but in all subsequent markets through which the goods passes in successive stages of processing.

Public irrigation project sells water to sugarcane farmers who sell cane to sugar mills. If sugar mills enjoy monopoly power in sugar markets their willingness to pay for sugarcane will be higher than market price they pay and market price farmer pays for irrigation water will understate their willingness to pay if competitive conditions existed everywhere. Society's gain from additional irrigated water higher than market price of irrigation water.

3.2.2. Labour: Social cost of labour is lower than market wage because of massive un/under employment along with traditions, changes in life style etc. Removal of labour from farms should not cause reduction in agricultural output as other members work harder to offset the loss. Employing labour on non farm activities is costless. Shadow wage is zero. Un/under employment is a seasonal phenomenon. During busy months there shall be full employment but full time withdrawal leads to reduction of output in villages. Wage rates in urban areas are higher than rural areas. Substantial migration takes place from rural areas. Every job created in urban areas at the going wage may lead to migration of more workers. Urban unemployment is a severe problem due to large influx into cities thereby straining their capacity to provide minimum basic overheads. Migrants come from productive part of labour force.

3.2.3. Foreign Exchange: Existence of extensive trade controls leads to official undervaluation of foreign exchange. Official exchange rate understates the benefit of exports and costs of imports in terms of domestic resources. An upward adjustment is necessary.

3.2.4. Social Rate of Discount: Market rate of interest does not reflect society's preference for current consumption over future consumption. Choice of social discount rate is based on value judgment about weights to be attached to the welfare of future generations compared to

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that of present generations. This is treated as a parameter and computations are carried out for a number of values within a certain range. Final decision rests with the policy maker.

3.2.5. Shadow Price of Investment: Society as a whole gives importance to future generations than that accorded by private decision makers. Imperfections of capital markets lead to less than optimal total investment. Money devoted to investment in terms of immediate consumption is much more than money itself.

3.3 Other Considerations: Certain amount of redistribution benefits flow to different groups in certain proportions. Costs may not be borne by same people or not in proportion to benefits they receive. Policy makers place different weights on net benefits flowing to different sections of population, project analyst should accommodate these weights.

2. Employment is always into the analysis by low shadow wages and distributional consideration does not warrant further weight to be attached.
3. Income generated in a region through multiplier effects of direct expenditures on the project. Intangibles-increased pollution, destruction of wild life, scenic beauty etc. Effects are spread over distant future and not enough is known about nature and extent-effect on rainfall in an area due to heavy exploitation of forests for a paper mill. Quantification is not possible here.
4. Uncertainty about future outputs, inputs, timely execution is to be considered. Some expected value maximization is resorted to for incorporation of quantifiable uncertainties.

3.4 Limitations

- (i) Successful application depends upon reasonable accuracy and dependability of the underlying forecasts as well as assessment of intangibles.
- (ii) Technique does not indicate whether given project evaluated on socio-economic considerations is best choice to reach national goals or whether same resources if employed in another project would yield better results.
- (iii) Cost of evaluation by such technique could be enormous for smaller projects.
- (iv) Social Cost Benefit Analysis takes into consideration those aspects of social costs and benefits which can be quantified. Other aspects like happiness, satisfaction, aesthetic pleasure, better quality of life cannot be quantified.

4. Capital Budgeting Under Risk and Uncertainty

As discussed in the paper Financial Management at PCC/IPCC level, we have ignored risk in capital budgeting decisions.

Risk denotes variability of possible outcomes from what was expected. Standard Deviation is perhaps the most commonly used tool to measure risk. It measures the dispersion around the mean of some possible outcome.

If investors are risk averse, the management shall be duty bound to select investment proposals after doing a careful analysis of the risk associated. Because investment proposals contain different degrees of business risk, it is necessary to analyse not only their expected

profitability but also the possible deviations from those expectations. When this is done, risk is expressed in terms of the dispersion of the probability distribution of possible net present values or possible internal rates of return and is measured by the standard deviation.

Consider an example of a single project in which the cash flows are independent from period to period. Following details are provided,

Table 1

Period 1		Period 2		Period 3	
Probability	Net Cash Flows	Probability	Net Cash Flows	Probability	Net Cash Flows
0.10	₹3000	0.10	₹2000	0.10	₹2000
0.25	₹4000	0.25	₹3000	0.25	₹3000
0.30	₹5000	0.30	₹4000	0.30	₹4000
0.25	₹6000	0.25	₹5000	0.25	₹5000
0.10	₹7000	0.10	₹6000	0.10	₹6000

Independent cash flows from period to period implies that the outcome in period t does not depend upon what had happened in period t-1.

As you would have noticed, there are several projections for the same period having different probabilities attached to themselves. Multiple probabilities along with multiple projections of cash flows shall result in possible multiple NPVs and IRRs. The mean of the probability distribution of possible net present values is calculated by using the following formula;

$$NPV = \sum_{t=1}^n \frac{\bar{A}_t}{(1 + R_f)^t}$$

Where \bar{A}_t is the expected net cash flow in period t, R_f is the risk free rate and n is the number of periods over which the cash flows are expected.

We use the risk free rate as the rate of discounting because our immediate task is to ascertain the riskiness of the investment because of which we need to isolate the time value of money. In case we include a premium for risk in the discount rate e.g. in cases where cost of capital is used as the discounting factor, we resort to imbibed double counting with respect to our analysis. This happens because the premium of risk imbibed in the discount helps address the risk by itself in the discounting process. A subsequent analysis of risk over such a risk adjusted result would be a second time adjustment and hence would be inappropriate.

Standard Deviation – The following formula may be used to compute this important measure of dispersion.

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$$\sigma = \sqrt{\sum_{t=1}^n \frac{\sigma_t^2}{(1+R_f)^{2t}}}$$

Where σ_t is the standard deviation of possible net cash flows in period t.

In the example above the standard deviation of possible net cash flows in periods 1,2 and 3 is ₹ 1,140. Using a risk free rate of 6% the standard deviation shall work out to be ₹ 1,761. Also if we employ the same risk free rate in the equation for the mean of the probability distribution of NPV, the latter would work out as ₹ 1,635. Assuming a normal probability distribution, it shall be possible to compute the probability of an investment proposal providing more or less than a specific amount.

The concept of risk till now has been applied for NPV computation. The same concept holds true for IRR also.

We have examined the case of 'serially independent cash flows' over time. However, frequently we come across situations where the cash flows of time period 't+1' is dependent on the cash flows of time period 't'. For example, the level of marketing capabilities of a firm to push through its products in time't+1' will invariably depend on the market share it has carved for its products in time period't'. This temporal dependency has two following possibilities, arising from the potency of the cash flow impact:

1. *Cash flows are perfectly correlated over time:* In cases where cash flows in period t + 1 are entirely dependent upon what happened in period t then perfect correlation is said to exist. In such cases, standard deviation is computed using the following formula,

$$\sigma = \sum_{t=1}^n \frac{\sigma_t}{(1+R_f)^t}$$

In case we compute the standard deviation from the data given in Table 1 assuming perfect correlation, we shall arrive at ₹ 3,047 which is significantly higher than the ₹ 1,761 computed with assumptions of serial independence.

2. *Cash flows are moderately correlated over time:* In cases where cash flows are moderately correlated over time, the standard deviation is computed as follows:

$$\sigma = \sqrt{\sum_{t=1}^n (NPV_t - \overline{NPV})^2 P_t}$$

Where NPV_t is the net present value for series t of net cash flows covering all periods, \overline{NPV} is the mean net present value of the proposal and P_t is the probability of occurrence of that specific series.

This calculation of the standard deviation is illustrated below:-

Illustration 3

S Ltd finds an opportunity to invest in a 2 year project and will cost ₹ 1 lakh. The estimated cash flows for the first year is given in the following table:-

S Ltd finds an opportunity to invest in a 2 year project and will cost ₹1 lakh. The estimated cash flows for the first year is given in the following table:-

- Year 1 ₹ 40,000 with probability of 30% (Scenario 1)
- Year 1 ₹ 60,000 with probability of 40% (Scenario 2)
- Year 1 ₹ 80,000 with probability of 30% (Scenario 3)

The second year cash flows with conditional probability are

- Scenario 1 - ₹ 20,000 with probability of 20%
- Scenario 1 - ₹ 50,000 with probability of 60%
- Scenario 1 - ₹ 80,000 with probability of 20%
- Scenario 2 - ₹ 70,000 with probability of 30%
- Scenario 2 - ₹ 80,000 with probability of 40%
- Scenario 2 - ₹ 90,000 with probability of 30%
- Scenario 3 - ₹ 80,000 with probability of 10%
- Scenario 3 - ₹ 1,00,000 with probability of 80%
- Scenario 3 - ₹ 1,20,000 with probability of 10%

If the relevant cost of capital to evaluate is 8% (risk free rate), find the project NPV.

Solution

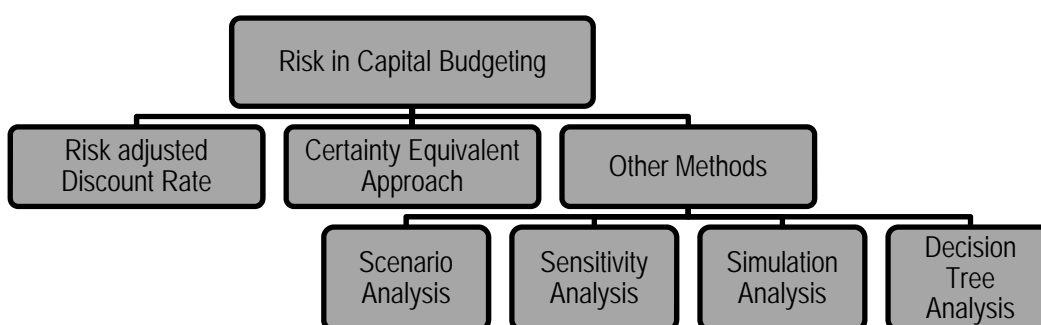
		PVIF ₁		PVIF ₂						
		0.9259		0.8573						
1	2	3	4	5	6	7	8	9	10	11
CF _{t=1}	Prob. _{t=1}	CF _{t=2}	Prob. _{t=2}	Col.1 x PVIF ₁	Col.2 x PVIF ₂	Col.6+ Col.7-100000	Jt. Prob.	NPVj	NPVj-Exp.NPV	Sq. deviations x Jt. Prob.*
40,000	30%	20,000	20%	37,036	17,146	-45,818	6.00%	-2,749	-24,315	35,473,679
40,000	30%	50,000	60%	37,036	42,865	-20,099	18.00%	-3,618	-25,184	114,161,369
40,000	30%	80,000	20%	37,036	68,584	5,620	6.00%	337	-21,229	27,039,972
60,000	40%	70,000	30%	55,554	60,011	15,565	12.00%	1,868	-19,698	46,562,763
60,000	40%	80,000	40%	55,554	68,584	24,138	16.00%	3,862	-17,704	50,149,172
60,000	40%	90,000	30%	55,554	77,157	32,711	12.00%	3,925	-17,641	37,343,654
80,000	30%	80,000	10%	74,072	68,584	42,656	3.00%	1,280	-20,286	12,346,165
80,000	30%	100,000	80%	74,072	85,730	59,802	24.00%	14,352	-7,214	12,488,715
80,000	30%	120,000	10%	74,072	102,876	76,948	3.00%	2,308	-19,258	11,125,724
							100.00%		σ ²	346,832,711
Expected NPV								21,571	σ	18,623

* Calculated using Excel.

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It should be noted that SD as a measure of risk becomes a difficult proposition in complex situations. Risks of the project may be assessed by (i) Simulation Analysis (ii) Sensitivity Analysis, which are discussed later on.

Methods of Incorporating Risk: The methods of incorporating risk into capital budgeting analysis can be broadly categorised as follows:



We shall now discuss each of the above methods in detail in forthcoming sections.

4.1 Risk Adjusted Discount Rate Method: The use of risk adjusted discount rate is based on the concept that investors demands higher returns from the risky projects. The required return of return on any investment should include compensation for delaying consumption equal to risk free rate of return, plus compensation for any kind of risk taken on. The case, risk associated with any investment project is higher than risk involved in a similar kind of project, discount rate is adjusted upward in order to compensate this additional risk borne.

After determining the appropriate required rate of return (Discount rate) for a project with a given level of risk cash flows are discounted at this rate in usual manner.

Adjusting discount rate to reflect project risk- If risk of project is greater than, equal to, less than risk of existing investments of firm, discount rate used is higher than, equal to or less than average cost of capital as the, case may be.

