

Chapter -10

Market Potential Analysis

Components

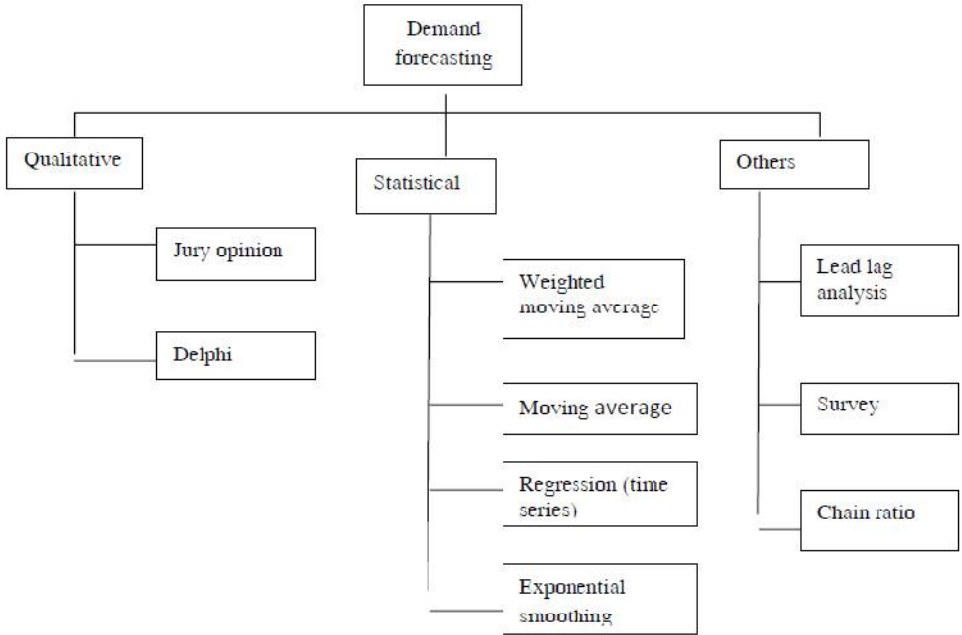
After studying this unit you will be able to understand the • Commercial aspects of the project • Demand analysis • Demand forecasting techniques • Qualitative techniques – Jury opinion and Delphi techniques • Statistical techniques involving moving average method, exponential smoothing, regression, etc.

Demand Analysis

Market potential of a product or service is the estimated maximum total sales revenue of all supplies of a product or service in a market during a certain period. Estimation of demand alone is not sufficient and other marketing aspects such as proper pricing, distribution and advertising issues are also essential to assess the market. Since the inception of project planning, estimating demand-supply gap has been the technique for estimating market potential. The process starts with estimating demand in future and then comparing the same with present supplies and prospective new suppliers. A positive demand-supply gap favours the market potential and vice versa.

Demand forecasting techniques

Demand forecasting is a crucial aspect in gap analysis. There are various quantitative and qualitative methods used for forecasting in different situations. All the techniques are classified in Figure 5.1



Qualitative Techniques

Jury Opinion

Jury opinion is a method of combining views of several executives regarding a forecast. The general practice is to bring together top executives from various fields of management, viz., finance, human resources, marketing, purchasing and production.

They provide information experiences and opinions to project planning. Jury opinion is simple and commonly used as it is less time-consuming.

Delphi Technique

Delphi technique is drawing upon the group's expertise by getting individual submissions, without the drawback of face-to-face meeting. It is a systematic and interactive (though no direct interaction is involved) forecasting method which is based on the outcomes of responses of panels of experts. The convener of the process prepares a questionnaire and mails it to various experts. Based on the

preliminary responses, a secondary questionnaire is prepared and resent to the experts. It sometimes may require more than two rounds of questionnaires. After each round, a moderator provides summary of the experts forecasts from the previous round as well as the reasons they provided for their judgment. This encourages participant experts to revise their earlier responses. Finally, the experts converge in their opinion without any direct interaction.

Statistical Techniques

Moving Average Method

Simple moving average method uses simple mean of last few time intervals to forecast future demand. The number of time intervals generally varies from three to five.

Example

Calculate the forecast (using simple moving average method) for 2010 if demand were 32,36, 40,35,32,35 and 45, respectively, in each corresponding year from 2003 to 2009.

Table 5.1

Year	Demand	4-year moving average forecast
2006	32	
2007	36	
2008	40	
2009	35	
2010	32	35.75
2011	35	35.75
2012	45	35.5

Forecast for 2013 = $\frac{384}{10} = 38.4$

10

Exponential Smoothing

Exponential smoothing refers to a particular type of moving average technique applied to time series data, either to produce smoothed data for presentation, or to make forecasts. The time series data themselves are a sequence of observations. The simplest form of exponential smoothing is given by the formula.

$$F_{t+1} = F_t + \alpha e$$

Where F_{t+1} is next year forecast; F_t is current year forecast; and α is the smoothing factor, and the smoothed F_t is a simple weighted average of the latest observation D_t and the previous smoothed statistic F_{t-1}

$$0 < \alpha < 1$$

$$e = D_t - F_t$$

Regression (Time Series)

Regression methods involve determining the trend of consumption based on past consumption and project future consumption by extrapolating this trend.

Linear relationship $D = a + bT$ where $D =$ Demand, $T =$ year, a & $b =$ constants Regression is the most commonly used technique for forecasting demand in project planning as it provides demand forecast for many years to come. The earlier methods are generally applied in operations management whereas this method is significantly useful in project management due to its longer time horizon.

Example

Determine the forecast for 2010 and 2013 using least square method for the data given below:

Year	2005	2006	2007	2008	2009
Demand	35	42	45	51	56

Solution

Table 5.5 represents the technique of least square method.
Least square method

Year	Demand (D)	Year (T)	T ²	TD
2005	35	-2	4	-70
2006	42	-1	1	-42
2007	45	0	0	0
2008	51	1	1	51
2009	56	2	4	112
Total	229		10	51

Equation of line is $D = a + bT$

$$a = \frac{\sum D}{n}$$

$$b = \frac{\sum DT}{\sum T^2} \quad (5.9)$$

$$a = 45.8; b = 5.1$$

Forecast for 2010 is 61.1 (using $T = 3$).

Similarly, forecast for 2013 is 76.3 (using $T = 6$).

In the above example, the middle year is assigned a value of 0; if the number of data available is even, the two middle terms can be assigned value of -1 and +1, respectively, with a common difference of 2.

Financial Feasibility

Components

After going through this unit, you will be in a position to

- Understand the importance of financial feasibility of the project
- Explain the crucial role of financial feasibility for any organization
- Know about the steps in financial analysis
- Explain the components of cost of project and its estimation
- Understand the guidelines of various financing
- Know about working capital estimation

- Explain different types of cash flows in the project One of the most important and essential analysis of any project is its financial feasibility. After going through technical and market analysis, the project should also meet the financial objectives of the organization.

Importance and Steps of Financial Feasibility

Financial feasibility is the process of identifying the overall investment outlay, determining expected rate of returns and evaluating project financially.

Financial feasibility is crucial for any organization as:

- It influences the firm's growth in long term
- It affects risk of the firm into consideration
- It involves huge quantum of funds generally
- A wrong decision with regard to investment of huge sum of funds may prove fatal for an existing firm. A careful analysis of cash outflows and inflows is essential before applying any capital budgeting technique.
- Capital budgeting is the process of identifying, evaluating and selecting a project that requires large sums of funds and generates long-term benefits in future.



Figure 6.1 Steps in financial analysis

The various steps involved in financial analysis are

- **Estimation of cost of project:** There are various components of the cost of project.

It mainly consists of two types of costs, fixed investment and working capital.

The cost of project includes all costs incurred before commissioning of commercial production (manufacturing projects) or operations (service projects).

- **Estimation of project cash flows:** This estimate involves all the project cash flows during the life cycle of the project. It includes the initial investments, cash flows generated during operations, and at the termination of a project.
- **Estimation of expected rate of return:** For financing a project, there are many sources of funds. After careful evaluation, we design optimum capital structure for the firm. The expected return from the project includes two components, risk free component (generally weighted average cost of capital) and risk component (risk premium due to the investments).
- **Application of decision rule:** The last stage of financial analysis is to apply various tools for checking the financial feasibility of a project. Capital budgeting techniques are applied to ascertain profitability and expected returns from the project.

Components of cost of project and its estimation

Project includes all expenses incurred before commercialization of the project. It includes capital investments and all other recurring expenses (like salary, interest, etc) incurred before the completion of a project or before the project is handed over for operations.

The various components of cost of project as per the guidelines of various financing and appraising authorities are as follows:

Land and site development: It includes all expenses incurred on the acquisition of land and making it suitable for implementation of the project. The various subcomponents are:

- Purchase price of land

- Legal and registration charges
- Levelling of land
- Laying of internal and approach roads
- Boundary wall/fencing of land
- Gates and site office
- Tubewell and electrification for project implementation
- Any other expenses of similar nature

Construction cost: This cost includes expenses incurred on the construction of factory/non-factory buildings of all nature including RCC, PCC, etc. Different factory buildings are:

- Production shed
- Boiler house

Transformer room / generator room

- Workshop
- Laboratory, etc.

The various non-factory buildings are:

- Warehouse
- Stores
- Security house
- Workers' rest room
- Parking
- Time office/excise room
- Administrative block
- Essential quarters for workers
- Canteen

Plant and machinery: This is generally the biggest cost in manufacturing projects.

It comprises the overall cost of imported and indigenous machinery including its erection and foundation cost. The following costs are included under this head:

- Basic cost of equipment
- Excise/custom duty and sales tax
- Transshipment cost (from vendor to site) and insurance during transportation
- Erection and foundation cost
- Piping cost
- **Technical know-how:** Whether generated or transferred, technology has its own cost. This technical know-how cost includes:
 - Basic cost of technology development or purchase
 - Training cost for employees
 - Royalty paid (if lump sum)
- **Utility:** Utilities are common facilities used for various plants of the same organization. This seems similar to plant and machinery cost, but the difference lies in the fact that utilities are used for various plants whereas plant and machinery is for individual plant .
 - Boiler
 - Compressor
 - Generator/transformer
 - Underground/overhead water tank
 - Effluent treatment plant
- **Miscellaneous fixed assets:** There are various costs which are not included in the costs, mentioned before. They are termed miscellaneous fixed assets:
 - Furniture/fixtures
 - Computers/fax/printers and accessories

- Vehicles
- Weigh bridge
- **Preliminary expenses:** These include market survey expenses, public issue expenses and interest during implementation.
- **Preoperative expenses:** These include the normal expenses such as salary and rent incurred by an enterprise prior to commercial production. This also includes travelling expense, company formation expense, commissioning expense, trial run costs, etc.
- **Contingency:** This is cushion fund kept for some foreseen over expenditures or some unforeseen expenses.
- **Margin money for working capital:** Working capital is generally financed through short-term sources of finance.

