

# **Lesson 1**

## **MEANING, NATURE AND IMPORTANCE OF PROJECT**

### **STRUCTURE**

- 1.0 Objective
- 1.1 Introduction
- 1.2 Concept of project and project management
- 1.3 Characteristics of project
- 1.4 Project Family tree
- 1.5 Classification of Project
- 1.6 Project selection process
- 1.7 Project life cycle
- 1.8 Project report
- 1.9 Project appraisal
- 1.10 Tools and techniques for project management
- 1.11 Project manager's roles and responsibilities
- 1.12 Summary
- 1.13 Keywords
- 1.14 Self assessment questions
- 1.15 Suggested readings.

### **1.0 OBJECTIVE**

After reading this lesson, you should be able to

- a) Define the project and explain the nature and classification of project.
- b) Understand the concepts of idea generation, project life cycle and project management.

## **1.1 INTRODUCTION**

Projects have a major role to play in the economic development of a country. Since the introduction of planning in our economy, we have been investing large amount of money in projects related to industry, minerals, power, transportation, irrigation, education etc. with a view to improve the socio-economic conditions of the people. These projects are designed with the aim of efficient management, earning adequate return to provide for future development with their own resources. But experience shows that there are several shortcomings in the ultimate success of achieving the objectives of the proposed project.

## **1.2 CONCEPT OF PROJECT AND PROJECT MANAGEMENT**

The term project has a wider meaning. A project is accomplished by performing a set of activities. For example, construction of a house is a project. The construction of a house consists of many activities like digging of foundation pits, construction of foundation, construction of walls, construction of roof, fixing of doors and windows, fixing of sanitary fitting, wiring etc. Another aspect of project is the non-routine nature of activities. Each project is unique in the sense that the activities of a project are unique and non routine. A project consumes resources. The resources required for completing a project are men, material, money and time. Thus, we can define a project as an organized programme of pre determined group of activities that are non-routine in nature and that must be completed using the available resources within the given time limit.

Let us now consider some definitions of 'project'. Newman et. al define that "a project typically has a distinct mission that it is designed to achieve and a clear termination point the achievement of the mission".

Gillinger defines "project" as the whole complex of activities involved in using resources to gain benefits. Project management institute, USA defined project as "a system involving the co-ordination of a number of separate department entities throughout organization, in a way it must be completed with prescribed schedules and time constraints".

According to the encyclopedia of management, “project is an organized unit dedicated to the attainment of goal, the successful completion of a development project on time, within budget, in conformance with predetermined programme specification.”

Though project management is in the process of getting evolved as a separate branch of study, projects are not new to the earth. One of the seven wonders of the world, the pyramids date back to 2650 B.C. which stand as the hall mark of Egyptian civilization. The period of construction of the Taj Mahal, another wonder of the world is reported to be during 1626-1648 A.D. It is reported that about 20,000 persons worked for nearly 22 years to complete this spectacular structure, which stands today as mankind’s proudest creation. One can imagine the extent of resources and expertise that would have been put forth for the completion of such magnificent projects.

Project management is an organised venture for managing projects, involves scientific application of modern tools and techniques in planning, financing, implementing, monitoring, controlling and coordinating unique activities or task produce desirable outputs in accordance with the determined objectives with in the constraints of time and cost.

### **1.3 CHARACTERISTICS OF PROJECT**

- (1) **Objectives** : A project has a set of objectives or a mission. Once the objectives are achieved the project is treated as completed.
- (2) **Life cycle** : A project has a life cycle. The life cycle consists of five stages i.e. conception stage, definition stage, planning & organising stage, implementation stage and commissioning stage.
- (3) **Uniqueness** : Every project is unique and no two projects are similar. Setting up a cement plant and construction of a highway are two different projects having unique features.
- (4) **Team Work** : Project is a team work and it normally consists of diverse areas. There will be personnel specialized in their respective areas and co-ordination among the diverse areas calls for team work.
- (5) **Complexity** : A project is a complex set of activities relating to diverse areas.
- (6) **Risk and uncertainty** : Risk and uncertainty go hand in hand with project. A risk-free, it only means that the element is not apparently visible on the surface and it will be hidden underneath.