Risk Adjusted Discount Rate for Project 'k' is given by

$$r_k = i + n + d_k$$

Where,

i → risk free rate of interest.

n → adjustment for firm's normal risk.

d_k → adjustment for different risk of project 'k'.

r_k → firm's cost of capital.

d_k is positive/negative depending on how the risk of the project under consideration compares with existing risk of firms. Adjustment for different risk of project 'k' depends on management's perception of project risk and management's attitude towards risk (risk - return preference).

If the project's risk adjusted discount rate (r_k) is specified, the project is accepted if NPV is positive.

$$NPV = \sum_{t=1}^n A_t / (1 + r_k)^t - I$$

$A_t \rightarrow$ expected cash flow for year 't'.

$r_k \rightarrow$ risk adjusted discount rate for project 'k'.

Illustration 4

A company engaged in manufacturing of toys is considering a line of stationary items with an expected life of five years. From past experience the company has a conservative view in its investment in new products. Accordingly company considers the stationary items an abnormally risky project. The company's management is of view that normally required rate of return of 10% will not be sufficient and hence minimum required rate of return should be 15%. The initial investment in the project will be of ₹ 1,10,00,000 and expected free cash flows to be generated from the project is ₹ 30,00,000 for 5 years. Determine whether project should be accepted or not

Solution

PV of cash inflows	=	₹ 30,00,000 x PVIAF (15%, 5)
	=	₹ 30,00,000 x 3.352
	=	₹ 1,00,56,000
NPV	=	PV of Cash Inflow – Initial Investment
	=	₹ 1,00,56,000 – ₹1,10,00,000
	=	–₹ 9,44,000

Thus project should not be accepted.

Had the required rate of return be 10%. The position would have been as follows.

Present value of Cash Inflows	=	₹ 30,00,000 x PVIAF (10%, 5)
	=	₹ 30,00,000 x 3.791
	=	₹ 1,13,73,000
NPV	=	₹ 1,13,73,000 – ₹ 1,10,00,000
	=	₹ 3,73,000

Illustration 5

A pencil manufacturing company is considering the introduction of a line of gel pen with an expected life of five years. In the past the firm has been quite conservative in its investment in new projects, sticking primarily to standard pencils. In this context, the introduction of a line of gel pen is considered an abnormal risky project. The CEO of the company is of opinion that the normal required rate of return

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for the company of 12% is not sufficient. Therefore, the minimum acceptable rate of return of this project should be 18%. The initial outlay of the project is ₹ 10,00,000 and the expected free cash flows from the projects are given below:

Year	Cash Flow
1	₹ 2,00,000
2	₹ 3,00,000
3	₹ 4,00,000
4	₹ 3,00,000
5	₹ 2,00,000

Solution

$$\begin{aligned} \text{NPV} &= 2,00,000/(1.18) + 3,00,000/(1.18)^2 + 4,00,000/(1.18)^3 + 3,00,000/(1.18)^4 + 2,00,000/(1.18)^5 - \\ &\quad 10,00,000 \\ &= (-) ₹ 1,29,442 \end{aligned}$$

Project not feasible.

Firms used different discount rate related to risk factor for different types of investment projects. Discount rate is low for routine replacement investments, moderate for expansion investments and high for new investments.

Usually companies classify projects based on their type, and apply pre-determined risk premiums. One such classification could be

1. Replacement projects in existing business
2. Balancing equipments in existing projects
3. Marginal increase in capacity
4. Significant increase in capacity (organic growth)
5. Forward or backward integration projects
6. Diversification projects
7. Foreign projects

For instance, a company could lay down the guidelines, based on its risk preferences (risk-return appetite) as below:

Normal risk premium on existing projects (Rf + RP) = 14%

Therefore, for all the project classifications in previous slide, the chart could look like:

Replacement projects in existing business	14% + 0%
Balancing equipments in existing projects	14% + 0%
Marginal increase in capacity	14% + 0%
Significant increase in capacity (organic growth)	14% + 2%
Forward or backward integration projects	14% + 3%

Diversification projects	14% + 5%
Foreign projects	14% + x% + y%

(The company could further classify countries into greater risk categories – for example, projects in Afghanistan would have much higher risk premium than in Finland or Sweden)

Limitations:

- (1) Difficult to estimate d_k consistently - determined by adhoc basis.
- (2) Risk increases with time at constant rate - not a valid assumption.

4.2 Certainty Equivalent Approach (CE Approach): This approach allows the decision maker to incorporate his or her utility function into the analysis. In this approach a set of risk less cash flow is generated in place of the original cash flows.

It is based on game theory. Suppose on tossing out a coin, if it comes head you will get ₹ 10,000 and if it comes out to be tail, you will win nothing. Thus you have 50% chances of winning and expected value is ₹ 5,000. In such case if you are indifferent at receiving ₹ 3,000 for a certain amount and not playing then ₹ 3,000 will be certainty equivalent and 0.3 (i.e 3,000/10,000) will be certainty equivalent coefficient.

Students may remember a popular game show on TV called “Deal or No Deal”. The entire game is based on the Certainty Equivalent Approach. The participant is asked by the ‘Banker’ (hidden to the viewers and participants) periodically whether he/she would accept a certain amount (say ₹ 225,000) in exchange for the sum of uncertain amounts left in ‘more than one closed box” (say the expected value of the same could be ₹ 275,000). Depending upon the risk appetite of the ‘player’, the player would call ‘NO DEAL’ for the offer and continue to play the game or accept the offer and call it a DEAL.

The takeaway here is that someone else may not have as much of fear of risk as you do and as a result, you will have a different certainty equivalent.

4.2.1 Steps in the Certainty Equivalent (CE) approach

Step 1: Remove risk by substituting equivalent certain cash flows from risky cash flows. This can be done by multiplying each risky cash flow by the appropriate α_t value (CE coefficient)

Step 2: Discounted value of cash flow is obtained by applying risk less rate of interest. Since you have already accounted for risk in the numerator using CE coefficient, using the cost of capital to discount cash flows will tantamount to double counting of risk.

Step 3: After that normal capital budgeting method is applied except in case of IRR method, where IRR is compared with risk free rate of interest rather than the firm’s required rate of return.

Note: If CE coefficient is not given then we shall compute it as follows:

$$\alpha_t = \frac{\text{Certain cash flow}}{\text{Risky or expected cash flow}_t}$$

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The main problem with this method is that it is arbitrary. Two persons may have different perception about for a project. Due to this reason this method is not often used.

Thus Certainty Equivalent reflects two aspects:

- (a) Variability of outcomes.
- (b) Attitude towards risk.

Certainty Equivalent Coefficients transform expected values of uncertain flows into their Certainty Equivalents.

It is important to note that the value of Certainty Equivalent Coefficient lies between 0 & 1. Certainty Equivalent Coefficient 1 indicates that the cash flow is certain or management is risk neutral. In industrial situation, cash flows are generally uncertain and managements are usually risk averse.

$$NPV_{CE} = -INV + \sum_{t=1}^n \frac{\alpha_t \times NCF_t}{(1+r_f)^t}$$

Where,

α is the certainty equivalent coefficient of the Net Cash flow of year 't'

INV is the investment in the project

NCF_t is the Net cash flow of year 't'

r_f is the risk free interest rate

Illustration 6

Investment Proposal - ₹ 45,00,000

Year	Expected cash flow	Certainty Equivalent coefficient
1	₹ 10,00,000	0.90
2	₹ 15,00,000	0.85
3	₹ 20,00,000	0.82
4	₹ 25,00,000	0.78

Assuming $i = 5\%$, calculate NPV.

Solution

$$N. P. V. = 10,00,000(0.90)/(1.05) + 15,00,000(0.85)/(1.05)^2 + 20,00,000(0.82)/(1.05)^3 + 25,00,000(0.78) / (1.05)^4 - 45,00,000 = ₹ 5,34,570$$

Certainty Equivalent Method is superior to Risk Adjusted Discount Rate Method as it does not assume that risk increases with time at constant rate. Each year's Certainty Equivalent Coefficient is based on level of risk impacting its cash flow. Despite its soundness, it is not preferable like Risk Adjusted Discount Rate Method. It is difficult to specify a series of Certainty Equivalent Coefficients but simple to adjust discount rates.

Illustration 7

XYZ PLC employs certainty-equivalent approach in the evaluation of risky investments. The finance department of the company has developed the following information regarding a new project:

Year	Expected CFAT	Certainty-equivalent quotient
0 (Initial Outlays)	(£ 200,000)	1.0
1	£ 160,000	0.8
2	£ 140,000	0.7
3	£ 130,000	0.6
4	£ 120,000	0.4
5	£ 80,000	0.3

The firm's cost of equity capital is 18%; its cost of debt is 9% and the riskless rate of interest in the market on the treasury bonds is 6%. Should the project be accepted?

Solution

Determination of NPV:

Year	Expected CFAT	Certainty-equivalent (CE)	Adjusted CFAT (CFAT X CE)	PV factor (at 0.06)	Total PV
0	(£ 200,000)	1.0	£ (200,000)	1.000	(£ 200,000)
1	£ 160,000	0.8	£ 128,000	0.943	£ 120,704
2	£ 140,000	0.7	£ 98,000	0.890	£ 87,220
3	£ 130,000	0.6	£ 78,000	0.840	£ 65,520
4	£ 120,000	0.4	£ 48,000	0.792	£ 38,016
5	£ 80,000	0.3	£ 24,000	0.747	£ 17,928
NPV					129,388

Since NPV is positive the project should be accepted.

4.3 Other Methods

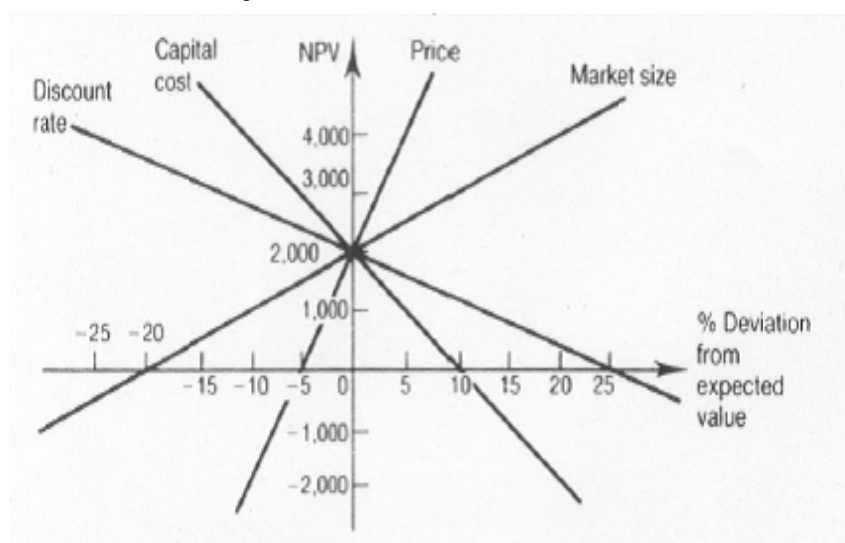
4.3.1. Sensitivity Analysis. Also known as "What if" Analysis. Till now in our analysis we have assumed that all the quantitative factors in the investment decisions i.e. cash inflows, outflows, cost of capital (discount rate) and duration of the project are known with certainty, whereas it rarely happens. Sensitivity analysis helps to overcome this problem. It should be noted sensitivity analysis can be applied to a variety of planning activities not just to capital budgeting decisions.

This analysis determines how the distribution of possible NPV or internal rate of return for a project under consideration is affected consequent to a change in one particular input variable. This is done by changing one variable at one time, while keeping other variables (factors) unchanged. Sensitivity analysis begins with the base-case situation which is developed using the expected values for each input. It provides the decision maker with the answers to a whole range

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of “what if” question. For example, what is NPV, if the selling price falls by 10%. Similarly what will be IRR if project’s life is only 3 years instead of expected 5 years. This analysis can also be used to compute Break-even points. For example, revenue required to meet costs (i.e., break-even level of volume) in net present value terms.

As mentioned above, each variable is changed by several percentage points above and below the expected value, holding all other variables constant. Then a new NPV is calculated using each of these values. Finally the set of NPVs is plotted on graph to show how sensitive NPV is to the change in each variable. As shown in the figure below, the slope of lines in the graph shows how sensitive NPV is to the change in each of input. The steeper the slope, the more sensitive the NPV is to a change in a variable.



Sensitivity analysis is widely used because of its simplicity and ability to focus on particular estimates. It is widely used by the bankers while evaluation of the projects for funding.