Working Capital Estimations

Working capital is referred to as operating capital. Working capital should just be adequate: A higher working capital will mean underutilization of funds and a lower working capital may hinder smooth operations.

Various determinants of working capital are

- Raw material inventory (less creditors)
- Work in progress inventory
- Finished goods inventory
- Debtors
- Cash (less bills payables)

Project cash flows

Project cash flows differ from financial cash flows during operations. Project cash flows can be classified into three types, viz. initial outlay, operating cash flow, and terminal cash flow.

Types of cash flows

Initial outlay	Fixed investment + working capital	Generally outflow	Generally in 0 th year
Operating cash Flow	EBIT - tax + depreciation	Generally inflow	From 1 st year to <i>n</i> th year
Terminal cash flow	Salvage value + working capital	Inflow	<i>n</i> th year

EBIT is Earning before Interest and Tax

Operating cash flow is calculated without considering interest as an expense. Initial outlay is generally before the project starts, but when there is capacity enhancement or increase in sales, there is additional outlay in next years. One should be careful in computing working capital. It should be made available one year in advance. For example, working capital of Rupees 2 millions is needed in the second year. There is working capital available for Rupees 1.5 millions in the first year, additional Rupees 0.5 millions should be considered in the first year's cash flow as first year's cash flow is basically at the end of first year or starting of second year.

Initial outlay is generally in the zero's year, but sometimes additional working capital requirement in succeeding years or reduction in working capital in succeeding years may incur addition or subtraction. Operating cash flow is non cash expenditure (like depreciation) added to net profit after tax.

Salvage value and redemption of working capital is considered as terminal cash flow in the last year of project life. The sum of the three cash flows in corresponding years is project cash flow.

Format of calculation of project cash flow

Year	0	1	2	3	4	5
Initial Outlay	FI + WC	Add. WC	Add. WC	Add. WC	Add. WC	-
Operating cash flow	-	EBIT -Tax + Depr.	EBIT -Tax + Depr.	EBIT -Tax + Depr.	EBIT -Tax + Depr.	EBIT -Tax + Depr.
Terminal cash flow	-	-	-	-	-	SV + WC
Project cash flow	Sum of all 3	Sum of all 3	Sum of all 3	Sum of all 3	Sum of all 3	Sum of all 3

FI is fixed investment; WC is working capital; Depr. Is depreciation; SV is salvage value. It should be noted that only real expenses are considered in cash flows and not the accounting expenses like preliminary expenses written off or written down over heads.

Project Financing

Components

After studying this unit, you will be in a position to

- Understand the different sources of long term finances available for the project
- Know about debt financing, equity financing and other financing sources
- Understand the various institutions advancing project loans
- Explain the venture capital financing and the process involved
- Know about the short term sources of working capital
- We have determined the various components of cost of project, the cost of project as well as working capital requirement. Now, the question arises, where to get the funds for financing the project? Before deciding the sources, it is important to understand the various sources of funds and then evaluate the alternatives and decide the finance mix for the project.

Sources of long-term finance

The major classification of long-term sources is debt financing (outsider's liability) and equity financing (insider's liability)

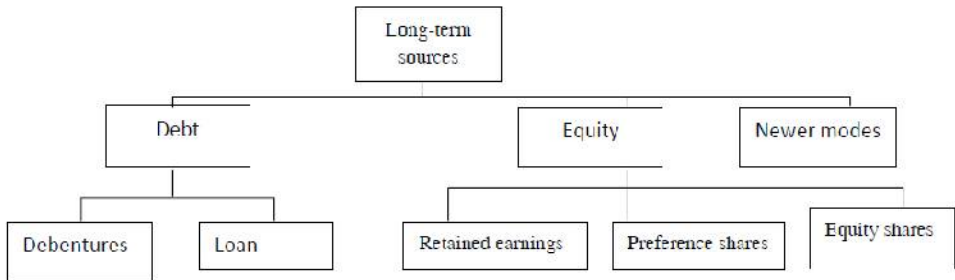


Figure 7.1 Source of Long-term finance

Debt Financing

Debt funds are the outsider's liability. The funding agencies evaluate the project and provide finance for the same with predetermined terms of returns and repayments.

The repayment schedule is predetermined and so is the interest rate. The term, or time limit to pay a debt, is generally commensurate with the value of an item or investment.

Business and governmental bodies carry long-term debt in the form of loans or bonds.

Loans are taken from institutes or banks and are paid back with an agreed interest rate. Bonds or debentures are similar to loans, but are usually purchased by individuals or other businesses.

Types of Debts

There are two broad classifications of debts: loans and debentures

Loans

Loans are the most common source of financing. There are several development banks/institutions and commercial banks providing finance with a predefined rate of interest. The repayment schedule is also predefined. Repayments are generally made in installments (quarterly/semi annually/annually) whereas interest payment is generally on quarterly basis in India. There are various banks/institutes providing loans. Some of them are: **Central financial institutions/development banks:** Financial intuitions like IFCI (Industrial Financial Corporations of India), IRBI (Industrial Reconstruction Bank of India), and development banks like IDBI (Industrial Development Bank of India), ICICI Bank, SIDBI, GIC, EXIM, etc.

- **State Financial Corporations (SFCs):** All major states have their own SFC for funding medium sized projects. They all are refinanced by IDBI. For example, APSFC (Andhra Pradesh State Financial Corporation) in Andhra Pradesh, UPFC (Uttar Pradesh Financial Corporation), etc.
- **State Industrial Development Corporations (SIDCs):** The role of SIDC is not restricted to financing but they are also responsible for zones for industrial developments and infrastructural facility. Pithampur (near Indore) and Mandideep (near Bhopal) are developed by MPAKVN (Madhya Pradesh Audhyogic Kendra Vikas Nigam), Similarly, MIDC (Maharashtra Industrial Development Corporation) and GIDC (Gujarat Industrial Development Corporation) have developed a number of industrial areas in their respective states and contributed towards its development.
- **Commercial banks:** All commercial banks finance long-term debt at a predefined rate of interest, generally with collateral security. Both nationalized and private commercial banks are playing a major role in financing agro industries and service projects.

Private financing: Private companies and NBFC are also providing long-term loans for projects.

- **International financial institutions:** These institutions provide funding to the projects of great magnitude. World Bank, International Finance Corporation, Asian Development Bank, Overseas Economic Co – operation Fund, etc.

Debentures

Debentures are loans that are usually secured and are said to have either fixed or floating charges with them. They are different from loans as loan is provided by a bank or an institution whereas debenture is funded by public or group of people.

A secured debenture is one that is specifically tied to the financing of a particular asset such as a building or a machine. Then, just like a mortgage for a private house, the debenture holder has a legal interest in that asset and the company cannot dispose of it unless the debenture holder agrees. If the debenture is for land and/or buildings, it can be called a mortgage debenture.

Debenture holders have the right to receive their interest payments before any dividend is payable to shareholders and, most importantly, even if a company makes a loss, it still has to pay its interest charges.

If the business fails, the debenture holders will be preferential creditors and will be entitled to the repayment of all of their money before the shareholders receive anything.

This provides safety to the holders of debentures.

Equity Financing

Although owners of equity instruments are the owners of a company, it is actually equity shareholders who are the real owners of the company. There are various sources of equity financing.

- Preference shares

- Equity shares
- Returned earnings

Preferential Shares

Preference shares offer their owners preferences over ordinary shareholders. There are two major differences between ordinary and preference shares:

1. Preference shareholders are often entitled to a fixed dividend even when ordinary shareholders are not.
2. Preference shareholders cannot normally vote at general meetings.

Equity Shares

Equity shareholders are the true owners of the company. They have the voting rights and right on all the remainder profit after paying interest to debt and preferential dividends. Who owns Reliance Industries? Mukesh Ambani? No, he is just holding majority stake of the company, and so is controlling the company. All shareholders of Reliance industries are the owners of the company. The equity shares are generally not subjected to buy back and under no circumstances can equity shareholders be forced for the buy back. Companies may offer a buy back but can never force buy back on shareholder. Returns to shareholders are in the form of dividends, right shares or bonus shares. Generally, the return expected by shareholders is in the form of increased market prices. Future aspects, profits, reserves and all the aspects of the company are depicted by its share prices. The value of the company is determined by market price/share x No. of shares issued.

Retained Earnings

Retained earnings is the cheapest of equity source of capital. Companies do not declare dividends equal to their earnings; they retain some portions of their earnings for various reasons. One of the major reasons is future prospects. Such reserves are used as source of funding of a new project (generally in the case of brown field projects).

Short-Term Sources for Working Capita

The various short term sources of funds are

- **Cash credit limit/overdraft by banks:** This is a form of loan provided by a bank.

This is a cheaper means of fund as interest is payable on the amount which is withdrawn on a particular date. Banks offer a drawing limit to business for meeting its requirement of funds for working capital needs for raw material storage, work in progress, finished goods stock and debtors.

- **Commercial papers:** Commercial paper is an unsecured, short-term debt instrument issued by a company, typically for the financing of accounts receivable, inventories and meeting short-term liabilities

Newer Sources of Finance

International financing: The International Finance Corporation (IFC), the Multilateral Investment Guarantee Agency (MIGA), and International Project Financing Agency (IPFA) give loans to promote private sector, corporate investment in developing countries, under the theory that such investment will provide economic growth. Other major sources of international financing include

Euro Currency loans, Euro Bonds, Global Depository Receipt and American Depository Receipts.

3.3.2 Leasing: Lease is an agreement between two parties, the lessee and the lessor.

The lessor purchases capital goods for the use of the lessee and the lessee uses it by payment of predefined rentals. The lessee continues to be the owner of the asset. Leasing is generally used for financing capital goods.

3.3.3 Hire purchase: It is a form of instalment credit. Hire purchase is similar to leasing with the exception that ownership of the goods passes to the hire purchase

customer as soon as the final instalment is paid, whereas a lessee never becomes the owner of the goods.

Venture Capital Financing

Venture capital is the capital provided by outside inventors for financing of new, innovative or struggling business. Venture capital investments generally are high risk investments, but offer the chance for above average returns. A venture capitalist (also called angel investor) is a person who makes such investments. A venture capital funds is a pooled investment vehicle (often a partnership) that primarily invests the financial capital of third-party investors in enterprises that are too risky for the standard capital markets or bank loans. A venture capitalist is an expert not only in acquiring capital, but can also provide support and direction to early start-ups.

The Process

- **Deal origination:** Deals may be referred to the VCs through their parent organizations, trade partners, industry associations, friends, etc. There are various consultants like Mckinsey conduct quiz and competition to search out novel ideas.
- **Preliminary screening:** Venture capitalists carry out initial screening of all projects on the basis of some broad criteria like investment, risk, technology, and market scope.
- **Due diligence:** This is the step of detailed evaluation of the proposals. There are various criteria, but there are 11 guidelines given by I.M. Pandey from IIM Ahmedabad; integrity, urge to grow, long-term vision, commercial orientation, critical competence vis-à-vis venture, ability to evaluate and react to risk, well thought out strategy to remain ahead of competition, high market growth rate, expected return over 25% p.a. in five years, managerial skills, marketing skills.