- (7) **Customer specific nature** : A project is always customer specific. It is the customer who decides upon the product to be produced or services to be offered and hence it is the responsibility of any organization to go for projects/services that are suited to customer needs.
- (8) **Change** : Changes occur through out the life span of a project as a natural outcome of many environmental factors. The changes may vary from minor changes, which may have very little impact on the project, to major changes which may have a big impact or even may change the very nature of the project.
- (9) **Optimality** : A project is always aimed at optimum utilization of resources for the overall development of the economy.
- (10) **Sub-contracting** : A high level of work in a project is done through contractors. The more the complexity of the project, the more will be the extent of contracting.
- (11) **Unity in diversity** : A project is a complex set of thousands of varieties. The varieties are in terms of technology, equipment and materials, machinery and people, work, culture and others.

#### 1.4 PROJECT FAMILY TREE

A project normally originates from a plan, national plan or corporate plan. In normal scheme of things, the family tree for a project would be as given below

Plan = National/Corporate plan with target for growth.



Programme = health programme, educational programme, R&D programme.



Project = Power plant, hospital, housing project etc.



Work Package = Water supply, power supply and distribution package.



Task = Award of water supply contract, construction & foundation.

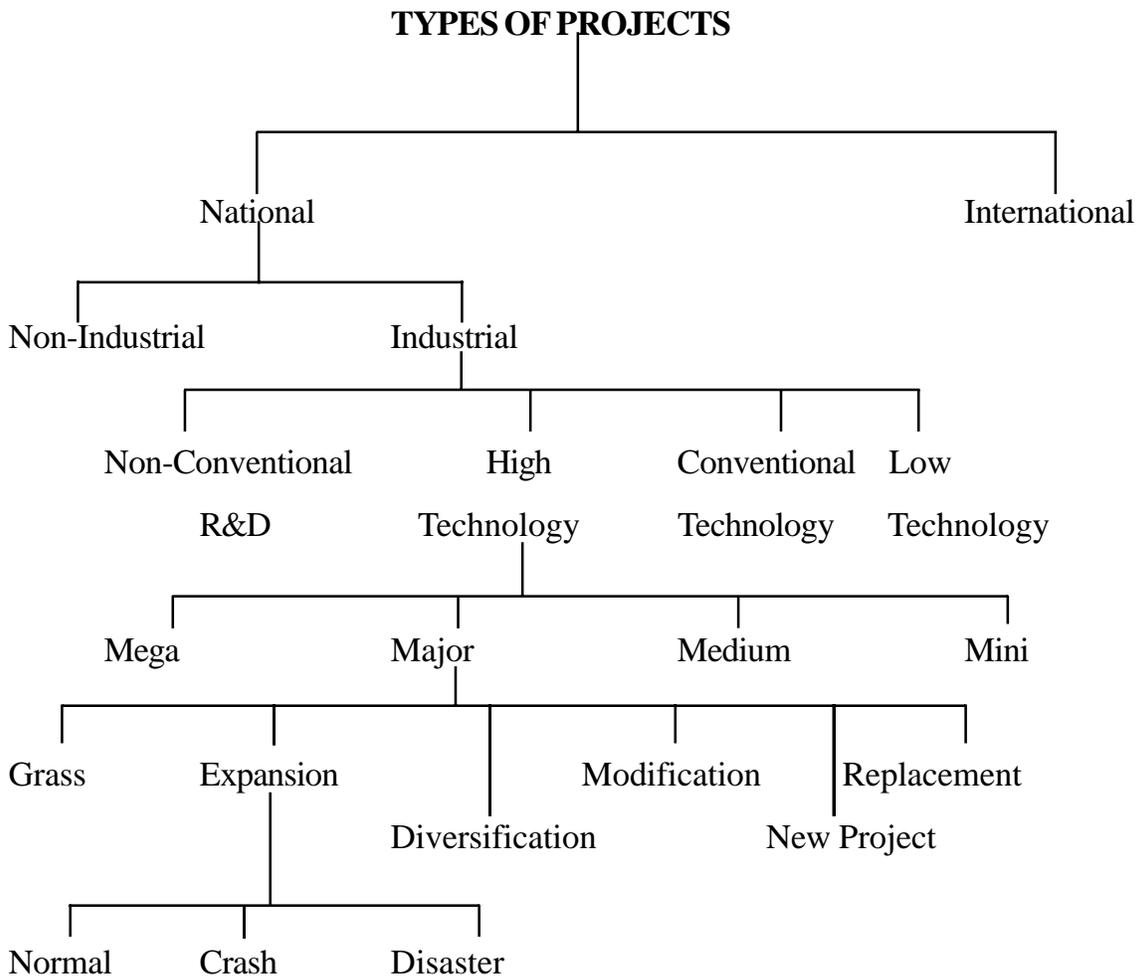


Activity = Excavation, laying of cable, preparation of drawing.