4.3.1.1 Advantages of Sensitivity Analysis: Following are main advantages of Sensitivity Analysis

- (1) Critical Issues: This analysis identifies critical factors that impinge on a project's success or failure.
- (2) Simplicity: This analysis is quite simple.

4.3.1.2 Disadvantage of Sensitivity Analysis: Following are main disadvantages of Sensitivity Analysis

- (1) Assumption of Independence: This analysis assumes that all variables are independent i.e. they are not related to each other, which is unlikely in real life.
- (2) Ignore probability: This analysis does not look to the probability of changes in the variables.
- (3) Not so reliable: This analysis provides information on the basis of which decisions can be made but does not point directly to the correct decision.

Illustration 8

The following information applies to a new project:

Initial Investment	₹ 125,000
Selling price per Unit	₹ 100
Variable costs per unit	₹ 30
Fixed costs for the period	₹ 100,000
Sales volume	2,000 units
Life	5 years
Discount rate	10%

Required: Project's NPV and show how sensitive the results are to various input factors.

Solution

$$NPV = -125,000 + [(100 - 30) 2,000 - 100,000] \times 3.791 = ₹ 26,640$$

Sensitivity to changes to

(1) Selling price

$$125,000 = [(P - 30) 2,000 - 100,000] \times 3.791$$

$$32,973 = 2,000P - 60,000 - 100,000$$

$$P = 96.49$$

i.e. fall of 3.51% $\left(\frac{96.49 - 100}{100} \right)$ before NPV is zero.

Alternatively

$$\text{₹ } 26,640$$

$$2,000 \times ₹ 100 \times 3.791$$

(2) Variable costs

$$125,000 = [(100 - v) 2,000 - 100,000] \times 3.791$$

$$32,973 = 200,000 - 2000V - 100,000$$

$$V = 33.51$$

i.e. increase of 11.71% $\left(\frac{33.51 - 30}{30} \right)$ before NPV is zero.

Alternatively

$$\text{₹ } 26,640$$

$$2,000 \times ₹ 30 \times 3.791$$

(3) Volume

$$125,000 = [(100 - 30) q - 100,000] \times 3.791$$

$$32,973 = 70q - 100,000$$

$$q = 1,900$$

in fall of 5.0% $\left(\frac{1900 - 2000}{2000} \right)$ before NPV is zero.

Alternatively

$$\text{₹ } 26,640$$

$$2,000 \times ₹(100 - 30) \times 3.791$$

(4) Initial cost

$$₹ (125,000 + 26,640) = ₹ 151,640$$

i.e. increase of 21.31% $\left(\frac{151640 - 125000}{125000} \right)$ before NPV is zero.

Alternatively

$$\text{₹ } 26,640$$

$$\text{₹ } 125,000$$

(5) Fixed costs

$$125,000 = [₹ 100 - ₹ 30) 2,000 - F] \times 3.791$$

$$32,973 = 140,000 - F$$

$$F = 107,027$$

Alternatively

$$\text{₹ } 26,640$$

$$₹ 100,000 \times 3.791$$

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i.e. an increase of 7.03% $\left(\frac{107027 - 100000}{100000} \right)$ before NPV is zero

(6) Life

$$₹125,000 = ₹ 40,000 \times AF_n @ 10\%$$

$$3.125 = AF_n @ 10\%$$

AF for 4 years at 10% is 3.17

i.e. life can fall to approximately 4 years before NPV is zero.

(7) Discount rate

$$3.125 = AF \text{ for 5 years } @ x \%$$

From tables AF for 5 year @ 18% is 3.127, so x is approximately 18%

i.e. an increase of 80% $\left(\frac{18\% - 10\%}{10\%} \right)$ before NPV is zero.

4.3.2 Scenario Analysis: Although sensitivity analysis is probably the most widely used risk analysis technique, it does have limitations. Therefore, we need to extend sensitivity analysis to deal with the probability distributions of the inputs. In addition, it would be useful to vary more than one variable at a time so we could see the combined effects of changes in the variables.

Scenario analysis provides answer to these situations of extensions. This analysis brings in the probabilities of changes in key variables and also allows us to change more than one variable at a time.

This analysis begins with base case or most likely set of values for the input variables. Then, go for worst case scenario (low unit sales, low sale price, high variable cost and so on) and best case scenario.

In other words, scenario analysis answers the question "How bad could the project look". Some enthusiastic managers can sometimes get carried away with the most likely outcomes and forget just what might happen if critical assumptions such as the state of the economy or competitors' reaction are unrealistic. This analysis seek to establish 'worst and best' scenarios so that whole range of possible outcomes can be considered.

Although, the analysis appears to be simple, but it contains four critical components:

1. The first component involves determining the factors around which the scenarios will be built. These factors can range from the state of economy to the response of competitors on any action of the firm.
2. Second component is determining the number of scenarios to analysis for each factor. Normally three scenarios are considered in general i.e. a best case, an average and a worst case. However, they may vary on long range.
3. Third component is to place focus on critical factors and build relatively few scenarios for each factor.

4. Fourth component is the assignment of probabilities to each scenarios. This assignment may be based on the macro factors e.g. exchange rates, interest rates etc. and micro factors e.g. competitor's reactions etc.

In conclusion, we can say that when we calculate the NPV of several scenarios we are performing a scenario analysis.

Illustration 9

XYZ Ltd. is considering a project "A" with an initial outlay of ₹ 14,00,000 and the possible three cash inflow attached with the project as follows:

	(₹000)		
	Year 1	Year 2	Year 3
Worst case	450	400	700
Most likely	550	450	800
Best case	650	500	900

Assuming the cost of capital as 9%, determine whether project should be accepted or not.

Solution

The possible outcomes will be as follows:

Year	PVF @9%	Worst Case		Most likely		Best case	
		Cash Flow '000	PV '000	Cash Flow '000	PV '000	Cash Flow '000	PV '000
0	1	(1400)	(1400)	(1400)	(1400)	(1400)	(1400)
1	0.917	450	412.65	550	504.35	650	596.05
2	0.842	400	336.80	450	378.90	500	421.00
3	0.772	700	540.40	800	617.60	900	694.80
NPV			-110.15		100.85		311.85

Now suppose that CEO of XYZ Ltd. is bit confident about the estimates in the first two years, but not sure about the third year's high cash inflow. He is interested in knowing what will happen to traditional NPV if 3rd year turn out the bad contrary to his optimism.

The NPV in such case will be as follows:

$$\begin{aligned}
 &= - ₹ 1400000 + \frac{550000}{(1+0.09)} + \frac{450000}{(1+0.09)^2} + \frac{700000}{(1+0.09)^3} \\
 &= - ₹ 1400000 + ₹ 504587 + ₹ 378756 + ₹ 540528 = ₹ 23871
 \end{aligned}$$

Thus, CEO's concern is well founded that, as a worst case in the third year alone yield a marginally positive NPV.

4.3.3. Simulation Analysis (Monte Carlo): Monte Carlo simulation ties together sensitivities and probability distributions. The method came out of the work of first nuclear bomb and was so named because it was based on mathematics of Casino gambling. Fundamental appeal of

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this analysis is that it provides decision makers with a probability distribution of NPVs rather than a single point estimates of the expected NPV.

This analysis starts with carrying out a simulation exercise to model the investment project. It involves identifying the key factors affecting the project and their inter relationships. It involves modeling of case flows to reveal the key factors influencing both cash receipt and payments and their inter relationship.

This analysis specifies a range for a probability distribution of potential outcomes for each of model's assumptions.

4.3.3.1 Steps for Simulation Analysis:

1. Modelling the project: The model shows the relationship of NPV with parameters and exogenous variables. (Parameters are input variables specified by decision maker and held constant over all simulation runs. Exogenous variables are input variables, which are stochastic in nature and outside the control of the decision maker).
2. Specify values of parameters and probability distributions of exogenous variables.
3. Select a value at random from probability distribution of each of the exogenous variables.
4. Determine NPV corresponding to the randomly generated value of exogenous variables and pre-specified parameter variables.
5. Repeat steps (3) & (4) a large number of times to get a large number of simulated NPVs.
6. Plot probability distribution of NPVs and compute a mean and Standard Deviation of returns to gauge the project's level of risk.

Example: *Uncertainty associated with two aspects of the project: Annual Net Cash Flow & Life of the project. NPV model for the project is*

$$\sum_{t=1}^n [CF_t / (1+i)^t] - I$$

Where $i \rightarrow$ Risk free interest rate, $I \rightarrow$ initial investment are parameters, $CF =$ Annual Cash Flow

With $i = 10\%$, $I = ₹ 1,30,000$, CF_t & n stochastic exogenous variables with the following distribution will be as under:

Annual Cash Flow		Project Life	
Value (₹)	Probability	Value (Year)	Probability
10,000	0.02	3	0.05
15,000	0.03	4	0.10
20,000	0.15	5	0.30
25,000	0.15	6	0.25
30,000	0.30	7	0.15

35,000	0.20	8	0.10
40,000	0.15	9	0.03
		10	0.02

Ten manual simulation runs are performed for the project. To perform this operation, values are generated at random for the two exogenous variables viz., Annual Cash Flow and Project Life. For this purpose, we take following steps

- (1) set up correspondence between values of exogenous variables and random numbers
- (2) choose some random number generating device.

Correspondence between Values of Exogenous Variables and two Digit Random Numbers:

<i>Annual Cash Flow</i>				<i>Project Life</i>			
<i>Value (₹)</i>	<i>Probability</i>	<i>Cumulative Probability</i>	<i>Two Digit Random No.</i>	<i>Value (Year)</i>	<i>Probability</i>	<i>Cumulative Probability</i>	<i>Two Digit Random No.</i>
10,000	0.02	0.02	00 – 01	3	0.05	0.05	00 – 04
15,000	0.03	0.05	02 – 04	4	0.10	0.15	05 – 14
20,000	0.15	0.20	05 – 19	5	0.30	0.45	15 – 44
25,000	0.15	0.35	20 – 34	6	0.25	0.70	45 – 69
30,000	0.30	0.65	35 – 64	7	0.15	0.85	70 – 84
35,000	0.20	0.85	65 – 84	8	0.10	0.95	85 – 94
40,000	0.15	1.00	85 - 99	9	0.03	0.98	95 – 97
				10	0.02	1.00	98 - 99

Random Number

53479	81115	98036	12217	59526
97344	70328	58116	91964	26240
66023	38277	74523	71118	84892
99776	75723	03172	43112	83086
30176	48979	92153	38416	42436
81874	83339	14988	99937	13213
19839	90630	71863	95053	55532
09337	33435	53869	52769	18801
31151	58295	40823	41330	21093
67619	52515	03037	81699	17106

For random numbers, we can begin from any-where taking at random from the table and read any pair of adjacent columns, column/row wise. For the first simulation run we need two digit random numbers (1) For Annual Cash Flow (2) For Project Life. The numbers are 53 & 97 and corresponding value of Annual Cash Flow and Project Life are ₹ 3,000 and 9 years respectively.

Simulation Results

Annual Cash Flow			Project Life			
Run	Random No.	Corres. Value of Annual Cash Flow (1)	Random No.	Corres. Value of Project Life	PVAF @ 10% (2)	NPV (1)x(2) – 1,30,000
1	53	30,000	97	9	5.759	42,770
2	66	35,000	99	10	6.145	85,075
3	30	25,000	81	7	4.868	(8,300)
4	19	20,000	09	4	3.170	(66,600)
5	31	25,000	67	6	4.355	(21,125)
6	81	35,000	70	7	4.868	40,380
7	38	30,000	75	7	4.868	16,040
8	48	30,000	83	7	4.868	16,040
9	90	40,000	33	5	3.791	21,640
10	58	30,000	52	6	4.355	650

4.3.3.2. Advantages of Simulation Analysis: Strength lies in Variability.

- (1) Handle problems characterised by (a) numerous exogenous variables following any kind of distribution. (b) complex inter-relationships among parameters, exogenous variables and endogenous variables. Such problems defy capabilities of analytical methods.
- (2) Compels decision maker to explicitly consider the inter-dependencies and uncertainties featuring the project.

4.3.3.3 Shortcomings

- (1) Difficult to model the project and specify probability distribution of exogenous variables.
- (2) Simulation is inherently imprecise. Provides rough approximation of probability distribution of NPV. Due to its imprecision, simulation probability distribution may be misleading when a tail of distribution is critical.
- (3) Realistic simulation model being likely to be complex would probably be constructed by management expert and not by the decision maker. Decision maker lacking understanding of the model may not use it.
- (4) Determine NPV in simulation run, risk free discount rate is used. It is done to avoid pre-judging risk, which is reflected in the dispersion of the distribution of N.P.V. This derived measure of NPV takes a different meaning from its original value, and, therefore, is difficult to interpret.