- **Deal structuring:** After evaluating the project, it is time to finalize the terms and condition for the deal. The venture capitalist and the investment company negotiate the terms of the deal and decide the terms and conditions of the deal.
- **Exit:** Venture capital fund is not a permanent fund, it has to withdraw after a particular period of time, 5-10 years. There are various ways to exit. The most common way is an IPO (Initial Public Offer). Some others are the investee company re-purchase the shares, or shares are sold to a third party, or the firm itself is sold.

Financial Analysis

Objectives

This unit helps the reader to

- Understand the ratios which helps in analyzing the financial feasibility of the Project
- Know about the undiscounted techniques of capital budgeting like payback period, Average Rate of Return, etc.
- Solving the problems and understanding the discounting techniques like IRR, NPV. Etc.
- Explain the relation between discounting factor and NPV

Ratios like return on investment, return on equity, profit margins, breakeven analysis are some of the tools used for the purpose of financial feasibility.

Ratio Analysis

Return on investment: This measures overall return on overall investments.

EBIT is earning before interest and taxes. $ROI = \frac{EBIT - Tax}{Investment}$

Return on equity: This measures return for shareholders.

EAT is earning after tax.

$$\text{ROE} = \frac{\text{EAT} - \text{Preferential dividend}}{\text{Equity}}$$

Operating profit margin: This measures the profitability in its gross terms.

$$\text{OPM} = \frac{\text{EBIT}}{\text{Sales}}$$

Net profit margin: This measures profitability in its true terms.

$$\text{NPM} = \frac{\text{EAT}}{\text{Sales}}$$

Break even analysis: This determines minimum quantity to be produced and sold to avoid losses. A company should not have break even efficiency of more than 50%; otherwise, it will lead to very high operating risk. Break even efficiency of 50% means that if the company performs at 50% of its installed capacity, it will not suffer losses.

Moreover, only the remaining 50% production is capable of generating profits.

$$\text{BEQ} = \frac{\text{Fixed cost}}{\text{Contribution/unit}}$$

$$\text{BEQ} = \frac{\text{Fixed cost} * \text{Sales}}{\text{Total Contribution}}$$

$$\text{Break even efficiency} = \frac{\text{BEQ}}{\text{Installed capacity}} = \frac{\text{Fixed cost}}{\text{Total contribution}}$$

Debt service coverage ratio: This is the ratio which shows the proportion of earnings utilized for servicing debt. Ideally, DSCR should be Two. But it depends upon debt proportion or debt equity ratio. A company with lower D/E ratio should have a higher DSCR as compared to a company with higher D/E ratio.

$$\text{DSCR} = \frac{\text{EAT} + \text{Interest}}{\text{Interest} + \text{Loan repayment}}$$

Let us take an example to understand the ratio mentioned above.

EXAMPLE

A company is planning to invest Rs. 400 lacs in a project which will be financed with Rs. 240 lacs of debt @ 11% and the remaining through equity. The company is expecting variable cost to be 60% of sales and fixed cost to be Rs. 125 lacs. The company plans to repay loan in ten equal installments together with interest on outstanding loan.

Determine financial feasibility of the project if projected sales is Rs. 500 lacs every year and tax rate is 30%.

Solution:

Sales	= Rs. 500 lacs	
Variable cost	= Rs. 300 lacs (60%)	
Fixed cost	= Rs. 125 lacs	
EBIT	= Rs. 75 lacs	
Interest	= Rs. 26.4 lacs (11% of Rs. 240 lacs)	
EBT	= Rs. 48.6 lacs	
Tax	= Rs. 14.58 lacs (30%)	
EAT	= Rs. 34.02 lacs	
ROI	= 60.42/400	= 15.1%
ROE	= 34.02/160	= 21.25%
OPM	= 75/500	= 15%
NPM	= 34.02/500	= 6.84%
Break even efficiency		= 80.7%
DSCR (1 year)		= 1.2

Working notes:

$$\text{EBIT} - \text{Tax} = \text{Rs. 75 lacs} - \text{Rs. 14.58 lacs} = \text{Rs. 60.42 lacs}$$

$$\text{Equity} = \text{Total investment} - \text{Loan} = \text{Rs. 400 lacs} - \text{Rs. 240 lacs} = \text{Rs. 160 lacs}$$

$$\text{Break even efficiency} = \frac{\text{Fixed cost}}{\text{Total contribution}} = \frac{\text{Rs. 125 lacs} + \text{Rs. 26.4 lacs}}{\text{Rs. 200 lacs}} = 80.7\%$$

Note: Fixed cost also includes interest cost for break even analysis.

$$DSCR = \frac{EAT + Interest}{Interest + Loan repayment} = \frac{Rs, 340.02 \text{ lacs} + Rs, 26.4 \text{ lacs}}{Rs, 26.4 \text{ lacs} + Rs, 24 \text{ lacs}} = 1.1988$$

Analyzing the above ratios, we can comment that although the project is lucrative from the angle of ROI and ROE but the project is having very high break even efficiency and lower NPM and DSCR. The company should try to reduce the fixed cost and debt proportion. That will improve DSCR and break even efficiency, otherwise, this project is not feasible as it is having very high risk associated with it.

Techniques of Capital Budgeting

There are various techniques used for capital budgeting. They can broadly be classified as non-discounting and discounting techniques.

Non-discounting techniques are those techniques which do not consider time value of money. Discounting techniques take time value of money into account. All the methods of capital budgeting are depicted in Figure. 8.1

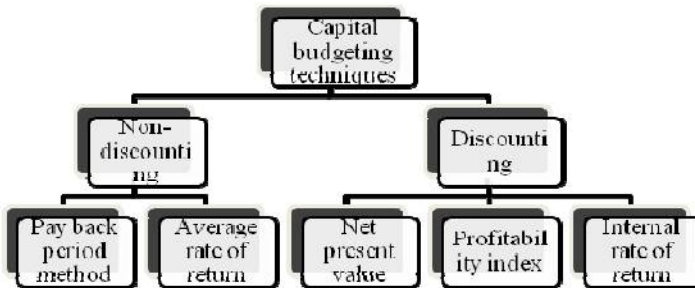


Figure: 8.1 Capital budgeting techniques.

Pay Back Period Method

Payback period is the easiest method to assess financial feasibility. Payback period is the time period in which the investor gets back his invested money in fixed assets from the project.

For example, Mr. Mehta invests Rs. 200 lacs in a project and he is projecting cash flow of Rs. 50 lacs every year. Then, his payback period is 4 years. A better project always has a lower pay back period.

$$\text{Pay Back Period} = Y_0 - \frac{\text{Cu. CF}_0}{\text{CF}_1}$$

Where Y_0 is the year just before the pay back is attained.

Cu. CF_0 is cumulative cash flow of Y_0

CF_1 is cash flow of pay back year

Example

A company is projecting a cash flow of Rs. 30 lacs in the first year and the cash flow is going to increase @ Rs. 10 lacs every year for 4 years, after which the cash flow will start decreasing @ 15 lacs every year and thus will be closed after 5 years. The fixed investment for the project is Rs. 120 lacs and working capital requirement is Rs. 20 lacs.

The company foresees to fetch a net salvage value of Rs. 35 lacs after 5 years.

Solution

Year	Cash flow	Cumulative cash flow
0	-140	-140
1	30	-110
2	40	-70
3	50	-20
4	60	40
5	45	

All Rs. in lacs and investment is assumed in the zero year.

The year where cumulative cash flow becomes positive is identified (4th year).

For computing exact Pay Back Period we apply the formula

$$\text{Pay back period} = 3 - \frac{-20}{60} = 3.33 \text{ or } 3 \text{ years } 4 \text{ months}$$

Note: Salvage value and working capital are not considered in calculating cash flows.

Average Rate of Return

It considers the cash flows after the payback period and considers working capital and salvage value. The average return is the ratio of average return and average investment.

$$\text{Average rate of return (ARR)} = \frac{\text{Average return}}{\text{Average investment}}$$

$$\text{Average return} = \frac{(\sum_0^n CF)}{n} = \left(\frac{CF_0 + CF_1 + \dots + CF_n}{n} \right)$$

Average investment = $1/2$ (Initial investment + Terminal cash flow) = $1/2$ {(FI + WC) +

$$(WC + SV)} = WC + 1/2(FI + SV)$$

FI is Fixed Investment, WC is Working Capital and SV is Salvage Value.

Time Value of Money

Rs. 20,000 after 3 years or Rs. 20,000 now.

Which offer will one select?

Certainly, everyone will go for the money now. That shows that time matters.

Present value of money is more than equivalent amount in future. The time value of money is money's potential to grow in value over time.

Money available today is worth more than the same amount of money in the future, based on its earning potential. This principle asserts that money can earn interest and grow, and so any amount of money is worth more the sooner a person has it so that that person can put it to use now rather than later.

Recalling the formula for compound interest

$$\text{Compound amount} = \text{Principal} (1 + r)^n$$

$$\text{Or, we can write Principal} = \text{compound amount}/(1 + r)^n$$

Or, Present value of money = Future value x Present value factor

where present value factor (PVF) = $1/(1 + r)^n$

R = Discounting factor

N = No. of periods

Some important terms as used in time value of money are discussed here.

Present value: Any value that occurs at the beginning of the problem is a present value. As zero is good baseline, all cash flows are converted into their present value for analysis.

Future value: The last cash flow is generally called *future value*. It can be understood as the cash transaction taking place after certain duration of time. If the same amount is transacted after a regular interval, it is termed *annuity*.

Annuity payment: As per literary meaning, an annuity payment means the yearly payment that occurs every year for more than one year. But in financial terms, the duration may not be yearly, it may be less as well, say quarterly, monthly, weekly, etc., but the duration between two successive payments remains constant. Each payment, if taken alone, is a future value, but together they make an annuity. It is important that annuity value is the sum of present values for the interest rate for n years and it starts from the first year.

Discounting factor (r): Discounting factor is the expected returns per unit period over the life of the project or investment. It is necessary to understand that if annuity is for quarterly payments or transactions, the annual expected return should be reduced to one quarter for computational purpose. Similarly, if transactions are made monthly, the annual expected return should be adjusted to 1/12th.

Number of periods (n): The total number of periods in any annuity is very important as they define the value of any annuity. It should again be noted that if transactions are done yearly, it is the number of years, but in the situation of

quarterly payments, the number of periods should be quadrupled the number of years.

Example

Mr. Roy wishes to invest some money for future need of Rs. 2 lacs after 5 years. How much should he deposit in the bank if the bank, is offering an interest rate of 9% per year? What should be the invested amount if interest is paid semi annually?

Solution

$$\text{Present value} = \frac{500000}{(1 + .09)^5} = \text{Rs. } 3,25,000$$

If interest is paid semi-annually, $n = 10$ and $r = 4.5\%$

$$\text{Present value} = \frac{500000}{(1 + .045)^{10}} = \text{Rs. } 3,18,712$$

4.2.4. Profitability Index and Net Present Value

Net present value is the most common approach used in the field of financial investment analysis. It is very simple to use and evaluates on the basis of wealth maximization objective. It is defined as the difference between the present value of cash inflows and the present value of cash outflows. Profitability index is the ratio of inflows and outflows whereas net present value (NPV) is the difference between the two.