**Fig. 1.1 Project Family Tree**

## 1.5 CLASSIFICATION OF PROJECTS

The location, type, technology, size, scope and speed are normally the factors which determine the effort needed in executing a project. Project can be classified under different heads, some of which are shown in figure 1.2.



**Fig. 1.2 Classification of Project**

## 1.6 PROJECT SELECTION PROCESS

Identification of a new project is a complex problem. Project selection process starts with the generation of project ideas. In order to select the most promising project, the entrepreneur needs to generate a few ideas about the possible project one can

undertake. The project ideas as a process of identification of a project begins with an analytical survey of the economy (also known as pre-investment surveys). The surveys and studies will give us ideas. The process of project selection consists of following stages :

- Idea generation
- Environment appraisal.
- Corporate appraisal
- Scouting for project ideas.
- Preliminary screening.
- Project rating index
- Sources of positive Net Present Value.
- Entrepreneur qualities.

**Idea Generation** :- Project selection process starts with the generation of a project idea. Ideas are based on technological breakthroughs and most of the project ideas are variants of present products or services. To stimulate the flow of ideas, the following are helpful:

**SWOT Analysis** :- SWOT is an acronym for strengths, weaknesses, opportunities and threats. SWOT analysis represents conscious, deliberate and systematic effort by an organisation to identify opportunities that can be profitably exploited by it. Periodic SWOT analysis facilitates the generation of ideas.

Operational objectives of a firm may be one or more of the following.

- Cost reduction.
- Productivity improvement.
- Increase in capacity utilisation.
- Improvement in contribution margin.

**Fostering a conducive climate :-** To tap the creativity of people and to harness their entrepreneurial skills, a conducive organisation climate has to be fostered. Two conspicuous examples of organisation which have been exceptionally successful in tapping the creativity of employees are the Bell Telephone Laboratory and the 3M Corporation. While the former has succeeded in harnessing creativity by providing an unconstrained environment, the latter has effectively nurtured the entrepreneurial skills of its employees as sources of idea generation. The project ideas can be generated from various internal and external sources. These are :-

- Knowledge of market, products, and services.
- Knowledge of potential customer choice.
- Emerging trends in demand for particular product.
- Scope for producing substitute product.
- Market survey & research.
- Going through Professional magazines.
- Making visits to trade and exhibitions.
- Government guidelines & policy.
- Ideas given by the experienced person.
- Ideas by own experience.
- SWOT analysis.

**Environment appraisal :-** An entrepreneur or a firm systematically appraise the environment and assess its competitive abilities. For the purposes of monitoring, the business environment may be divided into six broad sectors as shown in fig. no. 1.3. The key elements of the environment are as follow :

**Economic Sector**

- State of the economy
- Overall rate of growth

- Cyclical fluctuations
- Inflation rate
- Growth rate of primary, secondary and tertiary sector
- Growth rate of world economy
- Trade surplus and deficits
- Balance of Payment

### **Government Sector**

- Industrial policy
- Government programmes and projects
- Tax structure
- EXIM policy
- Financing norms
- Subsidies incentives and concessions
- Monetary policy

### **Technological Sector**

- Emergence of new technologies
- Access to technical know-how, foreign as well as indigenous

### **Socio-demographic Sector**

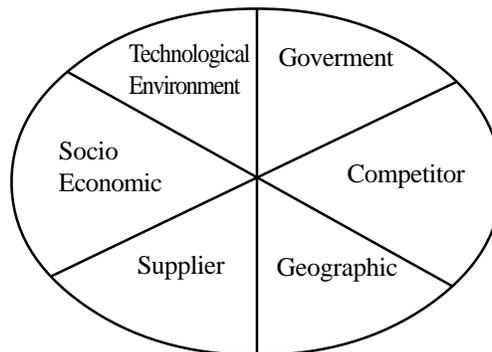
- Population trends
- Age shifts in population
- Income distribution
- Educational profile
- Employment of women
- Attitudes toward consumption and investment