4.3.4. Decision Tree Analysis: Till now we have discussed simple accept-or-reject decisions which view current investments in isolation of subsequent decisions. However, practically investment decisions may have implications for future or further investment decisions, and may also impact future decision and events. Such situation can be handled by taking a

sequence of decisions over a period of time. The technique to handle this type of sequential decisions is done through "Decision Tree" technique.

Basically decision tree is a graphic display of the relationship between a present decision and future events, future decision and their consequences.

This approach assumes that there are only two types of situation that a finance manager has to face. The first situation is where the manager has control or power to determine what happens next. This is known as "Decision", as he can do what he desires to do.

The second situation is where finance manager has no control over what happens next. This is known as "Event". Since the outcome of the events is not known, a probability distribution needs to be assigned to the various outcomes or consequences. It should, however, be noted when a finance manager faced with a decision situation, he is assumed to act rationally. For example in a commercial business, he will choose the most profitable course of action and in non-profit organization, the lowest cost may be rational choice.

4.3.4.1 Steps involved in Decision Tree analysis:

Step 1- Define Investment: Decision tree analysis can be applied to a variety of business decision-making scenarios. Normally it includes following types of decisions.

- Whether or not to launch a new product, if so, whether this launch should be local, national, or international.
- Whether extra production requirement should be met by extending the factory or by out sourcing it to an external supplier.
- Whether to dig for oil or not if so, upto what height and continue to dig even after finding no oil upto a certain depth.

Step 2- Identification of Decision Alternatives: It is very essential to clearly identify decision alternatives. For example if a company is planning to introduce a new product, it may be local launch, national launch or international launch.

Step 3- Drawing a Decision Tree: After identifying decision alternatives, at the relevant data such as the projected cash flows, probability distribution expected present value etc. should be put in diagrammatic form called decision tree.

While drawing a decision tree, it should be noted that NPVs etc. should be placed on the branches of decision tree, coming out of the decisions identified.

While drawing a decision tree, it should be noted that the:-

- The decision point (traditionally represented by square), is the option available for manager to take or not to take - in other words action at these points.
- The event or chance or outcome (traditionally represented by circle) which are dependent on chance process, along with the probabilities thereof, and monetary value associated with them.
- This diagram is drawn from left to right.

Step 4- Evaluating the Alternatives: After drawing out the decision the next step is the evaluation of alternatives. The various alternatives can be evaluated as follows:

- (i) This procedure is carried out from the last decision in the sequence (extreme right) and goes on working back to the first (left) for each of the possible decision.
- (ii) At each final stage decision point, select the alternative which has the highest NPV and truncate the other alternatives. Each decision point is assigned a value equal to the NPV of the alternative selected at the decision point.
- (iii) Proceed backward in the same manner calculating the NPV at chance or event or outcome points (○) selecting the decisions alternative which has highest NPV at various decision points [□] rejecting the inferior decision option, assigning NPV to the decision point, till the first decision point is reached.

In Capital Budgeting, the decision taker has to identify and find out the various alternatives available to an investment decision. By drawing a decision tree, the alternatives are highlighted through a diagram, giving the range of possible outcomes. The stages set for drawing a decision tree is based on the following rules.

1. It begins with a decision point, also known as decision node, represented by a rectangle while the outcome point, also known as chance node, denoted by a circle.
2. Decision alternatives are shown by a straight line starting from the decision node.
3. The Decision Tree Diagram is drawn from left to right. Rectangles and circles have to be sequentially numbered.
4. Values and Probabilities for each branch are to be incorporated next.

The Value of each circle and each rectangle is computed by evaluating from right to left. This procedure is carried out from the last decision in the sequence and goes on working back to the first for each of the possible decisions. The following rules have been set for such evaluation.

- (a) The expected monetary value (EMV) at the chance node with branches emanating from a circle is the aggregate of the expected values of the various branches that emanate from the chance node.
- (b) The expected value at a decision node with branches emanating from a rectangle is the highest amongst the expected values of the various branches that emanate from the decision node.

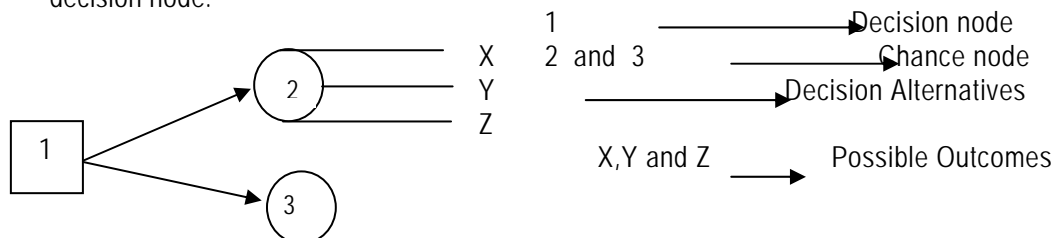
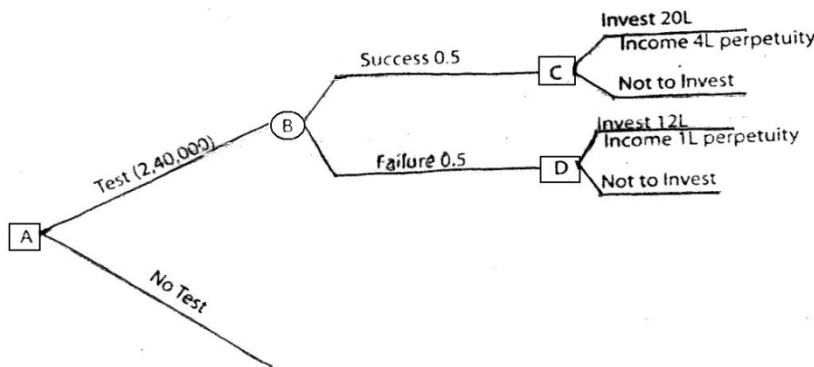


Illustration 10

L & R Limited wishes to develop new virus-cleaner software. The cost of the pilot project would be ₹ 2,40,000. Presently, the chances of the product being successfully launched on a commercial scale are rated at 50%. In case it does succeed, L&R can invest a sum of ₹ 20 lacs to market the product. Such an effort can generate perpetually, an annual net after tax cash income of ₹ 4 lacs. Even if the commercial launch fails, they can make an investment of a smaller amount of ₹ 12 lacs with the hope of gaining perpetually a sum of ₹ 1 lac. Evaluate the proposal, adopting decision tree approach. The discount rate is 10%.

Solution

Decision tree diagram is given below:



Evaluation

At Decision Point C: The choice is between investing ₹ 20 lacs for a perpetual benefit of ₹ 4 lacs and not to invest. The preferred choice is to invest, since the capitalized value of benefit of ₹ 4 lacs (at 10%) adjusted for the investment of ₹ 20 lacs, yields a net benefit of ₹ 20 lacs.

At Decision Point D: The choice is between investing ₹ 12 lacs, for a similar perpetual benefit of ₹ 1 lac. and not to invest. Here the invested amount is greater than capitalized value of benefit at ₹ 10 lacs. There is a negative benefit of ₹ 2 lacs. Therefore, it would not be prudent to invest.

At Outcome Point B: Evaluation of EMV is as under (₹ in lacs).

Outcome	Amount (₹)	Probability	Result (₹)
Success	20.00	0.50	10.00
Failure	0.00	0.50	00.00
Net result			10.00

EMV at B is, therefore, ₹10 lacs.

At A: Decision is to be taken based on preferences between two alternatives. The first is to test, by investing ₹ 2,40,000 and reap a benefit of ₹ 10 lacs. The second is not to test, and thereby losing the opportunity of a possible gain.

The preferred choice is, therefore, investing a sum of ₹ 2,40,000 and undertaking the test.

5. Capital Budgeting Under Capital Rationing

Generally, firms fix up maximum amount that can be invested in capital projects, during a given period of time, say a year. The firm then attempts to select a combination of investment proposals, that will be within the specific limits providing maximum profitability, and put them in descending order according to their rate of return, such a situation is then considered to be capital rationing.

A firm should accept all investment projects with positive NPV, with an objective to maximise the wealth of shareholders. However, there may be resource constraints due to which a firm may have to select from among various projects with positive NPVs. Thus there may arise a situation of capital rationing where there may be internal or external constraints on procurement of necessary funds to invest in all investment proposals with positive NPVs.

Capital rationing can be experienced due to external factors, mainly imperfections in capital markets which can be attributed to non-availability of market information, investor attitude etc. Internal capital rationing is due to the self-imposed restrictions imposed by management like not to raise additional debt or laying down a specified minimum rate of return on each project.

There are various ways of resorting to capital rationing. For instance, a firm may affect capital rationing through budgets. It may also put up a ceiling when it has been financing investment proposals only by way of retained earnings (ploughing back of profits). Since the amount of capital expenditure in that situation cannot exceed the amount of retained earnings, it is said to be an example of capital rationing.

Capital rationing may also be introduced by following the concept of 'responsibility accounting', whereby management may introduce capital rationing by authorising a particular department to make investment only upto a specified limit, beyond which the investment decisions are to be taken by higher-ups.

In capital rationing it may also be more desirable to accept several small investment proposals than a few large investment proposals so that there may be full utilisation of budgeted amount. This may result in accepting relatively less profitable investment proposals if full utilisation of budget is a primary consideration. Similarly, capital rationing may also mean that the firm foregoes the next most profitable investment following 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 always lead to optimum results.

Capital Rationing can be divided into following two categories:

- (a) Hard Capital Rationing
- (b) Soft Capital Rationing

- (a) **Hard Capital Rationing:** Hard capital rationing is a situation related to external sources. Agencies either capital market itself of Government (may or may not act through Capital Market) will supply only limited amount of capital in spite of fact the projects with positive NPVs have been identified. This situation implies existence of imperfect capital market as in perfect capital market hard capital rationing should never be occurred.

(b) **Soft Capital Rationing:** Soft Capital Rationing is due to internal forces such as limits imposed by management on capital expenditure. There may be many reasons for such imposition some of which are as follows:

- In order to retain control senior management may place limits.
- Although some ambitious managers may be interested to overstate the extent of investment opportunities in their sector of responsibility. But their individual evaluation to sort out good project shall be time consuming and bureaucratic.
- Even though the firm may be operating in a dynamic environment and have a large number of profitable expansion opportunities. However, accepting all of them may lead to difficulties in planning and control.
- Management may be worried about the increasing risk associated with extensive borrowings and asset levels.
- Existing owners, managers and family shareholders may not be interested in losing control by way of issuing additional equity to meet the requirement of finance.

The following illustration shows how a firm may resort to capital rationing under situation of resource constraints.

Illustration 11

Alpha Limited is considering five capital projects for the years 2012 and 2013. The company is financed by equity entirely and its cost of capital is 12%. The expected cash flows of the projects are as follows:

Year and Cash flows (₹ '000)

Project	2012	2013	2014	2015
A	(70)	35	35	20
B	(40)	(30)	45	55
C	(50)	(60)	70	80
D	-	(90)	55	65
E	(60)	20	40	50

Note : *Figures in brackets represent cash outflows.*

All projects are divisible i.e. size of investment can be reduced, if necessary in relation to availability of funds. None of the projects can be delayed or undertaken more than once.

Calculate which project Alpha Limited should undertake if the capital available for investment is limited to ₹ 1,10,000 in 2012 and with no limitation in subsequent years. For your analysis, use the following present value factors:

Year	2012	2013	2014	2015
Factor	1.00	0.89	0.80	0.71

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Solution

Computation of Net Present Value (NPV) & Profitability Index (PI)

(₹ '000)

Project	Discounted Cash Flows					NPV	PI
	2012	2013	2014	2015			
A	(70)	31.15	28	14.20	3.35	1.048	
B	(40)	(26.70)	36	39.05	8.35	1.209	
C	(50)	(53.40)	56	56.80	9.40	1.188	
D	–	(80.10)	44	46.15	10.05	1.125	
E	(60)	17.80	32	35.50	25.30	1.422	

Ranking of Projects in descending order of NPV

Rank	1	2	3	4	5
Projects	E	D	C	B	A

Selection and Analysis : For Project 'D' there is no capital rationing but it satisfies the criterion of required rate of return. Hence Project D may be undertaken.