The advantage of NPV are:

1. Considers all cash flows.
2. Considers time value of money.
3. Computes contribution towards wealth creation.
4. Allows expected change in cost of capital.

The limitation of NPV is, it: requires pre-determination of discounting factor.

Example

Determine profitability index and net present value assuming discounting factor as 10%.

Solution

Cash flows are multiplied with the present value factor of the corresponding year to calculate present value for the year. The sum total of all negative and positive present value is net present value. The ratio of positive and negative cash flow is profitability index.

Year	Cash flow	PVF (10%)	PV
0	-160	1	-160
1	30	0.9091	27.27
2	40	0.8264	33.06
3	50	0.7513	37.57
4	60	0.6830	40.98
5	100	0.6209	62.09
Total			40.97

$$\text{Profitability index} = 200.97/160 = 1.256$$

$$\text{Net present value (NPV)} = 200.97 - 160 = 40.97$$

Project is accepted at 10% discounting as PI is greater than one and NPV is positive.

Internal Rate of Return

Internal rate of return is defined as the discounting rate which delivers a net present value equal to zero. It is the true interest yield from an investment. A simple decision-making criterion can be stated to accept a project if its internal rate of return exceeds the cost of capital and rejected if this IRR is less than the cost of capital.

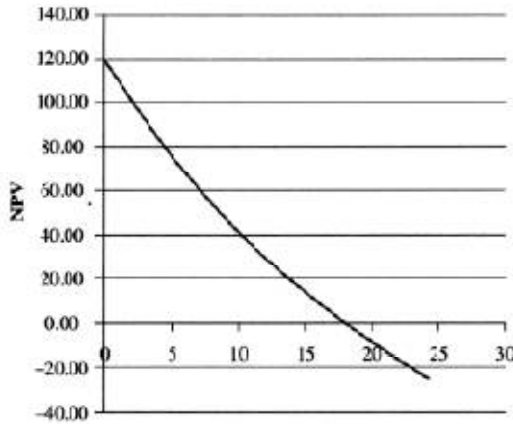


Figure: 8.2 Relation between discounting factor and NPV.

Calculating IRR is always considered a tedious process. It is done with the help of trial and error method. Continue increasing r to decrease NPV till it reaches negative.

And then interpolate between the consecutive r values where it is positive and negative, respectively. This interpolation is assuming that it is a straight line. As mentioned earlier, interpolating with a difference of higher percentage (10% or less) will lead to inaccurate answer.

The interpolation formula:

$$(IRR) = r_0 + \frac{NPV_0}{NPV_1 - NPV_1}$$

where r_0 is the rate at which NPV is just positive

NPV_0 is just positive NPV

NPV_1 is just negative NPV

But we have to first ascertain rates at which NPV is just positive and just negative.

This is generally a very time-consuming process of trials and error. Here, I just provide an approximation formula for IRR calculation.

$$\text{Internal Rate of Return (IRR)} = \text{Base rate} + \frac{1.7 \text{ NOV at base rate}}{n * \text{Initial Investment}}$$

Example

Determine IRR for the earlier

Solution

Using the approximation formula

$$\text{IRR} = .1 + (1.7 * 40.97)/(5 * 160) = .1 + .087 = .187 = 18.7\%$$

Let us try at 18% and then 17% as 18% NPV is just negative. The following table shows calculation of net present value with discounting rates of 18% and 17%.

Year	Cash flow	18%		17%	
		PVF	PV	PVF	PV
0	-160	1	-160	1	-160
1	30	0.847	25.42	0.855	25.64
2	40	0.718	28.73	0.731	29.22
3	50	0.609	30.43	0.624	31.22
4	60	0.516	30.95	0.534	32.02
5	100	0.437	43.71	0.456	45.61
Total			-0.76		3.71

Further exact IRR is computed using the formula.

$$\text{Exact IRR} = 17 + 3.71/(3.71 - .76) = 17.84\%$$

However, if we interpolate using higher difference, we tend to receive an incorrect answer.

Computing IRR in the case of an annuity (constant cash flow)

Example

What is the IRR of a project with initial investment of Rs. 200 lacs and expected cash flow is Rs. 55 lacs for 5 years.

Solution

$$55 * (PVIFA r, 5) = 200$$

$$\text{Or } PVIFA (r, 5) = 3.737$$

Looking into PVIFA table, for period of 5 years, for $r = 10\%$ $PVIFA = 3.791$ and for $r = 11\%$, $PVIFA = 3.696$

$$\text{Interpolating the result; } IRR = 10 + (3.791 - 3.737) / (3.791 - 3.696) = 10.48\%$$

Risk Analysis

Objectives

At the end of this unit, the reader will be able to

- Explain the sources of risk in project management which includes operational, market, economic, financial, technological, commercial, etc.
- Understand the various steps involved in managing the risk such as identification, mapping, quantification, developing alternatives, etc.

Risk can be defined as a combination of probability of an event and its consequence on the outcome. Risk can enhance opportunities for benefit as well as can enhance the chances of threats to success.

Sources of Risk in Project Management

- There are various sources of risk. Any change in economy of a nation or globe, any change in price levels of inputs or outputs may lead to risk. Let us enumerate the various sources of risk.
- **Operational risk:** Any decrease in operational efficiency may lead to reduced profitability or even at times can lead to loss for the project. In some projects, the effects of decreased operational efficiency may be high or may not be high.

- Similarly, the possibility of variation of efficiency may vary from project to project. The breakdown of machines, demand and supply of the resources and products, shortfall of the goods and services, lack of efficient logistic and inventory may lead to inefficiency of production. Operational leverage is a measure of operational efficiency.
- **Market risk:** Although every project undergoes market potential analysis and demand forecasting, there are chances of variations due to various foreseen or unforeseen reasons, which may adversely affect market potential or sales of product or services to be rendered by the planned project. This is user acceptance risk.
- **Economic risk:** Global or national economy is always in different phases and no project can shield itself from ongoing economic changes. All projects are prone to risk of economy. Recession in economy reduces the purchasing power of the customers and thus can affect the sales or revenues of the project. It can also lead to reduce demand as well as selling price. Inflation rate varies with changes in economic situation which also affects prospects of any project.
- **Financial risk:** Any change in interest rates or cost of capital will affect the prospects of a project. A project which is feasible at the expected return of 12% may become infeasible if the expected return increases to 15%. The expected returns directly vary with interest rates. The degree of financial risk for different projects varies with its debt equity ratio and can be measured by the financial leverage.
- **Technological risk:** The failure of the selected technology is one of the biggest risks to any project. Moreover, a project may face the problem of up gradation of technology. Many projects have failed due to inability to cope up with technological innovations. This particular source of risk is vital in the present world scenario as technology is changing very fast.

- **Commercial risk:** There is always the risk of a customer or debtor becoming insolvent. Although the company does manage and keeps provision for such bad debts, at times when the customer is a major one and the amount outstanding with him is large, it may affect the working of the project.
- **Quality risk:** Today's world is quality conscious and any degraded quality product may lead to rejections and the brand may lose its value in the long run if it is not able to maintain quality norms as per the customer's requirement.

Legal or regulatory risk: Political environment of a country may lead to changes in legal or regulatory changes and may cause risk due to new taxes being imposed or barriers to imports or exports being introduced.

- **International risk:** If international prices with addition of transaction cost (transportation cost and duties) becomes less than domestic prices, there is an import threat. Any change in foreign exchange rates also affects projects with international exposure. A devaluated Indian currency may adversely affect a project which is dependent on imports of goods or services. Similarly, devaluation of foreign exchange may adversely affect project which are export oriented. Risk of war, imposition of export or import bans and change in political scenario of a country can also lead to risk in project involving international business.

Managing Risk

The various steps in managing risk are as follows:

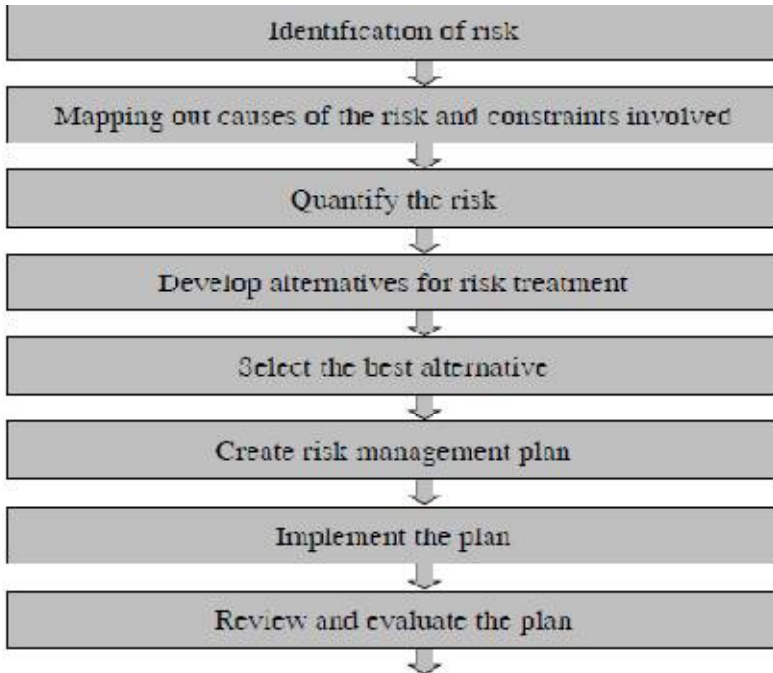


Figure 9.1: Risk Management

Identification of risk: There are various methods used for risk identification.

They are: **Objective related risk identification:** The activities of the project are not in coherence with the objectives of the project.

- **Source based risk identification:** The sources or the stakeholders of the project are not as per expectations.
- **Industry based risk identifications:** The overall sector of industry may not be in a good shape.
- **Economy related risk identification:** The project is not fulfilling the desired performance due to poor economic conditions in aggregate.

- **Time based risk identification:** The project is running far behind the desired schedule.
- **Financial ratio based risk identification:** This is one of the most common methods of risk identification. Various financial ratios reveal the project getting riskier.
- **Mapping out causes of risk and constraints involved:** Identify the cause/causes of the risk. There can either be one cause or more than one possible causes for the risk involved. The project owner should search as many possible causes as possible. There can be financial, economic, marketing, production or technology constraints. The cause identified may be varied in the boundaries of constraints.

For example, there is a high deviation in the cost of production; the cause can be poor efficiency of the organization.