### **Competition Sector**

- Number of firms in the industry and the market share of the top few
- Degree of homogeneity and differentiation among the products
- Entry barrier
- Comparison with substitutes in term of quality and price
- Marketing polices and practices

### **Supplier Sector**

- Availability and cost of raw material
- Availability and cost of energy
- Availability and cost of capital



**Fig. 1.3 Business Environment**

**Corporate Appraisal :-** A realistic appraisal of corporate strengths and weaknesses is essential for identifying investment opportunities which can be profitably exploited. The broad areas of corporate appraisal and the important aspects to be considered under them are as follow :

### **Marketing and Distribution**

- Market Image
- Product Line

- Product Mix
- Distribution Channels
- Customer loyalty
- Marketing & distribution costs

### **Production and Operations**

- Condition and capacity of plant and machinery
- Availability of raw material and power
- Degree of vertical integration
- Locational advantage
- Cost structure

### **Research and Development**

- Research capabilities of the firm
- Track record of new product developments
- Laboratories and testing facilities
- Coordination between research and operations

### **Corporate Resources and Personnel**

- Corporate image
- Dynamism of top management
- Relation with government and regulatory agencies
- State of industry relations

### **Finance and Accounting**

- **Financial leverage and borrowing capacity**
- Cost of capital
- Tax structure

- Relation with share holders and creditors
- Accounting & control system
- Cash flow and liquidity

## **1.7 PROJECT LIFE CYCLE**

A project is not a one shot activity. Even a shooting star has a time and life span. Project lifecycle is spread over a period of time. There is an unavoidable gestation period for the complex of activities involved to attain the objectives in view. This gestation period, however, varies from project to project but it is possible to describe, in general term, the time phasing of project planning activities common to most projects. The principal stages in the life of a project are :

- Identification
- Initial formulation
- Evaluation (selection or rejection)
- Final formulation (or selection)
- Implementation
- Completion and operation

Development projects are expressly designed to solve the varied problems of the economics whether in the short or long run. The surveys or in depth studies would locate the problems and the project planner will have to identify the projects that would solve the problems most effectively. At this stage, we are concerned with the kind of action and type of project that would be required in rather broad term. In other words the surveys and studies will give us ideas and throw up suggestions which would be worked out in detail later and then evaluated objectively before being accepted for implementation.

What types of surveys and studies are to be undertaken? The current socio-political economic situation has to be critically assessed. It will also be necessary to review it in its historical perspective necessitating the undertaking of a survey of the

behaviour and growth of the economy during the preceding decades. On the basis of past trends, extrapolation may be made of future possible trends and tendencies, short and long term. There are scientific techniques for doing so which can be broadly grouped as forecasting methodology. It is however not sufficient to view the socio-economic panorama on the historical canvas. More detailed investigations from an operational point of view would be called for in respect of each economic sector.

**Initial Formulation :-** Identification is only the beginning in the lifecycle of a project. Having identified the prospective projects, the details of each project will have to be worked out and analysed in order to determine which of them could be reckoned as suitable for inclusion in the plan, allocate funds and put into execution. As a follow up to the finding of techno-economic surveys, and number of feasibility study group are set up, as the name implies to examine the possibility of formulating suitable projects and to put concrete proposals in sufficient detail to enable authorities concerned to consider the feasibility of the proposal submitted.

**Evaluation or Project Appraisal :-** After the socio-economic problems of an economy have been determined and developments objectives and strategies agreed, concrete steps have to be taken. The main form this takes is that of formulating appropriate development projects to achieve plan objectives and meet the development needs of the economy. Proposals relating to them are then put to the plan authorities for consideration and inclusion in the plan. These proposals as pointed out above take the following forms of feasibility studies :

- Commercial viability
- Economic feasibility
- Financial feasibility
- Technical feasibility
- Management

The scope for scrutiny under each of these five heads would necessarily render their careful assessment and the examination of all possible alternative approaches.

The process almost invariably involves making decision relating to technology, scale, location, costs and benefits, time of completion (gestation period), degree of risk and uncertainty, financial viability, organisation and management, availability of inputs, know-how, labour etc. The detailed analysis is set down in what is called a **feasibility report**.