For other projects the requirement is ₹ 2,20,000 in year 2012 whereas the capital available for investment is only ₹ 1,10,000. Based on the ranking, the final selection from other projects which will yield maximum NPV will be:

Project and Rank	Amount of Initial Investment
	₹
E(1)	60,000
B(2)	40,000
C(3)	10,000

(Restriction)

Ranking of Projects excluding 'D' which is to start in 2013 when there is no limitation on capital availability :

Projects	E	B	C	A
Rank	1	2	3	4

Working Notes:

Computation of Discounted Cash flows

(₹ '000)

Year	2012	2013	2014	2015
Present value factor	1.00	0.89	0.80	0.71
Project				
A Cash flows	(70)	35	35	20
Discounted cash flows	(70)	31.15	28	14.20
B Cash flows	(40)	(30)	45	55
Discounted cash flows	(40)	(26.70)	36	39.05

C	Cash flows	(50)	(60)	70	80
	Discounted cash flows	(50)	(53.40)	56	56.80
D	Cash flows	–	(90)	55	65
	Discounted cash flows	–	(80.10)	44	46.15
E	Cash flows	(60)	20	40	50
	Discounted cash flows	(60)	17.80	32	35.50

Above illustration was based on the concept that the products are divisible. It may be possible that projects may not be divisible. In such situation 'Combination Approach' should be adopted consisting of following steps:

- (a) Find all combinations of projects, which are feasible given the capital budget restriction and project interdependencies.
- (b) Select the feasible combination having highest NPV.

Illustration 12

A firm has capital budget constraint of ₹ 30,00,000. The expected outlay and cash flows of various projects is as follows :

Project	Outlay (₹ In lakhs)	NPV (₹ In lakhs)
A	18.0	7.5
B	15.0	6.0
C	12.0	5.0
D	7.5	3.6
E	6.0	3.0

Projects B & C mutually exclusive while other projects are interdependent.

Determine which possible combination the firm should select.

Solution

Feasible combination & their NPV is as follows

Feasible Combination	Outlay (₹ In lakhs)	NPV (₹ In lakhs)
A	18.0	7.5
B	15.0	6.0
C	12.0	5.0
D	7.5	3.6
E	6.0	3.0
A & C	30.0	12.5
A & D	25.5	11.1
A & E	24.0	10.5
B & D	22.5	9.6

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B & E	21.0	9.0
C & D	19.5	8.6
C & E	18.0	8.0
B, D & E	28.5	12.6
C, D & E	25.5	11.6

Desirable feasible combination of projects consists of B, D & E giving highest NPV.

6. Capital Budgeting Under Inflation

Adjustment for inflation is a necessity for capital investment appraisal. This is because inflation will raise the revenues & costs of the project. The net revenues after adjustment for inflation shall be equal to net revenues in current terms. The considerations, which cause distortion, are:

- (1) Depreciation charges are based on historical costs. Tax benefits accruing from depreciation charges do not keep parity with inflation.

As annual after tax cash inflow of a project is equal to

$$(R - C - D)(1 - T) + D = (R - C)(1 - T) + DT$$

Where,

R → Revenue from project

C → Costs (apart from depreciation) relating to the project

D → Depreciation charges

T → Tax Rate

Here $(R - C)(1 - T)$ tends to move in line with inflation as inflation influences revenues & costs similarly. DT does not depend on inflation as depreciation charges are based on historical costs. The effect of inflation is to reduce the actual rate of return.

Example:

Initial outlay of a project	- ₹ 80,000
Expected life	- 4 years
Salvage value	- Nil
Annual revenues	- ₹ 60,000
Annual costs other than depreciation	- ₹ 20,000
Tax Rate	- 50%

Depreciation on straight-line basis presuming as if there is no inflation.

Year	1	2	3	4
Revenues	₹ 60,000	₹ 60,000	₹ 60,000	₹ 60,000
Costs other than depreciation	₹ 20,000	₹ 20,000	₹ 20,000	₹ 20,000

Depreciation	₹ 20,000	₹ 20,000	₹ 20,000	₹ 20,000
Taxable profit	₹ 20,000	₹ 20,000	₹ 20,000	₹ 20,000
Tax	₹ 10,000	₹ 10,000	₹ 10,000	₹ 10,000
Profit after tax	₹ 10,000	₹ 10,000	₹ 10,000	₹ 10,000
Net cash inflow	₹ 30,000	₹ 30,000	₹ 30,000	₹ 30,000

If there is inflation @ 10% applicable to revenues & cost of project.

Year	1	2	3	4
Revenues	₹ 66,000	₹ 72,600	₹ 79,860	₹ 87,846
Costs other than depreciation	₹ 22,000	₹ 24,200	₹ 26,620	₹ 29,282
Depreciation	₹ 20,000	₹ 20,000	₹ 20,000	₹ 20,000
Taxable profit	₹ 24,000	₹ 28,400	₹ 33,240	₹ 38,564
Tax	₹ 12,000	₹ 14,200	₹ 16,620	₹ 19,282
Profit after tax	₹ 12,000	₹ 14,200	₹ 16,620	₹ 19,282
Net cash inflow	₹ 32,000	₹ 34,200	₹ 36,620	₹ 39,282

The actual net cash flow stream after deflating for inflation rate of 10% .

Real Net Cash Flow	₹ 29,091	₹ 28,264	₹ 27,513	₹ 26,830
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So actual net cash flows are less than net cash flow if there is no inflation.

- (2) Costs of capital considered for investment appraisals contain a premium for anticipated inflation. Due to inflation investors require the nominal rate of return to be equal to:

Required Rate of Return in real terms plus Rate of Inflation.

Formula

$$R_N = R_R + P$$

R_N → Required rate of return in nominal terms.

R_R → Required rate of return in real terms.

P → Anticipated inflation rate.

If cost of capital (required rate of return) contains a premium for anticipated inflation, the inflation factor has to be reflected in the projected cash flows.

If there is no inflation, then it has to be discounted at required rate of return in real terms.

Illustration 13

Determine NPV of the project with the following information:

Initial Outlay of project	₹ 40,000
Annual revenues (Without inflation)	₹ 30,000
Annual costs excluding depreciation (Without inflation)	₹ 10,000
Useful life	4 years

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<i>Salvage value</i>	<i>Nil</i>
<i>Tax Rate</i>	<i>50%</i>
<i>Cost of Capital (Including inflation premium of 10%)</i>	<i>12%</i>

Solution

Annual Cash Flow of project is

$$(\text{₹ } 30,000 - \text{₹ } 10,000) (1 - 0.50) + \text{₹ } 10,000 \times 0.50 = \text{₹ } 15,000$$

It would be inconsistent to discount these real cash flows at 12% (nominal rate of return).

There are two alternatives:

- (i) Either to restate the cash flow in nominal term and discount at 12% or
- (ii) Restate the discount rate in real terms and use this to discount the real cash flows.

NPV using (i) approach

Since inflation rate is 10% a year, real cash flows may be stated in nominal cash flows as follows:

$$\text{Nominal Cash Flow} = (1 + \text{Inflation Rate}) \text{ Real Cash Flows}$$

Year	Real Cash Flows	Nominal Cash flows
1	15000	$15,000 \times 1.10 = 16,500$
2	15,000	$15,000 \times (1.10)^2 = 18,150$
3	15,000	$15,000 \times (1.10)^3 = 19,965$
4	15,000	$15,000 \times (1.10)^4 = 21,962$

NPV using nominal discounting rate 12%

$$\frac{16,500}{(1.12)} + \frac{18,150}{(1.12)^2} + \frac{19,965}{(1.12)^3} + \frac{21,962}{(1.12)^4} - 40,000$$

$$= \text{₹ } 14,732 + \text{₹ } 14,469 + \text{₹ } 14,211 + \text{₹ } 13,957 - \text{₹ } 40,000$$

$$= \text{₹ } 17,369 \text{ (Approx)}$$

NPV using (ii) approach

To compute NPV using (ii) approach, we shall need real discount rate, which shall be computed as follows:

$$\text{Real Discount Rate} = \frac{1 + \text{Nominal Discount Rate}}{1 + \text{Inflation Rate}} - 1$$

$$\text{Real Discount Rate} = \frac{1 + 0.12}{1 + 0.10} - 1 = 0.0182 \text{ i.e. } 1.8\%$$

$$NPV = \sum_{t=1}^n cf_t - I_0$$

Where t = Time Period
 cf_t = Annual Cash Flow
 I₀ = Initial Outlay

Accordingly NPV of the project

$$\frac{15,000}{(1.0182)} + \frac{15,000}{(1.0182)^2} + \frac{15,000}{(1.0182)^3} + \frac{15,000}{(1.0182)^4} - 40,000$$

= ₹ 14,732 + ₹ 14,469 + ₹ 14,210 + ₹ 13,956 – ₹ 40,000
 = ₹ 57,367 – ₹ 40,000 = ₹17,367(Approx)

NPV based on consideration that inflation rate for revenue and cost are different shall be computed as follows:

$$N.P.V. = \sum_{t=1}^n [(R_t (1+i_r) - C_t \sum_{r=1}^t (1+i_c)) (1-T) + D_t T] / (1+k)^t - I_0$$

R_t → revenues for the year 't' with no inflation.

i_r → annual inflation rate in revenues for 'r' th ' year.

C_t → costs for year 't' with no inflation.

i_c → annual inflation rate of costs for year 'r'.

T → tax rate.

D_t → depreciation charge for year 't'.

I₀ → initial outlay.

k → cost of capital (with inflation premium).

Illustration 14

XYZ Ltd. requires ₹ 8,00,000 for an unit. Useful life of project - 4 years. Salvage value - Nil. Depreciation Charge ₹ 2,00,000 p.a. Expected revenues & costs (excluding depreciation) ignoring inflation.

Year	1	2	3	4
Revenues	₹ 6,00,000	₹ 7,00,000	₹ 8,00,000	₹ 8,00,000
Costs	₹ 3,00,000	₹ 4,00,000	₹ 4,00,000	₹ 4,00,000

Tax Rate 60% cost of capital 10%.

Calculate NPV of the project if inflation rates for revenues & costs are as follows:

Year	Revenues	Costs
1	10%	12%

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2	9%	10%
3	8%	9%
4	7%	8%

Solution

Computation of Annual Cash Flow

(i) Inflation adjusted Revenues

Year	Revenues (₹)	Revenues (Inflation Adjusted) (₹)
1	6,00,000	6,00,000(1.10) = 6,60,000
2	7,00,000	7,00,000(1.10)(1.09) = 8,39,300
3	8,00,000	8,00,000(1.10)(1.09)(1.08) = 10,35,936
4	8,00,000	8,00,000(1.10)(1.09)(1.08)(1.07) = 11,08,452

(ii) Inflation adjusted Costs

Year	Revenues (₹)	Revenues (Inflation Adjusted) (₹)
1	3,00,000	3,00,000(1.12) = 3,36,000
2	4,00,000	4,00,000(1.12)(1.10) = 4,92,800
3	4,00,000	4,00,000(1.12)(1.10)(1.09) = 5,37,172
4	4,00,000	4,00,000(1.12)(1.10)(1.09)(1.08) = 5,80,124

(iii) Tax Benefit on Depreciation = ₹ 2,00,000 x 0.60 = ₹ 1,20,000

(iv) Net Profit after Tax

Year	Revenues (Inflation Adjusted) (₹)(1)	Costs (Inflation Adjusted) (₹)(2)	Net Profit (₹) (3) = (1) - (2)	Tax (₹) (4) = 60% of (3)	Net after Profit (₹) (3) - (4)
1	6,60,000	3,36,000	3,24,000	1,94,400	1,29,600
2	8,39,300	4,92,800	3,46,500	2,07,900	1,38,600
3	10,35,936	5,37,172	4,98,764	2,99,258	1,99,506
4	11,08,452	5,80,124	5,28,328	3,16,997	2,11,331

(iv) Present Value of Cash Inflows

Year	Net after Profit (₹)	Tax Benefit on Depreciation (₹)	Cash Inflow (₹)	PVF@ 10%	PV (₹)
1	1,29,600	1,20,000	2,49,600	0.909	2,26,886
2	1,38,600	1,20,000	2,58,600	0.826	2,13,604
3	1,99,506	1,20,000	3,19,506	0.751	2,39,949
4	2,11,331	1,20,000	3,31,331	0.683	2,26,299
					9,06,738

$$NPV = ₹ 9,06,738 - ₹ 8,00,000 = ₹ 1,06,738$$

7. Capital Asset Pricing Model Approach to Capital Budgeting

The Capital Asset Pricing Model is based on the presumption that total risk of an investment consists of two components (1) Systematic risk (2) Unsystematic risk.