- **Quantifying the risk:** Various methods are used for quantifying the risk.
- **Develop the alternatives:** There can be various methods of reducing the risk, although it is not possible to eliminate it totally. There are various methods of risk management which are as follows:
- **Mitigation:** It is the process of reducing either the probability or consequence of an event which can cause threat to the project. This includes financial, marketing or other measures.
- **Sharing:** if a project is expected to have a higher risk, it can be shared with some other firm using joint ventures to reduce the risk.
- **Outsourcing:** This is a very common methodology used in recent years to reduce the risk. The riskier component is outsourced. Outsourcing can also be very helpful in the situation where huge capital investment is the cause of risk.
- **Diversification:** Diversification is a very common methodology suggested since ages to reduce the risk. Diversification to a product or project with high

negative correlation can reduce the risk of both the projects and products to a great extent.

- **Abandonment:** If a project is exposed to risk which is not manageable then, the project should be abandoned before its useful life. This is possible when exit is possible.
- **Retention:** Risk retention is a viable strategy for small risks. All risks that are not reduced or transferred are retained by default. In this situation, the firm should always be in a position to sustain itself in the occurrence of threatening event.
- **Contingency funding:** Contingencies are reserved for additional cost due to inflation or non-predicted costs. This eliminates sudden funding requirement during project implementation
- **Time buffers:** Managers tend to start the activities at the latest start times as a human practice. A too much crashing leads to problem in practical applications. Thus, some time buffers are kept for certain activities.
- **Selection of best alternative:** After developing various alternatives, the next step for risk management is to select the best alternative, which is cheap and easily manageable.
- **Creation of risk management plan:** The selected risk management strategy should always be implemented properly to obtain the result. The project manger should plan the strategy and share with all the stakeholders. Individuals should be assigned responsibilities. In the event of risk retention strategy, guidance should be provided to top management and the operations management team to implement the measures in the situation of occurrence of threatening event. The top management should be well aware of the action plan and the risk involved.

- **Implementation:** The project manager should lead the team to implement the plan. Constraints should always be identified and quantified before the implementation of risk reduction plans. Coordination between the project manager and his team is crucial in the success of the plan.
- **Review:** This is the phase, many a time, avoided by managers. But this is a very important activity as review may help in further improvement (reduction of risk to a greater extent). Moreover, if the desired results are not obtained, then some more steps may be required which are identified during the review phase.

Project Control through Networks

Components

At the end of this unit the individual will be in a position to

- Understand the work break down structure and develop various linkages between tasks or activities.
- Know to visualize the progress of activities on time scale through Gantt chart.
- Explain the network analysis.
- Know about the Fulkerson's rule for activity on arch networks.
- Make a network construction.
- Design the critical path for the project.
- Know about the use of slacks and floats in project management.
- As the entire project comprises so many activities and events, it becomes a difficult job for the project management team to control the project in aggregate. So, various activities of a project are identified and then it becomes easier to control individual task or activity. This unit describes the Gantt chart, work breakdown structure, and network techniques.

Work Breakdown Structure (WBS)

Work breakdown structure, as the name suggests, is breaking the project systematically into successive levels. But work breakdown structure is not limited to disintegration or breaking down; it also develops linkages between various tasks or activities. The breakdown can be:

1. **Agency-oriented:** In this type of breakdown, different agencies or type of agencies are allocated to a group or individual. For example, dealing with civil contractors, equipment suppliers, liasoning with government bodies.
2. **Function-oriented:** Like departmentalization, the activities are divided on the basis of type of work. A project can be divided into engineering works, accounting works, financial works, procurement works, and human resource works, and so on.
3. **Location-oriented:** This type of WBS is generally useful when the project is multilocational.
4. **Cost-orientation:** Different cost centres are identified and allocated to various groups or individuals.
5. **Life cycle-oriented:** There exists a project life cycle, so work can be divided on the basis of different phases of life cycle, like identification team, planning team, implementation team, and so on.

The WBS is depicted in figure 1.1

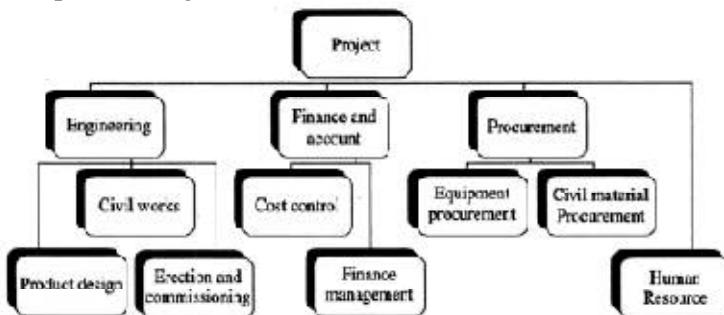


Figure: 1.1 Work breakdown structure on functional basis.

Gantt Chart

Henri Gantt (1861-1919) developed the bar charts to visualize the progress of activities on time scale. Due to his contribution in the field, he is also called *father of project management*. In the charts, the top line shows the time scale and various activities as recognized by WBS are systematically written on vertical line. Individual activities are drawn on time scale, the starting date and finishing date mentioned.

This helps the project management team to identify the current situation of the project. They can find out how much they are lagging behind or leading in the planned schedule of the project.

Figure 10.2 describes a typical bar chart of a small industrial project. The development of plan is done in the first week. Identification of resources will start in the second week and will last for two weeks, to be completed by the end of third week.

Total project will be implemented in eight weeks as per plans.

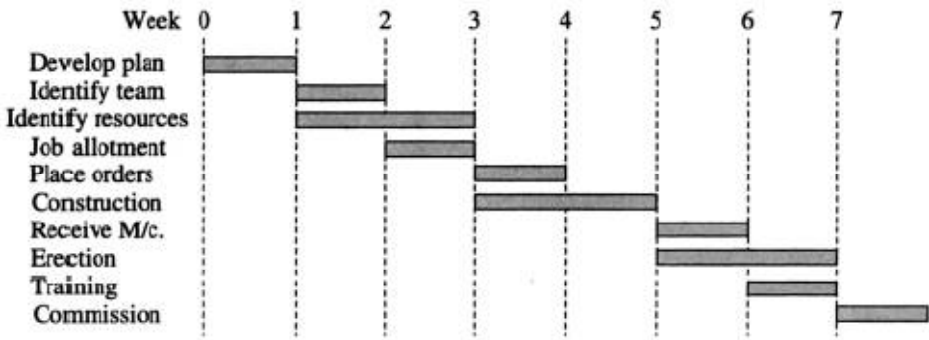


Figure: 1.2 Gantt chart

Networks

Network is a diagrammatic representation of various activities showing their interdependencies and dependencies, without drawing on scale. Networks are the most commonly used tool for planning and controlling any project.

Before discussing types of networks, we should understand various terms.

Activity: A specific task or group of tasks which are essential for completion of a project.

They have their own resource requirement and time.

Event: This can be defined as milestones, which depict starting or ending of an activity.

Critical activities: The identified activities which are crucial for completion of the project on scheduled time. Any delay in these activities will lead to delay in the project schedule.

Critical path: It is the sequence of critical activities. It is the longest path starting from the start of a project and leading to the end of the project. A network can have multiple critical paths.

Predecessor: All those activities are called predecessors of an activity which are essential to be completed before starting the activity.

Successors: A set of all those activities which cannot be started before the activity itself is not finished. The dependent activities are called successor activities.

Concurrent activities: Those set of activities which can be done during the same duration as they are not dependent on each other.

Dummy activities: Those activities which do not consume resource or time. They are just drawn to depict the dependencies between some activities and avoid crossing.

Applications of Project Networks

The applications of project networks are as follows:

1. Detailed project planning: In large projects in which time span may be as large as few months to few years, a network diagram provides helpful tool in correlation of various activities. It is helpful in identifying crucial activities (critical activities).

2. Project control: It is very helpful in developing Gantt chart and schedule bar charts, which are essential for tracking a project. It can be helpful in identifying the lagging and leading activities, which is essential to control the project. As tasks are completed on time, or over time, the number of time units used can accurately display. Resources from the leading activities can be transferred to lagging activities to complete those on time. It is helpful in identifying the impact of delay caused by a particular activity. Identification or diagnosis of a problem is always helpful in solving it.

3. Cost control: Some activities which are crucial can be completed earlier than their normally expected schedule by paying some extra cost or employing some additional resources. This can be helpful in completing the project earlier and provide the organisation with saved indirect cost as well as opportunity costs.

4. Resource control: Some activities which are not critical and have some additional time available can always be eased out and their resources can be utilised in critical activities to get them completed more efficiently with respect to time.

1.5 Fulkerson's rules for Activity on Arch (AOA) Networks

Dr. D.R. Fulkerson gave some set of rules to be followed for drawing a network on AOA basis.

1. All projects should start and end at one and one point only.
2. Activities are represented by arrows and depicted by small alphabets (a, b, c, ...).

No two different activities are depicted by same alphabet and vice versa.

3. Events are depicted by points and are labeled by numerals (1, 2, 3, ...).

Numbering should always be from left to right in increasing order. No activity can start at a higher event and end at a lower event.

4. Any two or more activities can be burst activities (starting at the same event but ending at different events) as in Figure 10.3 (a). Similarly any two or more activities can be merge activities (starting at different events but ending at the same event) as Figure 10.3 (b) but no two activities can be burst and merge simultaneously as Figure 10.3 (c). Either of the starting or ending event should be different. All starting activities are burst activities and all ending activities are merge activities.

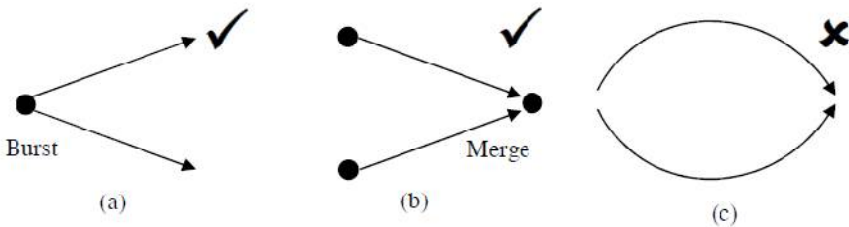


Figure 1.3: Burst/merge activities.

1. Avoid using arch, Figure 10.4 (a); try to depict every activity by a straight arrow like in Figure 10.4 (b).

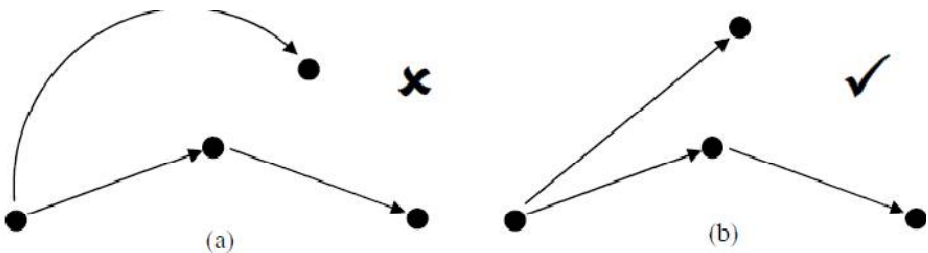


Figure 1.4: Fulkerson's rule regarding arch.