**Formulation :-** Once a project has been appraised and approved, next step would logically, appear to that of implementation. This is, however, not necessarily true, if the approval is conditional to certain modifications being affected or for other reasons, such as availability of funds, etc. The implementation stage will be reached only after these pre-conditions have been fulfilled. Project formulation divides the process of project development into eight distinct and sequential stages. These stages are

- General information
- Project description
- Market potential
- Capital costs and sources of finance
- Assessment of working capital requirement
- Other financial aspect
- Economic and social variables.

**Project Implementation :-** Last but not the least, every entrepreneur should draw an implementation time table for his project. The network having been prepared, the project authorities are now ready to embark on the main task of implementation the project. To begin with successful implementation will depend on how well the network has been designed. However, during the course of implementation, many factors arise which cannot be anticipated or adequately taken note of in advance and built into the initial network. A number of network techniques have been developed for project implementation. Some of them are PERT, CPM, Graphical Evaluation and Review Technique (GERT), Workshop Analysis Scheduling Programme (WRSP) and Line of Balance (LOB).

**Project Completion :-** It is often debated as to the point at which the project life cycle is completed. The cycle is completed only when the development objectives are realized.

## **1.8 PROJECT REPORT**

In simple words project report or business plan is a written statement of what an entrepreneur proposes to take up. It is a kind of course of action what the entrepreneur hopes to achieve in his business and how he is going to achieve it. In other words, project report serves like a road map to reach the destination determined by the entrepreneur.

### **Contents of Project Report**

- General Information
- Promoter
- Location
- Land and Building
- Plant and Machinery
- Production process
- Utilities
- Transport and communication
- Raw material
- Manpower
- Product
- Market

## **1.9 PROJECT APPRAISAL**

Project appraisal means the assessment of a project. Project appraisal is made for both proposed and executed projects. In case of former project appraisal is called ex-ante analysis and in case of latter 'post-ante analysis'. Here, project appraisal is related to a proposed project.

Project appraisal is a cost and benefits analysis of different aspects of proposed project with an objective to adjudge its viability. A project involves employment of scarce resources. An entrepreneur needs to appraise various alternative projects before allocating the scarce resources for the best project. Thus project appraisal helps select the best project among available alternative projects. For appraising a projects its economic, financial, technical market, managerial and social aspect are analysed. Financial institutions carry out project appraisal to assess its creditworthiness before extending finance to a project.

### **Method of Project Appraisal**

Appraisal of a proposed project includes the following analyses :

- 1 Economic analysis
- 2 Financial analysis
- 3 Market analysis
- 4 Technical analysis
- 5 Managerial competence
- 6 Ecological analysis

### **Economic Analysis :**

Under economic analysis the aspects highlighted include

- Requirements for raw material
- Level of capacity utilization
- Anticipated sales
- Anticipated expenses
- Proposed profits
- Estimated demand

It is said that a business should have always a volume of profit clearly in view which will govern other economic variable like sales, purchase, expenses and alike.

## **Financial Analysis**

Finance is one of the most important prerequisites to establish an enterprise. It is finance only that facilitates an entrepreneur to bring together the labour, machines and raw materials to combine them to produce goods. In order to adjudge the financial viability of the project, the following aspects need to be carefully analysed :

- Cost of capital
- Means of finance
- Estimates of sales and production
- Cost of production
- Working capital requirement and its financing
- Estimates of working results
- Break-even point
- Projected cash flow
- Projected balance sheet.

The activity level of an enterprise expressed as capacity utilization needs to be well spelled out. However the enterprise sometimes fails to achieve the targeted level of capacity due to various business vicissitudes like unforeseen shortage of raw material, unexpected disruption in power supply, instability to penetrate the market mechanism etc.

## **Market Analysis**

Before the production actually starts, the entrepreneur needs to anticipate the possible market for the product. He has to anticipate who will be the possible customer for his product and where his product will be sold. This is because production has no value for the producer unless it is sold. In fact, the potential of the market constitutes the determinant of possible reward from entrepreneurial career.

Thus knowing the anticipated market for the product to be produced become an

important element in business plan. The commonly used methods to estimate the demand for a product are as follows. :

### 1 Opinion polling method

In this method, the opinion of the ultimate users. This may be attempted with the help of either a complete survey of all customers or by selecting a few consuming units out of the relevant population.