Systematic risk arises from the effect of economic factors e.g. inflation, governmental expenditure, money supply, having a bearing on the existence of every firm although the level of effect vary from firm to firm Systematic risk cannot be overcome by diversification. Unsystematic risk arises from factors which are specific to a firm e.g. development of a new process, plant breakdown, access to market, etc. It can be eliminated by diversification.

For detailed discussion please refer chapter 7 of this Study Material. Systematic risk is indicated by β any can be calculated as follows:

(i) Regression Method: This model is based on the assumption that a linear relationship exists between a dependent variable and an independent variable. The formula of regression equation is as follows:

$$ER_i = \alpha + \beta R_m$$

ER_i = Expected return security

α = Estimated return from security if market return as zero

R_m = Market Return

β = Beta of security

(ii) Correlation Method: As per this method, the Beta of any security can be calculated as follows:

$$\beta_j = \frac{r_{jm} \sigma_j \sigma_m}{\sigma_m^2}$$

σ_{jm} = Coefficient of co-relation between return of security and market return

σ_j = Standard Deviation of Return on investment

σ_m = Standard Deviation of Return on Market return (Market Portfolio or Index)

With the help of β of any security the expected return of any security can be calculated using Capital Asset Pricing Model (CAPM) as follows:

$$ER = R_f + \beta(R_m - R_f)$$

Where,

ER = Expected return

R_f = Risk free rate of return

R_m = Market return

β = Beta of security

$R_m - R_f$ = Market risk premium

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Thus from above, it can be said that CAPM can be used to calculate appropriate discount taking into account the systematic risk of the project. However, this approach refers from limitations:

- ◆ CAPM is a single period model, whereas NPV is a multi period concept.
- ◆ In CAPM it is assumed that market shall remain constant which may not be possible in NPV due to its long period.

In spite of above limitations CAPM can provide on NPV discount rate, which is certainly a considerable improvement on estimation of discounting rate.

7.1. Estimating the beta of a capital project: The procedure consists of finding the regression relationship between the series of one period return on the security and the series of one period return on the market index.

While applying this procedure to determine the beta of a capital project, a problem arises. The profitability of a capital project is measured by its net present value or internal rate of return. These measures involving multi-period time frames are not compatible with the single period return calculated for the market index. Alternatives suggested are:

- (a) *Calculation of Project Beta on the Project's Market Values* One-period return of a project.

$$R_{jt} = (A_{jt} + V_{jt} - V_{j,t-1}) / V_{j,t-1}$$

Where R_{jt} = return on project j for period t

A_{jt} = cash flow of project j for period t

V_{jt} = market value of project j at the end of period t

$V_{j,t-1}$ = market value of project j at the end of period $t - 1$

Estimating the value of the project at the end of the period is a difficult task.

- (b) *Development of Beta on the Basis of Accounting Data* An accounting measure of annual return for the project, i.e. return on assets, is regressed on an economy-wide index of returns to obtain a measure for beta. It uses data which is easily available. Studies have shown that the relationship between accounting and market beta for companies is statistically significant. But, the relationship is not strong enough to warrant the use of accounting betas as substitutes for market betas.
- (c) *Use of Beta of a Company whose Operations are not Similar to that of the Proposed Project*-We have so far assumed that the proposed project and the proxy company are similar to each other as far as their debt to equity ratio is concerned. However, the beta is actually a function of the leverage as well as the business risk. In other words, we are dealing with equity beta until now. As a company increases the proportion of debt capital in its capital structure, both its beta and the required return increase in a linear manner. Hence in case one wishes to use the CAPM as a model for valuing cost of equity in order to determine financially feasible investments, one needs to take into account the difference of leverage in the proxy company/project and the company/project whose required return is to be computed.

Mathematically

$$\beta_j = \beta_{uj} \left[1 + \frac{D}{S} (1 - T) \right]$$

where β_j & β_{uj} are the levered and unlevered betas respectively., D/S is the debt to equity ratio in market value terms and T is the corporate tax rate.

7.2. Project Selection: The relationship between risk (as measured by beta) and return is to be determined as per the capital asset pricing model. This relationship is given by the security market line.

$$R_z = R_f + \beta_z [E(R_m) - R_f]$$

where R_z = Rate of return required on project z

R_f = Risk-free rate of return

β_z = Beta of project z

$E(R_m)$ = Expected rate of return on market portfolio

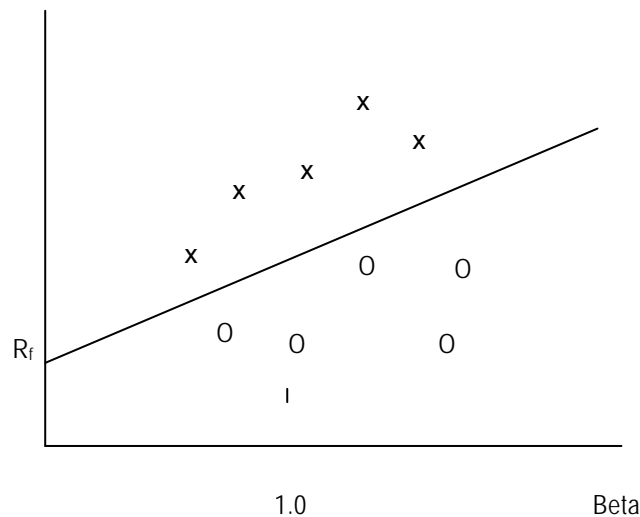
Since the beta of market portfolio, β_m , is 1, $[E(R_m) - R_f]$ may be regarded as the price per unit of risk.

Required rate of return on project z = Risk free rate of return + Risk premium

= Risk free rate of return + Level of risk for project z × Price per unit of risk

If the expected rate of return for a project exceeds its required rate of return as per the security market line relationship, the project is worthwhile. If not, the project is not worthwhile. In the diagram, projects lying above the security market line marked by X's, are acceptable and projects lying below the security market line, marked by O's, are not acceptable.

Required Rate of Return



8. Replacement Decision

Capital budgeting refers to the process we use to make decisions concerning investments in the long-term assets of the firm. The general idea is that the capital, or long-term funds, raised by the firms are used to invest in assets that will enable the firm to generate revenues several years into the future. Often the funds raised to invest in such assets are not unrestricted, or infinitely available; thus the firm must budget how these funds are invested. Among various capital budgeting decision, Replacement decision is one of the most important classifications of capital budgeting.

Replacement decision—a decision concerning whether an existing asset should be replaced by a newer version of the same machine or even a different type of machine that has the same functionality as the existing machine. Such replacements are generally made to maintain existing levels of operations, although profitability might change due to changes in expenses (that is, the new machine might be either more expensive or cheaper to operate than the existing machine).

Replacement analysis—evaluation of replacement projects is slightly more complicated comparing expansion projects because an existing asset is being replaced. When identifying the cash flows for replacement projects, keep in mind that the cash flows associated with the existing (replaced) asset will no longer exist if the new asset is purchased. Therefore, we must not only determine the cash flows that the new asset will generate, but we must also determine the effect of eliminating the cash flows generated by the replaced asset. For example, if a new asset that will produce cash sales equal to ₹100,000 per year is purchased to replace an existing asset that is generating cash sales equal to ₹75,000, then the incremental, or marginal, cash flow related to sales is ₹25,000. Likewise, if the asset that is replaced can be sold for ₹350,000, then the purchase price of the new asset effectively is ₹350,000 less than its invoice price. In other words, for replacement decisions, we must determine the overall net effect of purchasing a new asset to replace an existing asset—the cash flows associated with the old asset will be replaced with the cash flows associated with the new asset. Two items that you must remember to include when determining the incremental cash flows are depreciation—not because it is a cash flow, but because it affects cash flows through taxes—and taxes, both of which generally change when an older asset is replaced with a newer asset.

Therefore analysis of replacement decision follows certain steps:

Step I. Net cash outflow (assumed at current time / [Present value of cost]):

- a. $(\text{Book value of old equipment} - \text{market value of old equipment}) \times \text{Tax Rate} = \text{Tax payable/savings from sale}$
- b. $\text{Cost of new equipment} - [\text{Tax payable/savings from sale} + \text{market value of old equipment}] = \text{Net cash outflow}$

Step II. Estimate change in cash flow per year, if replacement decision is implemented.

$\text{Change in cash flow} = [(\text{Change in sales} + \text{Change in operating costs}) - \text{Change in depreciation}] (1 - \text{tax rate}) + \text{Change in depreciation}$

Step III. Present value of benefits = Present value of yearly cash flows + Present value of estimated salvage of new system

Step IV. Net present value = Present value of benefits - Present value of costs

Step V. Decision rule:

Accept when present value of benefits > present value of costs.

Reject when the opposite is true.

Illustration 15

A Company named Roby's cube decided to replace the existing Computer system of their organisation. Original cost of old system was ₹25,000 and it was installed 5 years ago. Current market value of old system is ₹5,000. Depreciation of the old system was charged with life of 10 years. Depreciation of the new system will be charged with life over 5 years. Estimated Salvage value of the old system was Nil. Present cost of the new system is ₹50,000. Estimated Salvage value of the new system is ₹1,000. Estimated cost savings with new system is ₹5,000 per year. Increase in sales with new system is assumed at 10% per year based on original total sales of ₹100000. Company follows straight line method of depreciation. Cost of capital of the company is 10% whereas tax rate is 30%.

Solution

Step I. Net cash outflow (assumed at current time) [Present values of cost]:

a. (Book value of old system - market value of old system) × Tax Rate = Tax payable/savings from sale

$$= [(\text{₹}25,000 - 5 \times \text{₹}2,500) - \text{₹}5,000] \times 0.30 = \text{₹}7,500 \times 0.30 \\ = \text{₹}2,250$$

b. Cost of new system - [Tax payable/savings from sale + Market value of old system] =
Net cash outflow

Or, $\text{₹}50,000 - [\text{₹}2,250 + \text{₹}5,000] = \text{₹}42,750$

Step II. Estimated change in cash flows per year if replacement decision is implemented

Change in cash flow = [(Change in sales + Change in operating costs) - Change in depreciation] (1 - tax rate) + Change in depreciation

$$= [\text{₹}1,00,000 \times 0.1 + \text{₹}5,000 - (\text{₹}49,000/5 - \text{₹}25,000/10)] (1 - 0.30) + (\text{₹}49,000/5 - \text{₹}25,000/10) \\ = \text{₹}12,690$$

Step III. Present value of benefits = Present value of yearly cash flows + Present value of estimated salvage of new system

$$= \text{₹}12,690 \times \text{PVIFA} (10\%, 5) + \text{₹}1,000 \times \text{PVIF} (10\%, 5) \\ = \text{₹}48,723$$

Step IV. Net present value = Present value of benefits - Present value of costs

$$= \text{₹}48,723 - \text{₹}42,750 \\ = \text{₹}5,973$$

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Step V. Decision rule: Since NPV is positive we should accept the proposal to replace the machine.

Case discussed above is a simple example replacement decision based on NPV. This decision was based on assumption that the projects do not form part of continuous replacement cycle.

However, sometimes, project may involve continuous replacement cycle. In such cases NPV decision rules needs modification. To determine optimal replacement cycle, concept of Equivalent Annual Cost [discussed at Intermediate (IPC) Level] is used.

This decision is based on assumption that as the machine (asset) becomes older its efficiency decreases and leading to increase in operating cost and reduction in resale value.

Illustration 16

X Ltd. is a taxi operator. Each taxi cost to company ₹ 4,00,000 and has a useful life of 3 years. The taxi's operating cost for each of 3 years and salvage value at the end of year is as follows:

	Year 1	Year 2	Year 3
Operating Cost	₹ 1,80,000	₹ 2,10,000	₹ 2,38,000
Resale Value	₹ 2,80,000	₹ 2,30,000	₹ 1,68,000

You are required to determine the optimal replacement period of taxi if cost of capital of X Ltd. is 10%.

Solution

NPV if taxi is kept for 1 Year

$$\begin{aligned} &= - 4,00,000 - 1,80,000 (0.909) + 2,80,000 (0.909) \\ &= - 3,09,100 \end{aligned}$$

NPV if taxi is kept for 2 Year

$$\begin{aligned} &= - 4,00,000 - 1,80,000 \times 0.909 + 20,000 \times 0.826 \\ &= - 5,47,100 \end{aligned}$$

NPV if taxi is kept for 3 Year

$$\begin{aligned} &= - 4,00,000 - 1,80,000 \times 0.909 - 2,10,000 \times 0.826 - 70,000 \times 0.751 \\ &= - 7,89,650 \end{aligned}$$

Since above NPV figures relate to different periods, there are not comparable. to make them comparable we shall use concept of EAC as follows:

EAC of 1 year

$$\frac{3,09,100}{0.909} = 3,40,044$$

EAC of 2 year

$$\frac{5,47,100}{1.735} = 3,15,331$$

EAC of 3 year

$$\frac{7,89,650}{2.486} = 3,17,639$$

Since lowest EAC incur if taxi for 2 year; Hence the optimum replacement cycle to replace taxi in 2 years.