2. Minimize the number of dummy activities used.
3. Crossing of activities is generally not permitted, Figure 10.5 (a) and Figure 10.5 (b), but if it is essential, then only dummy activities should be crossed.

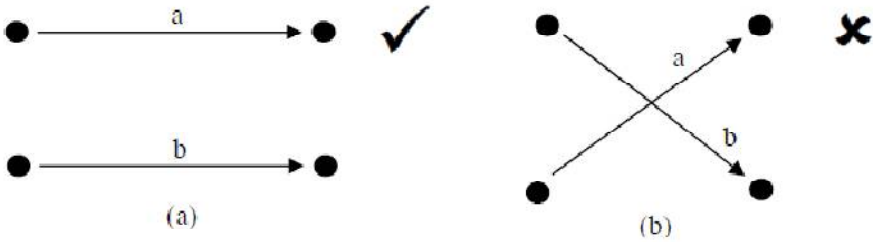


Figure 1.5: Fulkerson's rule regarding crossing of activities.

Network construction

Let us take an example to understand the construction of a network. A civil construction firm has to build a two-storied building with scope limited to civil works alone.

The various activities identified are:

Excavation of land (a) (1-2)

Foundation laying (b) (2-3)

Beams and columns of ground floor (c) (3-5)

Walls (ground floor) (d) (3-4)

Plaster ground floor walls (e) (4-8)

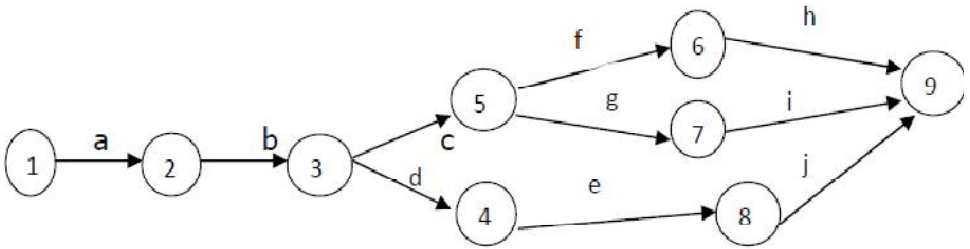
Roofing of ground floor (f) (5-6)

Beams and columns of first floor (g) (5-7)

Walls of first floor (h) (6-9)

Plaster first floor walls (i) (7-9)

Roofing first floor (j) (8-9)



Above Figure 10.6 clearly defines the relationship between various activities.

Foundation (b) cannot start unless excavation (a) is finished. Wall (c) and beams and columns (d) cannot start unless foundation (b) is completed. But these two activities, i.e. (c) and (d) are independent of each other and can go on at the same time. They are concurrent activities as well as burst activities. Activity (e), (i) and (j) are merge activities. Project starts at one point (event 1) and ends at one point (event 9).

Now, let us find out where we need a dummy activity and how to identify whether a dummy is essential. There are four types of situations where dummy is essential.

1. When two or more of the starting activities become common precedence activity for another activity, then dummy is essential.

Example-1.1

Activity	Precedence activity
a	-
b	-
c	b
d	a, b

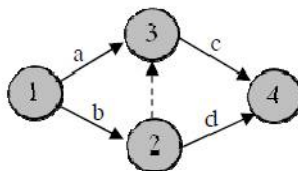


Figure: 1.7 Solution to Example-10.1

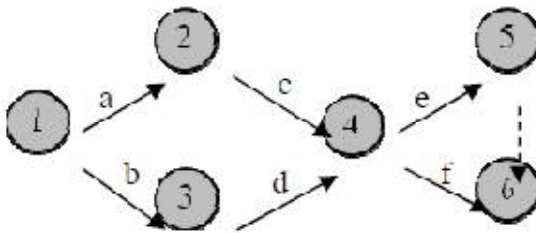
In this example, as activity (d) is dependent on both the starting activities (a) and (b), dummy is essential. Here, it should be noted that the direction of arrow is upward as activity (c) is dependent on activity (b) alone whereas activity (d) is dependent on both activity (a) and activity (b).

- When two or more ending activities have same predecessors, the dummy is essential.

Example-1.2

Activity	Precedence activity
a	-
b	-
C	A
D	B
E	c, d
F	c, d

Figure: 1.8 Solution to example 1.2

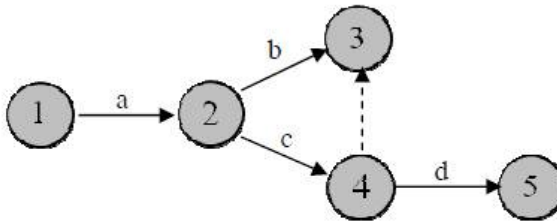


In the example, the two ending activities (e) and (f) have common set of precedence activities (c, d). Therefore, dummy is essential to complete the project at one point.

- In a situation where two or more activities have common precedence activity and become common precedence activities for another activity, then dummy is essential.

Example: 1.3

Activity	Precedence activity
A	-
B	a
C	a
D	b, c

**Figure: 1.9** Solution to Example-1.3

In the above cited example, activities (b) and (c) have the same precedence activity (a) and they are common precedence activity for another activity (d). Hence, dummy is unavoidable.

- When an activity have two or more predecessors and either of the predecessors is predecessors alone for another activity or grouped with another activity as predecessor, then dummy is unavoidable.

Activity	Precedence activity
A	-
B	a
C	a
D	b, c
E	c
F	d, e

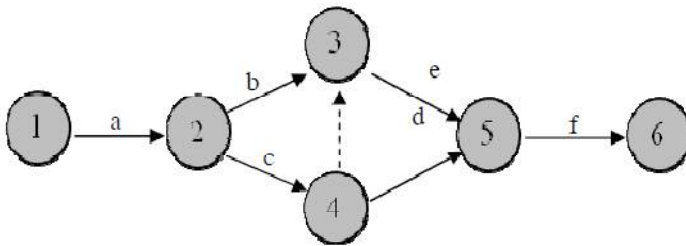


Figure: 1.10 Solution to Example-1.4

In the above example, as activities (b) and (c) are common precedence activity for activity (d) and (c) alone is precedence activity for (e). Therefore dummy is unavoidable.

Note the direction of the dummy again.

1.7. Critical Path Method

A giant chemical company, DuPont, while going for a big expansion project and to determine the time needed for the completion of the expansion project, developed a network technique in 1950 and named it CPM.

Critical path: Critical path is the longest path. It gives the minimum time to complete any project.

Earliest Occurrence Time (EOT): Earliest possible time to reach an event. To reach an event, all the activities prior to that event should be completed.

Latest Occurrence Time (LOT): Latest possible time to reach an event without affecting the overall project duration.

Forward pass: When we start with starting event and keep allocating EOT in order of increasing number of events.

Backward pass: When we start with ending event and keep allocating LOT in order of decreasing number of events.

Project duration: Minimum time to complete a project. A project is completed only when all the activities involved are completed.

The steps in CPM are:

1. Construct the network and number the events.
2. Allocate zero time to EOT of starting event (1)
3. Start forward pass. Add the duration for the activity between event (1) and

event

(2) to EOT of event (1) and get the EOT of event (2). Continue the process to reach the last event.

In the situation where more than one activity is ending on one event, and we have two or more paths to reach one particular event, all the different possible EOTs should be noted and the maximum of these should be selected as EOT for the event.

4. Now all the events have EOT. Let us start the backward pass. LOT of last event is same as its EOT. Subtract the duration of activity from the LOT of last event and allocate it as LOT of next to last event. Continue the backward process till we reach the first event.

In the situation when more than one activity is starting from an event, compute all possible LOT for the event and select the minimum of them to allocate the LOT to the event.

- 5. We will find that LOT of starting event comes out to be zero. Hence, EOT and LOT of first and last events are always the same.
- 6. Mark all the events with same EOT and LOT. Try to draw a path or paths from starting event to last event connecting all events with same EOT and LOT. There will be at least one path. This is the critical path. Note that dummy activity has zero time, but should be considered in forward as well as backward pass.

It can be noted that EOT of event (1) is zero.

Activity	Precedence activity	Duration (days)
a	-	8
b	-	9
c	a	9
d	a, b	4
e	a	6
f	c	5
g	c, d, e	7

For EOT (2) = EOT (1) + Duration of activity (a).

For event (3), $EOT(3) = \text{Max. } \{[EOT(1) + \text{Duration}(b)], [EOT(2) + 0]\}$

That is, $EOT(3) = \text{Max } \{(0 - 9), (8 + 0)\} = 9$

When we reach the last event (6), $EOT(6) = 24$ which is the project duration.

Now compute the LOT, starting with last event with $LOT(6) = EOT(6) = 24$

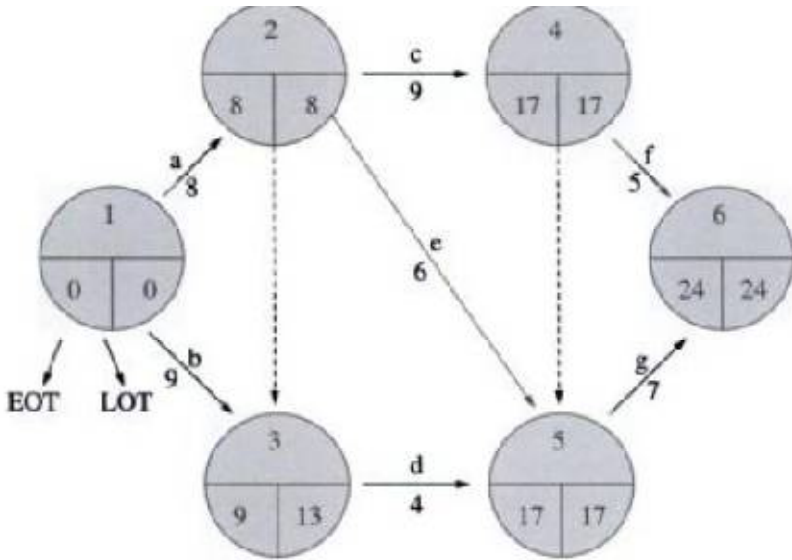


Figure: 1.2 Solution to Example-10.6

$$\text{LOT (5)} = \text{LOT (6)} - \text{Duration (g)} = 24 - 7 = 17$$

$$\text{LOT (4)} = \text{Min} [\{\text{LOT (6)} - \text{Duration (f)}\}, \{\text{LOT (5)} - 0\}] = \text{Min.} \{(24 - 5), (17 - 0)\} = 17$$

We carry on and reach event (1) with LOT = 0

We mark all the events with equal EOT an LOT, these are events (1, 2, 4, 5, 7).

And the critical path is the path joining all these events (1-2-4-5-7) or (a-c-g).

Dummy can be a part of critical path.