### 2. Life Cycle Segmentation Analysis

It is well established that like a man, every product has its own life span. In practice, a product sells slowly in the beginning. Barked by sales promotion strategies over period its sales pick up. In the due course of time the peak sale is reached. After that point the sales begins to decline. After sometime, the product loses its demand and dies. This is natural death of a product. Thus, every product passes through its life cycle. The product life cycle has been divided into the following five stage : Introduction, Growth, Maturity, Saturation and Decline.

The sales of the product varies from stage to stage as shown in figure No. 1.4

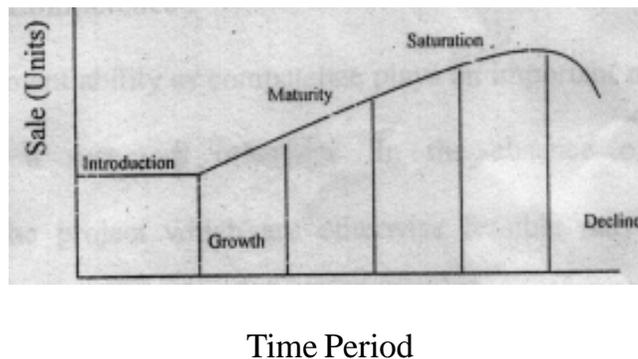


Fig. 1.4 Product Life Cycle

Considering the above five stages of a product life cycle, the sale at different stages can be anticipated.

## **Technical Analysis**

Technical analysis implies the adequacy of the proposed plant and equipment to prescribed norms. It should be ensured whether the required know how is available with the entrepreneur. The following inputs concerned in the project should also be taken into consideration.

- Availability of Land and site
- Availability of Water Power, transport, communication facilities.
- Availability of servicing facilities like machine shop, electric repair shop etc.
- Coping with anti pollution law
- Availability of work force
- Availability of required raw material as per quantity and quality.

## **Management Competence**

Management ability or competence plays an important role in making an enterprise a success. In the absence of Managerial Competence the project which are otherwise feasible may fail. On the contrary, even a poor project may become a successful one with good managerial ability. Hence, while doing project appraisal, the managerial competence or talent of the promoter should be taken into consideration.

## **Ecological Analysis**

In recent years, environmental concerns have assumed great deal of significance. Ecological analysis should also be done particularly for major projects which have significant implication like power plant and irrigation schemes, and environmental pollution industries like bulk-drugs, chemical and leather processing. The key factors considered for ecological analysis are :

- Environmental damage
- Restoration measure

## **1.10 TOOLS AND TECHNIQUES FOR PROJECT MANAGEMENT**

There are several tools and techniques which would contribute significantly towards effective project management these can be broadly grouped under the following heads :

- 1. Project selection techniques**
  - (a) Cost benefit analysis and
  - (b) Risk and sensitivity analysis
- 2. Project execution planning techniques**
  - (a) Work breakdown structure (WBS)
  - (b) project execution plan (PEP)
  - (c) Project responsibility matrix and
  - (d) Project management manual
- 3. Project scheduling and coordinating techniques**
  - (a) Bar charts
  - (b) Life cycle curves
  - (c) Line of balance (LOB) and
  - (d) Networking techniques (PERT/CPM)
- 4. Project monitoring and progressing techniques**
  - (a) Progress measurement technique (PROMPT)
  - (b) Performance monitoring technique (PERMIT) and
  - (c) Updating, reviewing and reporting technique (URT)
- 5. Project cost and productivity control techniques**
  - (a) Productivity budgeting techniques
  - (b) Value engineering (VE) and
  - (c) COST/WBS

## **6. Project communication and clean-up techniques**

- (a) Control room and
- (b) Computerised information systems

### **1.11 THE PROJECT MANAGER'S ROLES & RESPONSIBILITIES**

As things stand today, non of the present generation project manager, including the very successful ones, come from any of our management schools. They were just given the job-some succeeded and others did not. Those who succeeded are not many, because only a handful of projects in India were ever completed on time, within budget and performed to expectations. While the failures of these projects had been analysed in many seminars and workshops, the role of project managers and their development did not form the subject of any serious discussion. There could be two reasons for this: (a) Perhaps no one thinks that success or failure of a project depends on the project manager; and (b) It may also be that no one considers them as a special breed of managers. Surprisingly, even some of the practising project managers themselves subscribe to these views. The basic roles and responsibilities of a project manager that we are referring to could be grouped under twelve heads :

- 1 Defining and maintaining the integrity of a project;
- 2 Development of project execution plan;
- 3 Organization for execution of the plan;
- 4 Setting of targets and development of systems and procedures for accomplishment of project objectives and targets;
- 5 Negotiation for commitments;
- 6 Direction, coordination and control of project activities;
- 7 Contract management;
- 8 Non-human resource management including fiscal matters;
- 9 Problem-solving;

- 10 Man management;
- 11 Satisfaction of customer, Government and the public; and
- 12 Achievement of project objectives, cash surplus and higher productivity.