9. Real Option in Capital Budgeting

The traditional analytical methods project evaluation (IRR, NPV, etc.) assume management's passive commitment to a certain "operating strategy" - viz., initiate the project immediately and operate it continuously at a set scale until the end of its pre-specified expected useful life. These methods typically ignore the synergistic effects that an investment project can create. Sometimes the performance of one project will allow you to perform a second project that would not have been possible without the first (e.g., many research and development projects). Similarly, there could be significant value in waiting for additional information that could make an impact on the success of a project. Therefore, the existing analytical methods usually underestimate investment opportunities because they ignore management's flexibility to alter decisions as new information becomes available.

Therefore, Real Options methodology is an approach to capital budgeting that relies on option pricing theory to evaluate projects. Insights from option based analysis can improve estimates of project value and, therefore, has potential, in many instances to significantly enhance project management. However, Real options approach is intended to supplement, and not replace, capital budgeting analyses based on standard DCF methodologies.

Options in Capital Budgeting

The following is a list of options that may exist in a capital budgeting project.

Long call:

- Right to invest at some future date, at a certain price
- Generally, any flexibility to invest, to enter a business, to expand a business

Long put:

- Right to sell at some future date at a certain price
- Right to abandon at some future date at zero or some certain price
- Generally, any flexibility to disinvest, to exit from a business.

Short call:

- Promise to sell if the counterparty wants to buy
- Generally, any commitment to disinvest upon the action of another party

Short put:

- Promise to buy if the counterparty wants to sell
- Generally, any commitment to invest upon the action of another party

Valuation of Real Options

The methods employed to valuation of real options are same as used in valuation of Financial Options. However, sometimes it becomes difficult to identify the value of certain inputs. The various type of cash flows associated with Real Option can be analysed with cash flows involved in Financial options and method used in financial options can be employed easily. For example cost of an expansion decision is the exercise price or premium in financial option.

Broadly, following methods are employed in Valuation of Financial Options.

- (a) Binomial Model
- (b) Risk Neutral Method
- (c) Black-Scholes Model

Note: Above 3 methods have been discussed in detail in Chapter 5.

Type of Real Options

Following are broad type of Real Options

(a) Growth Options: Sometimes it may be possible that some projects have a negative or insignificant even the managers may be interested in accepting the project as it may enable companies to find considerable profitability and add values in future. Some of the examples of such options are as follows:

- Investment in R&D activities
- Heavy expenditure on advertisement
- Initial investment in foreign market to expand business in future
- Acquiring making rights
- Acquisition of vacant plot with an intention to develop it in future.

The purposes of making such investments are as follows:

- Defining the competitive position of firm hence it is called strategic investments.
- Gaining knowledge about project's from profitability.
- Providing the manufacturing and making flexibility to the firm.

Illustration 17

ABC Ltd. is a pharmaceutical company possessing a patent of a drug called 'Aidrex', a medicine for aids patient. Being an approach drug ABC Ltd. holds the right of production of drugs and its marketing. The period of patent is 15 year after which any other pharmaceutical company produce the drug with same formula. It is estimated that company shall require to incur \$ 12.5 million for development and market of the drug. As per survey conducted the expected cashflow from the sale of drug during 15 years shall be \$ 16.7 million. Cash flow from the previous similar type of drug have exhibited are variance of 26.8% of the present value of cashflows. The current yield on Treasury Bonds of similar duration (15 years) is 7.8%. Determine the value of the patent.

Solution

The given solution is like valuation of stock option wherein delay in introduction of drug 'Aidex' shall cause the loss of cashflow which is similar to payment of dividend.

To value the patent we shall use Black schole's Model for option pricing as follows:

Inputs

S (Price) = The Present Value of Cashflows = \$16.7 million

E (Exercise Price) = Cost of Development Formula = \$ 12.5 million

σ^2 (Variance of Cash flow) = 26.8% i.e. 0.27

R (Risk Free Rate of Return) = 7.8%

D (Expected cost of Delays) = $\frac{1}{15} = 0.0667$ i.e. 6.67%

Value call option

$$C = Se^{-df} - Ee^{-rt} N(d_2)$$

$$d_1 = \frac{\ln(S/E) + [R - D + (\frac{1}{2})\sigma^2] t}{\sigma\sqrt{t}}$$

$$d_2 = d_1 - \sigma\sqrt{t}$$

Accordingly,

$$d_1 = \frac{\ln(16.7/12.5) + [0.078 - 0.0667 + (\frac{1}{2})(0.268)] 15}{\sqrt{0.268} \sqrt{15}}$$

$$d_1 = \frac{0.28968 + (0.1453)15}{0.5177 \times 3.873}$$

$$d_1 = \frac{0.28968 + 2.1795}{2.005}$$

$$d_1 = \frac{2.46918}{2.005} = 1.2315$$

$$d_2 = 1.2315 - 2.005$$

$$d_2 = - 0.7735$$

$$N(d_1) = 0.8910$$

$$N(d_2) = 0.2196$$

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Value of Patent

$$\begin{aligned} &= 16.7 \times e^{-0.0667 \times 15} \times 0.8910 - 12.5 \times e^{-0.078 \times 15} \times 0.2196 \\ &= 16.7 \times 0.3677 \times 0.8910 - 12.5 \times 0.3104 \times 0.2196 \\ &= 5.471 - 0.852 = 4.619 \end{aligned}$$

Thus value of patents is \$ 4.619 million

(b) Abandonment Option

As we have already studied in Capital Budgeting (at IPCC level) that once funds have been committed in any Capital Budgeting project it can not be recorded without incurring a heavy loss. However, in some cases due to change in economic conditions the firm may like to opt for abandoning the project without incurring further huge losses.

The option to abandon the project is similar to a put option where option to abandon the project shall be exercised if value derived from project's assets is more than PV of continuing project for one or more period.

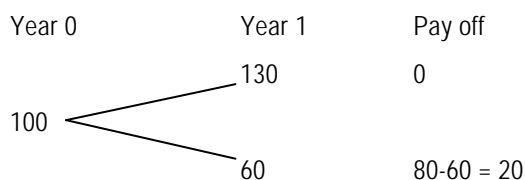
Illustration 18

PLP already in production of Fertilizer is considering a proposal of building a new plant to produce pesticides. Suppose, the PV of proposal is ₹ 100 crore without the abandonment option. However, if market conditions for pesticide turns out to be favourable the PV of proposal shall increase by 30%. On the other hand market conditions remain sluggish the PV of the proposal shall be reduced by 40%. In case company is not interested in continuation of the project it can be disposed off for ₹ 80 crore.

If the risk free rate of interest is 8% then what will be value of abandonment option

Solution

Decision Tree showing pay off



First of all we shall calculate probability of high demand (P) using risk neutral method as follows:

$$8\% = p \times 30\% + (1-p) \times (-40\%)$$

$$0.08 = 0.30p - 0.40 + 0.40p$$

$$p = \frac{0.48}{0.70} = 0.686$$

The value of abandonment option will be as follows:

Expected Payoff at Year 1

$$= p \times 0 + [(1-p) \times 20]$$

$$= 0.686 \times 0 + [0.314 \times 20]$$

$$= ₹ 6.28 \text{ crore}$$

Since expected pay off at year 1 is 6.28 crore. Present value of expected pay off will be:

$$\frac{6.28}{1.08} = 5.81 \text{ crore.}$$

This, the value of abandonment option (Put Option).

(c) Timing Option: In traditional capital budgeting the project can either be accepted or rejected, implying that this will be undertaken or forever not. However, in real life situation a sometime a third choice also arises i.e. delay the decision until later, in i.e. option when to invest. Possible reasons for this delay may be availability of better information or ideas later on. This case of real option is similar to American call option and generally Binomial Model or Risk Material Method is option pricing are used in such situations.

Illustration 19

Suppose MIS Ltd. is considering installation of solar electricity generating plant for light the staff quarters. The plant shall cost ₹ 25 crore and shall lead to saving in electricity expenses at the current tariff by ₹ 21 lakh per year forever.

However, with change in Government in state, the rate of electricity are subject to change. Accordingly, the saving in electricity can be of ₹ 12 lakh or ₹ 35 lakh per year and forever.

Assuming WACC of MIS Ltd. is 10% and risk free rate of rate of return is 8%. Determine the whether MIS Ltd. should accept the project or wait and see.

Solution

Here we shall evaluate NPV in two possible situations:

(1) As on Today

$$\text{At cost of Capital of 10\%, the value of saving forever} = \frac{₹ 21 \text{ lakhs}}{0.10} = ₹ 21 \text{ crore}$$

$$\text{NPV} = ₹ 21 \text{ crore} - ₹ 25 \text{ crore} = - ₹ 4 \text{ crore}$$

Since NPV is negative, it does not worth to accept the project.

(2) After one Year

After one year these are two possible situations, either rate of electricity decreases or increase.

The position of saving will be as follows:

$$\text{If price of electricity increase the NPV} = \frac{₹ 35 \text{ lakh}}{0.10} - ₹ 2.5 \text{ crore} = ₹ 1 \text{ crore}$$

$$\text{Value of saving forever} = ₹ 35 \text{ lakh} + \frac{₹ 35 \text{ lakh}}{0.10} = ₹ 3.85 \text{ crore}$$

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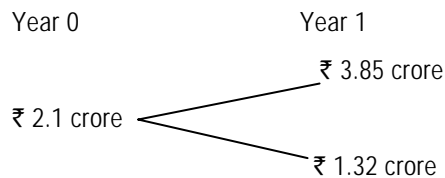
And Rate of Return will be $\frac{3.85}{2.10} - 1 = 0.833$ is 83.33%

If the price of electricity decreases, then value of saving forever will be

$$= 12 \text{ lakh} + \frac{12 \text{ lakh}}{0.10} = 1.32 \text{ crore}$$

and Rate of Return will be $\frac{1.32}{2.10} - 1 = -0.3714$ i.e. - 37.14%

Diagrammatically it can be shown below



Let prob. of price increase is p . Then using Risk Neutral Method, the risk free rate of return will be equal to expected saving as follows:

$$p \times 0.8333 + (1-p) (-0.3714) = 0.08$$

$$0.8333p - 0.3714 + 0.3714p = 0.08$$

$$1.2047p = 0.4514$$

$$p = 0.375$$

Comparing with Put Option after one year the pay off will either be ₹ 1 crore.

Hence, expected pay off = $0.375 \times ₹ 1 \text{ crore} + 0.625 \times 0 = ₹ 37.50 \text{ lakh}$.

$$\text{PV of Pay off after one year} = \frac{₹ 37.50}{10.08} = ₹ 34.72 \text{ lakh.}$$

Thus, it shall be advisable to wait and see as NPV may turn out to be positive after one year.

The Real Options approach to projects appraisal uses the similarity of projects to financial options which are traded in secondary markets. However, we must take care to note the following differences between real options and financial options:-

- (a) Financial options have an underlying asset that is traded - usually a security like a stock. A real option has an underlying asset that is not a security - for example a project or a growth opportunity, and it isn't traded.
- (b) The payoffs for financial options are specified in the contract. Real options are "found" or created inside of projects. Their payoffs can be varied.
- (c) Typically, the exercise period of real options are far, far higher than that of financial options. Financial options are "priced".
- (d) And finally, Real options are "valued" whereas financial options are "priced".

Summary

1. Feasibility Study

Study of feasibility of any investment under the following heads:

(A) Market Feasibility: The market feasibility study for a product already selling in the market consists of:

- (a) Economic Indicators
- (b) Demand Estimation
- (c) End-user profile
- (d) Influencing Factors
- (e) Market Potential
- (f) Infrastructure Facility
- (g) Demand Forecasting
- (h) Supply Estimation
- (i) Identification of Critical Success Factors
- (j) Estimation of the Demand-Supply Gap

(B) Technical Feasibility: The commercial side of technical details has to be studied along with the technical aspects such as plant location, raw material, utilities, technology availability, etc so that commercial viability of the technology can be evaluated.