We can verify the result by adding the duration of all critical activities,

$$8 + 9 + 7 = 24 \text{ days, that is the EOT of last event.}$$

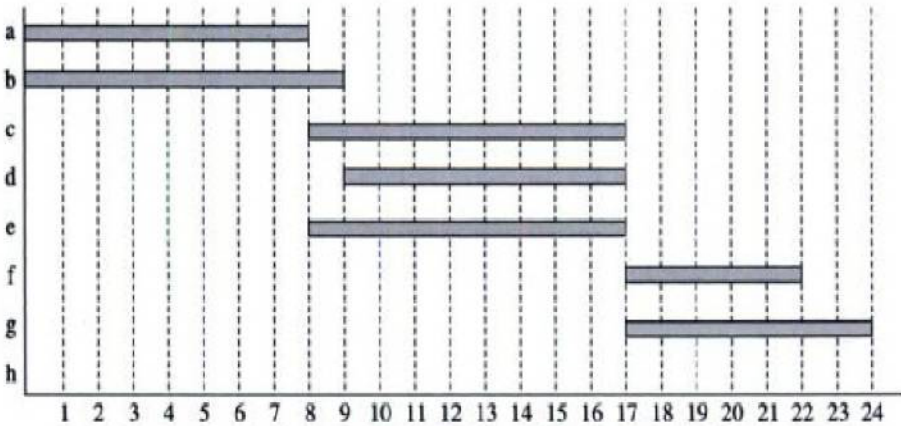


Figure: 1.13 Gantt chart for Example-6.

We can also construct Gantt chart for the network as shown in below figure.

1.8 Slacks, Floats and their applications

Slack is the maximum delay possible for an event without affecting its overall duration.

$$\text{Slack } (i) = \text{LOT}_i - \text{EOT}_i$$

In Example below, Slack (1) = 0 – 0 = 0 and Slack (2) = 13 – 9 = 4

Floats for activities are the same as slacks are for events. So, we can define float as maximum delays possible for an activity without changing the project duration.

There are three types of floats.

1. **Total float:** It is the maximum delay possible for an activity without causing any delay in its precedence or succeeding activity.
2. **Free float:** It is the maximum delay possible for activities which will not affect the float of the successor activity.

3. **Independent float:** It is the maximum delay possible for an activity with used floats of preceding activities and will not affect the floats of succeeding activities.

$$\text{Total float } (i, j) = \text{LOT}_j - \text{EOT}_i - d(i, j)$$

$$\text{Free float } (i, j) = \text{EOT}_j - \text{EOT}_i - d(i, j)$$

$$\text{Independent float } (i, j) = \text{EOT}_j - \text{LOT}_i - d(i, j)$$

The characteristics of float are:

$$\text{Independent float} \leq \text{Free float} \leq \text{Total float}$$

Only independent float can be negative, the rest two floats are always positive or zero.

Activities with all floats = 0, are critical activities.

The applications of floats are as follows:

1. It identifies the critical activities as well as quantify maximum delays possible for all non-critical activities.
2. It is very important in crashing of a network (reducing the time and/or cost of overall project).
3. It helps in resource allocation and smoothing

Economic and Social Cost Benefit Analysis

Components

On completing this unit you will be able to understand

- The meaning of social cost benefit analysis
- Various types of social costs involved in project management
- Various types of social benefits involved in project management

A bridge constructed on a river may incur its construction cost and maintenance cost as recurring cost and earn revenues from the toll tax. These are financial gains or losses. But there can be many other economic gains or losses like it provides employment to workers during the construction (benefit); save fuel or

foreign exchange as it cuts short the distance (benefit); may cause unemployment to the people operating ferry (cost); may increase pollution in the area (cost); few farmers may lose their field or even the houses for the sake of bridge and the connecting roads (cost). All this is considered in Social Cost Benefit Analysis (SCBA).

Social Cost Benefit Analysis

SCBA can be defined as the systematic evaluation of a concern's social performance as distinguished from its economic performance. It considers all such activities which have a social or macro economic impact. The technique of SCBA was developed by a French Engineer named Jules Dupuit in 1844. During the early stages of the 20th century, Professor A.C. Pigou, while working on welfare economics, pointed out the distinction between financial cost and benefit as against social cost and benefits. He said, "A project which may yield profit in monetary terms may not bring corresponding benefits to the society." Its practical application started in 1930 onwards. United States Government used it to analyze flood control measures in 1936.

For example, let us compare two projects, one producing cigarettes and another producing clothes. Financial gains are more in manufacturing cigarettes as per cost benefit analysis and various approaches used in capital budgeting. But it has just considered a very narrow aspect, monetary aspect, for the organization, but has it considered the effect of the products? Cigarette industry has wider effects other than monetary gains for the organization like increase in lungs or heart disease in the country, which may cost it too high. That cost is not considered while making the cost benefit analysis. Social cost benefit analysis uses broader parameters such as its impact on society and nation together with the monetary gains.

2.2. Social Costs

If any activity leads to depletion of a certain resource, it is a social cost. For example, a certain project like road quadrilateral project of the Central Government is using cement and that cement could have alternatively been used for the construction of homeless. It is a social cost. But if it is not leading to any decrease in the availability of cement for the construction of houses, it will not be a social cost.

Let us enumerate various types of social costs:

- **Environmental damage:** If any project disturbs the environment like cutting of trees or creating any type of pollution by emitting solid or liquid wasters, it is a social cost. It may be direct or indirect. An example of direct cost is the emission from the industry and indirect can be through the vehicles used in transportation of goods.
- **Ecological imbalance:** Many projects lead to ecological imbalance such as over usage of natural resources like cutting of forests may lead to decrease in availability of habitat for many creatures. Over usage of water may lead to shortage of water. Satellite townships developed in many big cities have caused huge ecological imbalance and people are going to face problems of acute water shortage, and creatures like birds will become extinct in the area.
- **Human services used:** Manpower used in a project during implementation or during the operations might have been utilized for some other work. Thus, it is social cost (opportunity cost). Moreover, the project may lead to illness or injuries related to the work. It may also cause occupational diseases which are social costs.
- **Material used:** Materials used in the project might have been used at some other application. Thus, it is a social cost.

- **Usage of public utility:** The project may use some public utility services like safety (police) or fire fighting, etc. It is also a social cost component.
- **Unemployment caused:** Many industries are creating problems of unemployment. Mechanization in agriculture may displace labour and their livelihood. A bridge over a river may cause unemployment for the people earning their bread through ferry services. A big industry kills many cottage or small scale industries and hence creates unemployment.
- **Depletion of energy and global warming:** Energy is a major concern in the present world. Any new organization or industry utilizes energy and thus reduces the availability of various sources of energy. The world is facing problem of energy shortage because of over usage of energy by big organizations. Over consumption of energy is leading to saturation of carbon dioxide which leads to global warming.
- **Usage of foreign exchange:** Some industries apply foreign exchange reserve of the country to procure resources like equipment or technology. This leads to decrease in foreign exchange reserve and it is a cost to the whole nation.
- **Subsidies:** Various types of subsidies like fertilizer subsidy, power subsidy or tax subsidy are again a cost to the nation, which is indirect cost to society as well.
- There are several other costs which can be identified for individual projects like increase in economic disparity, cost of soil erosion, deforestation etc.

2.3. Social Benefits

It is not that projects are only causing cost to society; they are also providing benefits to society.

Let us enumerate a few types of social benefits that a project can yield:

☐☐ **Improve environment:** Projects planned to plant trees, clean water and improve

energy utilization may lead to benefit to society.

□□**Products and services provided:** Projects provide many products and services to the society which improve the quality of life. A hospital, an educational institute or pharmaceutical products add to the quality of life to the society. This is an advantage for the society. A river bridge project may connect an isolated society to the rest of the society. This is again an example of social advantage.

□□**Employment creation:** New projects generally provide better chances of employment for the society. Agro based projects in the city attract many unemployed people from the rural areas and help them in improving their quality of life.

□□**Taxes:** Tax and excise payments made by projects during implementation and majorly after implementation are collected by government and are utilized for the benefit of the society. This is a major advantage to the society.

□□**Indirect employment:** Projects always raise opportunities of indirect employment. Transporters, food and other suppliers in the area flourish as an outcome of a project in the area. The small village and the villagers of Pithampur near Indore have flourished and got huge opportunities to earn through business of either transportation or supplies to the directly employed workers or the industries developed in the area.

□□**Earning foreign exchange:** Some projects earn foreign exchange through exports; others save the same through reducing imports. In both ways, they are adding to current account of foreign exchange reserve of the nation, thus, causing benefit to the nation and the society.

□□**Hospital and educational facility:** Many projects which are not directly involved in the development of educational or medical facilities develop the same for the benefit of the workers which are also used by the people in the vicinity.

□□ **Development of backward area:** Government provides various incentives to the projects which are located in backward areas. Industrialists are attracted by those incentives and set up their projects in the backward area. This leads to the uplift of backward areas and hence brings in better social equality.

There are many other advantages attached with individual projects such as decrease of class system, religious unity, decrease in poverty, etc. which all can be accounted as advantage or benefits to the society.

Human Aspects in Project Management

Components

On completing this unit the reader would

- Understand the various roles played by the project manager as a decision maker.
Entrepreneur, change agent, motivator etc.
- Know about the various traits of project manager in which human skills such as leadership, negotiation, versatility, time management, etc.
- Understand the hard skills of the project manager such as financial skills, risk management, etc.
- Explain the meaning and concept of change management and how best to reduce the negative impact of any change in the society.

3.1. Roles of the Project Manager

The project manager acts like the captain of a ship who has all authorities and is responsible for making the ship reach the shore safely in time or the project completed with its all scope in proper time and within the cost limits. His role is integrating various resources (including material, equipment and people) to attain the objective(s).

The project manager has to play various roles during his tenure. The roles of a project manager are:

- **Entrepreneur:** The project manager may not be the owner or entrepreneur himself, but has to play the role of an entrepreneur. He is responsible for procurement of funds, facilities and people for the project. He is accountable for failure and wins all credits in the situation of success. The success of any project majorly depends upon this entrepreneur.
- **Decision maker:** The project manager is the responsible for the allocation of resources, defining project scope, managing the cost and schedules as per the plans. He is controlling the project to retain the project schedules and costs and decrease the sources of deviations.
- **Communicator:** The project manager is the central point of all communications in a project. He acts like a communication hub or a server. He collects various information and processes them. He is also responsible for communicating the methods, targets to various members of the project team. He also heads the review meetings.
- **Change agents:** The project manager brings about the changes and attempts to reduce the opposing forces developed due to change process. All changes bring in oppositional forces and they are very high especially in projects as they are generally aimed at radical changes. Eg: Introducing Bt crops
- **Motivator:** No expedition is completed successfully without committed and motivated crew members. The captain of the ship or project manager is responsible to create motivation level of his team members and maintain it through ups and downs. A project also goes through situations when it is as dark as blue moon and no success is visualized. There are the times when the project manager's major role is to bring back the confidence of the team

members in the project. He should maintain the enthusiasm and excitement of his teams. There

- are basically two types of motivation:
- That stimulates people for doing work
- That refrain the workforce from fatigue
- Motivation in project management can be brought up by
- Making them feel meaningful for the project
- Making them feel that it will be helpful in boosting their career
- Not allowing them getting confused or insecure
- Removing misbalance between perceived and received rewards.
- **Foresighted and fire fighter:** Risk is an inherent characteristic of any project. The successful project manager foresees the risk or variations and plans the route to face the possible deviations. In the situations when the unexpected is not seen and it occurs, then the project manager leads the team to face the problem like fire fighter. For example, the project manager should forecast an increase in prices of steel which is going to be there for a short span of time and accumulate the steel in advance. But if due to transport strike or some other reason, a shortage of steel occurs, then he should plan it so that the project schedule does not suffer because of the strike. He may opt for either acquiring steel from other place or project and if that is not possible, he should replant the work schedule and complete the other remaining work without steel for the period when strike is there.