### **1.12 SUMMARY**

A project is an organized programme of pre-determined group of activities that are non-routine in nature and that must be completed using the available resources within the given time limit. Project management is an organized venture for managing projects. The location, type, technology, size, scope and speed are normally the factors which determine the effort needed in executing a project. Project can be classified under different heads. The project ideas as a process of identification of a project begins with an analytical survey of the economy. Project life cycle is spread over a period of time. Project report is a kind of course of action what the entrepreneur hopes to achieve in his business and how he is going to achieve it. Project appraisal is made for both proposed and executed projects. For appraising a project, its economic, financial, technical, market and social aspect are analysed. There are several tools and techniques which contribute significantly towards effective project management.

### **1.13 KEYWORDS**

**Project:** Project is the whole complex of activities involved in using resources to gain benefits.

**SWOT Analysis:** SWOT analysis represents conscious, deliberate and systematic efforts by an organisation to identify opportunities that can be profitably exploited by it.

**Project Report:** It is a written statement of what an entrepreneur proposes to take up.

**Project Appraisal:** Project appraisal means the assessment of a project.

### **1.14 SELF ASSESSMENT QUESTIONS**

1. Define Project Management and outline its features clearly.
2. Discuss the process of generating and screening the project ideas.

3. What can a firm do to stimulate the flow of Project Ideas?
4. Discuss the concept of project life cycle.
5. What factors influence the project ideas?. Discuss their implications.
6. Define the term 'Project'. How will you classify the projects ?
7. What do you understand by project identification? Discuss, with examples, the process involved in project identification.
8. How would you use SWOT analysis to identify and select a project for SSI?
9. How are projects classified ? In your view which criterion seems to be more rational and acceptable for classification of a project?

#### **1.15 SUGGESTED READINGS**

1. Prasana Chandra: Projects-Planning Analysis, Selection, Implementation & Review, Tata McGraw Hill, New Delhi.
2. Prasana Chandra : Financial Management, Tata McGraw Hill, New Delhi.
3. M.Shaghil and M. Mushtaque : Project Planning and Management Vol. 1
4. C. Choudhury : Project Management, Tata McGraw Hill, New Delhi – 1995
5. I.M. Pandey : Financial management, Vikas Publishing. Ed. 8.
6. Laura Brown and Tony Grundy : Strategic Project Management
7. P. Gopala Krishnan and V. Rama Moorthy : Project Management
8. Johan, M. Nicholas : Project Management for Business & Technology, Ed. 2nd.

## Lesson - 2

### **CAPITAL EXPENDITURE DECISION**

#### **STRUCTURE**

- 2.0 Objective
- 2.1 Introduction
- 2.2 Meaning and features of capital budgeting decisions
- 2.3 Importance of capital budgeting decisions
- 2.4 Kinds of capital expenditure decisions
- 2.5 Capital expenditure budgeting process
- 2.6 Criteria of capital budgeting
- 2.7 Resource allocation framework
- 2.8 Capital budgeting difficulties
- 2.9 Summary
- 2.10 Keywords
- 2.11 Self assessment questions
- 2.12 Suggested readings

#### **2.0 OBJECTIVE**

This lesson is designed to describe

- a) meaning, nature and importance of capital expenditure decisions; and
- b) criteria of capital expenditure decisions.

#### **2.1 INTRODUCTION**

The efficient allocation of funds is among the main functions of financial management. Allocation of funds means investment of funds in assets or activities. It is also called

investment decision because we have to select the assets in which investment has to be made. These assets can be classified into two parts :-

- i) Short-term or Current Assets.
- ii) Long-term or Fixed Assets.