(C) Financial Feasibility: Financial feasibility study requires detailed financial analysis based on certain assumptions, workings and calculations. Following are the two aspects:

(i) Risk Assessment: Basic indicators of financial viability use profit and cash flow estimates subject to risk or uncertainty. Evaluation of risk is necessary through the adoption of various analysis.

(ii) Financial Projections: In assessing the financial viability of a project it is necessary to look at the forecasts of financial condition and flows viz.

- Projected balance sheet
- Projected cash flow statement
- Combined multi year projections

2. Contents of a Project Report

Following are the various aspects of Project Report-

1. Promoters
2. Industry Analysis
3. Economic Analysis

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4. Cost of Project
5. Inputs
6. Technical Analysis
7. Financial Analysis
8. Social Cost Benefit Analysis
9. SWOT Analysis
10. Project Implementation Schedule

Post Completion Audit:

- Evaluates actual performance with projected performance verifying both revenues and costs
- Offers various advantages such as decision making, identifying abilities, discovering biases, inducing healthy cautions and serving useful training grounds.
- Most neglected aspect of capital budgeting due to difficulty in isolating the individual investments cash flows from whole financial accounts.
- Should be performed by an independent group to avoid any type of biasness.

3. Social Cost Benefit Analysis

Social cost benefits analysis is an approach for evaluation of projects in which isolated projects are appraised from the point of view of society as a whole.

Features

- 1) It includes many economic activities having indirect effects on which there is no possibility of putting a market value.
- 2) Investment money is regarded more valuable than current consumption money in inadequate savings scenario.
- 3) Society values, given quantum of additional consumption going to different sections of the population differently. So distributional considerations are important.
- 4) For society, taxes are transferred from the project in hand to government and does not involve real cost.
- 5) Relative valuation placed on future consumption compared to current consumption is different for the society.
- 6) Society may want to discourage consumption of certain goods and promote that of others.
- 7) External effects exist on consumption side

Technique of Social Cost Benefit Analysis

Estimation of shadow prices form the core of social cost benefit methodology. Economic resources have been categorised as follows:

- (a) Goods and services
- (b) Labour
- (c) Foreign Exchange
- (d) Social Rate of Discount
- (e) Shadow Price of Investment

Other Considerations

1. Flow of certain amount of redistribution benefits to different groups.
2. Employment is always into the analysis by low shadow wages and distributional consideration does not warrant further weight to be attached.
3. Income generated in a region through multiplier effects of direct expenditures on the project.
4. Considering uncertainty about future outputs, inputs and timely execution.

Limitations

- i) Dependability upon reasonable accuracy.
- ii) Non-indication of reaching national goals through alternative projects with same resources.
- iii) Enormous cost of evaluation for smaller projects.
- iv) Social Cost Benefit Analysis takes into consideration only quantifiable aspects.

4. Capital Budgeting under Risk and Uncertainty

Risk denotes variability of possible outcomes from what was expected. Standard Deviation (SD) is the most commonly used tool to measure risk . It measures the dispersion around the mean of some possible outcomes.

In case of dependent cash flows the SD can be calculated as follows:

- (a) Cash are perfectly correlated to each other-

$$\sigma = \sum_{t=1}^n \frac{\sigma_t}{(1 + R_f)^t}$$

- (b) Cash flows are moderately correlated over the time.

$$\sigma = \sqrt{\sum_{t=1}^n (NPV_t - \overline{NPV})^2 P_t}$$

Where \overline{NPV} is the mean net present value of the proposal and P_t is the probability of that specific series.

Methods of Incorporating Risk

(1) Risk adjusted discount rate method

Risk adjusted discount rate for project 'k' is given by

$$r_k = i + n + d_k$$

Where,

i → risk free rate of interest.

n → adjustment for firm's normal risk.

d_k → adjustment for different risk of project 'k'.

r_k → firm's cost of capital.

d_k is positive/negative depending on how the risk of the project under consideration compares with existing risk of firms. Adjustment for different risk of project 'k' depends on management's perception of project risk and management's attitude towards risk (risk - return preference).

If the project's risk adjusted discount rate (r_k) is specified, the project is accepted if N.P.V. is positive.

$$\text{N.P.V.} = \sum_{t=1}^n A_t / (1 + r_k)^t - I$$

A_t → expected cash flow for year 't'.

r_k → risk adjusted discount rate for project 'k'.

(2) Certainty equivalent approach (CE approach)

This approach allows the decision maker to incorporate his or her utility function into the analysis. In this approach a set of risk less cash flow is generated in place of the original cash flows.

Steps in the Certainty Equivalent (CE) approach

Step 1: Remove risk by substituting equivalent certain cash flows from risky cash flows. This can be done by multiplying each risky cash flow by the appropriate α_t value (CE coefficient)

Step 2: Discounted value of cash flow is obtained by applying risk less rate of interest.

Step 3: After that normal capital budgeting method is applied except in case of IRR method, where IRR is compared with risk free rate of interest rather than the firm's required rate of return.

Note: If C.E. coefficient is not given then we shall compute it as follows:

$$\alpha_t = \frac{\text{Certain cash flow}}{\text{Risky or expected cash flow}_t}$$

Due to its arbitrary nature this method is not often used.

Thus Certainty Equivalent reflects two aspects:

- (a) Variability of outcomes.
- (b) Attitude towards risk.

Certainty Equivalent Coefficients transform expected values of uncertain flows into their Certainty Equivalents.

It is important to note that the value of Certainty Equivalent Coefficient lies between 0 & 1.

Certainty Equivalent Coefficients 1 indicates that the cash flow is certain or management is risk neutral. In individual situation, cash flows are generally uncertain and managements usually risk averse. Certainty Equivalent Coefficients are normally less than 1.

$$\text{N.P.V.} = \sum_{t=1}^n \alpha_t A_t / (1+i)^t - I$$

$A_t \rightarrow$ expected cash flow for year 't'.

$\alpha_t \rightarrow$ certainty equivalent coefficient for cash flow of year 't'.

$i \rightarrow$ risk free interest rate.

$I \rightarrow$ initial investment (no uncertainty assumed).

(3) Other Methods

(a) **Sensitivity Analysis: Also known as "What If" analysis.** This analysis determines how the distribution of possible NPV or internal rate of return for a project under consideration is affected consequent upon a change in one particular input variable. This is done by changing one variable at one time, while keeping other variables (factors) unchanged.

(b) **Scenario Analysis:** This analysis brings in the probabilities of changes in key variables and also allows us to change more than one variable at a time.

This analysis begins with base case or most likely set of values for the input variables. Then, go for worst case scenario (low unit sales, low sale price, high variable cost and so on) and best case scenario. In other words, scenario analysis answers the question "How bad could the project look". This analysis seeks to establish 'worst and best' scenarios so that whole range of possible outcomes can be considered.

(c) **Simulation Analysis (Monte Carlo):** This analysis starts with carrying out a simulation exercise to model the investment project.

Steps for Simulation Analysis:

1. Modelling the project.
2. Specifying values of parameters and probability distributions
3. Selection of random value from probability distribution
4. Determine NPV corresponding to the randomly generated value

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5. Repeat steps (3) & (4) a large number of times to get a large number of simulated NPVs.
6. Plot probability distribution of NPVs and compute a mean and Standard Deviation of returns to gauge the project's level of risk.

(d) Decision Tree Analysis: Basically decision tree is a graphic display of the relationship between a present decision and future events, future decision and their consequences.

Steps involved in decision tree analysis

Step 1- Define investment

Step 2- Identification of Decision Alternatives

Step 3- Drawing a decision tree

Step 4- Evaluating the alternatives

5. Capital Budgeting under Capital Rationing

- Capital rationing situation arises where there may be internal or external constraints on procurement of necessary funds to invest in all investment proposals with positive NPVs.
- Capital rationing can be experienced due to external factors, or internal factors.
- A firm may resort to capital rationing through budgets.
- Capital rationing may also be introduced by following the concept of 'responsibility accounting'.
- In capital rationing it may also be more desirable to accept several small investment proposals than a few large investment proposals.
- Capital rationing does not always lead to optimum results.

6. Capital Budgeting under Inflation

- Adjustment for inflation is a necessity for capital investment appraisal.as inflation will raise the revenues & costs of the project.
- The net revenues after adjustment for inflation shall be equal to net revenues in current terms.
- Due to inflation investor's rate of return to be calculated as follows:

$$R_N \text{ (Nominal rate of return)} = R_R \text{ (Real Rate of Return)} + P \text{ (Inflation Rate)}$$

7. Capital Asset Pricing Model Approach to Capital Budgeting

Based on presuming two components of risk: (1) Systematic risk (2) Unsystematic risk

Systematic risk is indicated by β any can be calculated as follows:

(i) Regression Method: The formula of regression equation is as follows:

$$ER_i = \alpha + \beta R_m$$

ER_i = Expected return security

- α = Estimated return from security if market return as zero
 R_m = Market Return
 β = Beta of security

(ii) Correlation Method: the Beta of any security can be calculated as follows:

$$\beta_j = \frac{r_{jm} \sigma_j \sigma_m}{\sigma_m^2}$$

- σ_{jm} = Coefficient of co-relation between return of security and market return
 σ_j = Standard Deviation of Return on investment
 σ_m = Standard Deviation of Return on Market return (Market Portfolio or Index)

Using β the expected return of any security can be calculated using Capital Asset Pricing Model (CAPM) as follows:

$$ER = R_f + \beta(R_m - R_f)$$

Where,

- ER = Expected return
 R_f = Risk free rate of return
 R_m = Market return
 β = Beta of security
 $R_m - R_f$ = Market risk premium

(a) Estimating The Beta of a Capital Project

- (i) Calculation of Project Beta on the Project's Market Values*
(ii) Development of Beta on the Basis of Accounting Data
(iii) Use of Beta of a Company whose Operations are Similar to that of the Proposed Project

Mathematically

$\beta_j = \beta_{uj} \left[1 + \frac{D}{S} (1 - T) \right]$ where β_j = levered beta & β_{uj} = unlevered beta, D/S is the debt to equity ratio in market value terms and T is the corporate tax rate.

(b) Project Selection: The relationship between risk (as measured by beta) and return is to be determined as per the capital asset pricing model.

Since the beta of market portfolio, β_m , is 1, $[E(R_m) - R_f]$ may be regarded as the price per unit of risk.

A project is acceptable if its expected risk premium equalised for its risk exceeds the market risk premium. A project z is acceptable when:

$$[E(R_z) - R_f] \beta_z > [E(R_m) - R_f]$$

8. Replacement Decision

A decision concerning with the replacement of existing asset.

Replacement decision follows certain steps:

Step I. Calculation of Net cash outflow (assumed at current time / [Present value of cost]):

Net cash outflow = Cost of new equipment – [Tax payable/savings from sale + market value of old equipment]

Step II. Estimate change in cash flow per year, if replacement decision is implemented.

Change in cash flow = [(Change in sales + Change in operating costs) - Change in depreciation] (1 - tax rate) + Change in depreciation

Step III. Present value of benefits = Present value of yearly cash flows + Present value of estimated salvage of new system

Step IV. Net Present Value = Present value of benefits - Present value of costs

Step V. Decision rule:

Accept when present value of benefits > present value of costs.

Reject when the opposite is true.

9. Real Option in Capital Budgeting

Real Options methodology is an approach to capital budgeting that relies on option pricing theory to evaluate projects. Real options approach is intended to supplement, and not replace, capital budgeting analyses based on standard DCF methodologies.

Options in Capital Budgeting

The following is a list of options that may exist in a capital budgeting project.

Long call:

- Right to invest at some future date, at a certain price
- Generally, any flexibility to invest, to enter a business, to expand a business

Long put:

- Right to sell at some future date at a certain price
- Right to abandon at some future date at zero or some certain price
- Generally, any flexibility to disinvest, to exit from a business.

Short call:

- Promise to sell if the counterparty wants to buy

- Generally, any commitment to disinvest upon the action of another party

Short put:

- Promise to buy if the counterparty wants to sell
- Generally, any commitment to invest upon the action of another party

Valuation of Real Options

Broadly, following methods are employed in Valuation of Financial Options.

- (a) Binomial Model
- (b) Risk Neutral Method
- (c) Black-Scholes Model

Type of Real Options

Following are broad type of Real Options

- (a) Growth Options
- (b) Abandonment Option
- (c) Timing Option

Real Options Vs. Financial Options

- A Financial option has underlying asset that can be traded whereas a real option has an underlying asset that is not a security and isn't traded.
- Financial option's payoffs are specified whereas real option's payoffs can be varied.
- The exercise period of real options are far higher than that of financial options.
- Real options are "valued" whereas financial options are "priced".