3.2. Traits of Project Manager

Human Skills or Soft Skills

- **Leadership:** The project manager should be a leader instead of being a typical manager. He should be problem solver for his team and make his team feel that they have to work for him and make him successful.
- **Influencing:** A project manager should not just be influencing his team but he should be able to influence the project owners or top management. This can help him get the required resources and support for the project in a timely manner.
- **Decision making skills:** It is one of the most important skills expected of a manager. But it becomes a crucial skill for a project manager. This is because the teams and proper supportive decision makers are not generally available during project implementation and he has to take various decisions himself. A functional manager is always helped by other functional managers or experts but a project manager may not be able to get such skillfull hands for his support in decision making process.
- **Alertness and quickness:** The project manager has to respond to problems and take fast decisions. He should be well aware about the environment as it affects the progress and effectivity of the project.
- **Communicator:** The project manager has to deal with many categories of people.
- It includes the project owners, the subordinate teams, the subcontractors and vendors. He needs multicomunication skills to deal with all of them simultaneously. He should set proper channels for communications and frequency of communications with various agencies.
- **Negotiating skills:** A project comprises purchasing of various equipment and contracting with many contractors and subcontractors. A project manager should possess good negotiation skills to deal with all of them.

- **Training:** Project team may or may not possess experienced staff members, the project manager has to play the role of a trainer for his team members. This also helps himself to become a leader of heart for the project team members.
- **Time management skills:** Schedule is a major success parameter of any project.
- Time management becomes a crucial activity in project management. The project manager should possess skills to manage the time.
- **Flexibility and versatility:** Project management cannot be completed with rigid structures and sticking religiously to the principles. A project manager should have quality of versatility and flexibility depending on the situation.
- **Presentation skills:** A project manager's first job is to get the project appraised and funded by the project manager. He should have skills to present the project to get it appraised by the project owners and funding agencies.
- **Resourcefulness and creativity:** A project needs variety of resources during its implementation. The project may be planned to perfection, but there are still chances of unavoidable uncertainties. The project manager needs to apply his creativity to solve out the problem of inadequate resources or be resourceful to manage the gap between planning and execution.
- **Act like cheer leader:** The project manager should not be a miser in applauding or appreciating success of his team members and keep them cheerful and feel rewarded for the smallest of the successes.
- **Les bons comptes font les bons amis:** This is a French saying, which means good accounts always lead to good friends. The project manager although seats at the apex of the project organization, he should maintain good accounts and should understand his shortcomings and mistakes. He should be willing to learn from mistakes as learning from smaller mistakes avoids big mistakes and leads to long-term success.

Hard Skills

- The project manager does have support from technical experts, but he should also have technical skills up to some extent to be able to solve problems in project implementation. He should be able to at least follow the advice of his technical staff managers.
- **Financial skills:** Cost is a major success criterion of any project. Basic knowledge of Finance and financial transaction is an essential skill required in any project manager.
- **Risk management skills:** Project management is full of risks and uncertainty.

Uncertainty always leads to huge costs. The project manager should possess skill to anticipate the upcoming deviation and uncertainty as a diagnosed problem is half cured itself. Any diagnosed deviation with respect to any of the objective of the project like time, cost or scope can lead to corrective actions and keep project safe from risk or at least minimize its impact on the project. He should also have the ability to rapid planning as situations of fire fighting may arise due to unforeseen happening in the environment.

- **Generalist:** The project manager should be a generalist with the knowledge of various fields rather than specialized in one particular sector. Very high level technocrats may not be very good at project management as they may be specialized in their fields but may lack knowledge about various other fields.

3.3. Change Management

The success rate of all significant change initiatives is just 30%. Projects bring about big or radical changes and they are difficult to be absorbed by the people concerned.

Newton's first law of motion (there is always inertial offered to any change of state) is applicable to human behavior. It is a big task of any project manager to bring about the change and make it acceptable by the people concerned.

Managers, especially project managers, always face big challenge offered by various people, including all stakeholders, due to change. Following steps should be taken to reduce the negative effects of change:

- **Proactive communication:** The people or stakeholders who would be affected by the project should be informed and taken in confidence. It should be conveyed in such a manner that the project's result becomes the wish of the stakeholders and they start seeking for the change. They should be well informed about the benefits of the change which are brought in. Instead of declaring the project, an environment should be built where stakeholders ask for the project implementation.
- **Encourage middle level management:** Middle level managers can play an important role in reducing resistance change. They are in direct association and regularly in touch with other two levels of management. They should be communicated the results of the projects and support should be asked from them.
- **Avoid over communications:** Sometimes, over communication also leads to increased resistance to change. Grapevine communications should not be motivated during change management as it often results in greater resistance.
- **Make the change process gradual:** The change process should be gradual and slowed down to reduce the negative effects. Let it be absorbed by the concerned people. It is always difficult to digest a different food early, so let it be a slow process.

It should be understood that perception is a major cause of resistance. Let the change be conducted in more harmonious climate where perception or expectation of stakeholders is positive with respect to the outcomes of the project.

Project Termination

Components

This unit makes the reader to understand

- The reasons for termination of any project before their completion like poor market success, technical failure, low profitability etc.
- The concept and definition of project completion audit and its different types
- The specific reasons for failure of the projects related to planning, leadership, etc.
- The steps for successful implementation of project.

Every project has a fixed tenure. Every project always passes through the stage of termination. Sometimes, termination is after the success of the project or sometimes it has to be terminated before it attains its objectives. The termination process rarely affects the success or failure of the project itself, but it has a long lasting effect on attitude towards the project and success of subsequent projects. Why are projects terminated before their completion?

4.1. Reasons for pre-completion termination of any project.

Low chance of technical or marketing success as per reanalysis: During the Project implementation, high risk may be foreseen in technical or marketing success of the project. In such situation, project may get terminated before its completion.

Low profitability or returns as per expectation: While analyzing during the implementation, the top management feels that the expected returns of the project are not as per their expectation. Then, in a such scenario, they may be forced to drop the project.

- **Delay in schedule of implementation:** Sometime due to delay in implementation team is sometimes not able to find out solution to some

technical problem and it leads to failure of the project or closure of the project before it takes the final shape.

- **Change in market conditions or increased competition:** Market forces are changing very fast. There may be introduction of some substitution product during the implementation, which may lead to make the product of the project unattractive. Or sometimes, too many projects are seen in the pipeline and therefore decided to discontinue the project due to probable intense competition.
- **Changes in economic conditions:** World economic scenario is dynamic. Economic aspects like interest rates, purchasing power, government policy, etc. are changing. During the project implementation, changes in economic conditions may force the top management to drop down a project under implementation.
- **Top management plans for some better investment opportunity:** The top management may get a more lucrative investment opportunity and they may plan to skip the undergoing project and redirect the resources for the new and more lucrative project.

4.2 Project Completion Audit

Audit is generally defined as an unbiased examination and evaluation of the process, documents or statements of an organization. It can be done internally (by employees of the organization) or externally (by an outside firm)'. Project audit is assessing the actual profile of a project completed to what was desired and planned.

Project Completion Audit (PCA) is defined as evaluation of the project after its termination. Different types of PCA are:

- **Financial audit:** Every project has some financial projections made during the planning an appraisal phase. Financial audit compares the projections with the

actual.

- **Technical audit:** This audit throws light on the other objectives of the project, that is, quality and scope. The actual quality attained in product and services and the planned quality is compared in this audit.
- **Schedule audit:** Time is another important objective of any project. A delayed project may lead to a huge loss in the form of opportunity cost or unsatisfied customer. Schedule audit aims at comparison of actual time of completion of a project as compared to projected time.
- **Social audit:** This type of audit is generally applicable to either public sector undertakings or government projects. It tries to determine the social cost incurred to what was projected.

4.3 Reasons for Failure of Projects

Many of the projects fail and result either in closure before completion or create problems after completion. There are various reasons for the failure of any project.

4.3.1 Reasons Related to Planning

There are several types of mistakes done at the planning stage which lead to failure of any project. An underestimated cost can lead to shortfall in cash flows and may lead to delay in the project which, in turn, leads to project failure. Some of the major mistakes done at the planning stage can lead to problems in project implementation and also can lead to project failure.

- Underdefined or poorly defined scope or objectives
- Underestimation of time and cost
- Large project planning
- Selection of improper technology
- Defective process planning

4.3.2 Reasons Related to Leadership

- Unclear role and responsibility
- Fearful environment
- Ignoring reality
- Inadequate monitoring and control
- Inadequate communication
- Inadequate tracking
- Inadequate frequency of reporting

4.3.3 Other Reasons

- Improper change management
- Ignorance of social aspects

4.4 Steps for Project Success

- Rationalize the size of the project with regard to organizational capabilities
- Greater flexibility
- Reduced risk
- Chance of learning
- Earlier revenue generation
- Improved motivation
- Easier change management
- Better control
- Continuity of team
- Plan open-heartedly
- Execute cost effectively

are seen as effective methods of gaining the customer's attention and holding consumer loyalty. A somewhat discriminating public is thus part of the equation. In an environment where only price matters and consumers meekly put up with the

successive removal of services or features in order to get products as cheaply as possible, the strategy will be less successful. Not surprisingly, in the auto sector, where the investment is large and failure can be very costly, the Japanese have made great gains in market share; but trends in other sectors—in retailing, for instance, where labor is imposed on customers through self-service stratagems—a quality orientation seems less obviously rewarding.

For these reasons, the small business looking at an approach to business ideal for its own environment may well adapt TQM if it can see that its clientele will reward this approach. The technique can be applied in service and retail settings as readily as in manufacturing, although measurement of quality will be achieved differently. TQM may, indeed, be a good way for a small business, surrounded by "Big Box" outlets, to reach precisely that small segment of the consuming public that, like the business itself, appreciates a high level of service and high quality products delivered at the most reasonable prices possible.

References:

1. Project Management – R. Panneerselvam and P. Senthil Kumar, PHI Learning Pvt., Ltd., New Delhi, 2010.
2. Project Management – Rajeev M. Gupta, PHI Learning Pvt., Ltd., New Delhi, 2011.
3. Project Management – R.K. Sapru, Excel Books, New Delhi, 2007.
4. Project Management – Chander P. Tata McGraw Hill, New Delhi, 2005.
5. Project Management – Gopal Krishna P and Nagarajan K, New Age Publishers, 2005.