## **2.2 MEANING AND FEATURES OF CAPITAL EXPENDITURE OR BUDGETING DECISIONS**

A capital budgeting decision may be defined as the firm's decision to invest its current funds most efficiently in the long-term assets in anticipation of an expected flow of benefits over a series of years. In other words, "capital budgeting is used to evaluate the expenditure decisions such as acquisition of fixed assets, changes in old assets and their replacement." Activities such as change in the method of sales distribution or undertaking an advertisement campaign or a research and development programme have long-term implications for the firm's expenditure and benefits and therefore, they may also be evaluated as investment decisions.

### **Features of Capital Budgeting Decisions**

Following are the features of investment decisions

- Investment of fund is made in long-term assets.
- The exchange of current funds for future benefits.
- Future profits accrue to the firm over several years.
- These decisions are more risky.

It is significant to emphasise that expenditure and benefits of an investment should be measured in cash. In the investment analysis, it is cash flow which is important, not the accounting profit. It may also be pointed out that investment decisions affect the firm's value. The firm's value will increase if investments are profitable. Investment should be evaluated on the basis of a criteria on which it is compatible with the objective of the shareholder's wealth maximisation. An investment will add to the shareholder's wealth

if it yields benefits in excess of the minimum benefits as per the opportunity cost of capital.

### **2.3 IMPORTANCE OF CAPITAL EXPENDITURE DECISION**

Investment decisions require special attention because of the following reasons :

- 1. Growth :-** The effects of investment decisions extend into the future and have to endure for a longer period than the consequences of the current operating expenditure. A firm's decisions to invest in long-term assets has a decisive influence on the rate direction of its growth. A wrong decision can prove disastrous for the continued survival of the firm.
- 2. Risk :-** A long-term commitment of funds may also change the risk complexity of the firm. If the adoption of an investment increases average gain but causes frequent fluctuations in its earnings, the firm will become very risky.
- 3. Funding :-** Investment decisions generally involve large amount of funds. Funds are scarce resource in our country. Hence the capital budgeting decision is very important.
- 4. Irreversibility :-** Most investment decisions are irreversible
- 5. Complexity :-** Investment decisions are among the firm's most difficult decisions. They are concerned with assessment of future events which are difficult to predict. It is really a complex problem to correctly estimate the future cash flow of investment.

#### **Objectives of Capital Budgeting Decision**

Capital budgeting helps in selection of profitable projects. A company should have system for estimating cash flow of projects. A multidisciplinary team of managers should be assigned the task of developing cash flow estimates. Once cash flow have been estimated, projects should be evaluated to determine their profitability. Evaluation criteria chosen should correctly rank the projects. Once the projects have been selected

they should be monitored and controlled. Proper authority should exist for capital spending. Critical projects involving large sum of money may be supervised by the top management. A company should have a sound capital budgeting and reporting system for this purpose. Based on the comparison of actual and expected performance, projects should be reappraised and remedial action should be taken.

## **2.4 KINDS OF CAPITAL EXPENDITURE DECISIONS**

Capital expenditure decisions are of following types :

### **Expansion and diversification**

A company may add capacity to its existing product lines to expand existing operations. For example, a fertilizer company may increase its plant capacity to manufacture in more areas. Diversification of a existing business require investment in new product and a new kind of production activity within the firm. Investment in existing or new products may also be called as revenue-expansion investment.

### **Replacement and modernisation**

The main objective of modernisation and replacement is to improve operating efficiency and reduce costs. Assets become out dated and obsolete as a result of technological changes . The firm must decide to replace those assets with new assets that operate more economically. If a cement company change from semi-automatic drying equipment to fully automatic drying equipment, it is an example of modernisation and replacement. Yet an other useful way to classify investment is as follow :

- Mutually exclusive investments
- Independent investments
- Contingent investments

### **Mutually exclusive investment**

Mutually exclusive investment serve the same purpose and compete with each other. If one investment is selected other will have to be rejected. A company may, for example,

either use more labour-intensive, semi-automatic machine or employ a more capital intensive, highly machine for production.

### **Independent Investment**

Independent investment serve different purposes and do not compete with each other. For example a heavy engineering company may be considering expansion of its plant capacity to manufacture additional excavators and adding new production facilities to manufacture a new product - Light commercial vehicles. Depending on their profitability and availability of funds, the company can undertake both investment.

### **Contingent Investment**

Contingent investment are dependent projects. The choice of one investment necessitates under taking one or more other investments. For example, if a company decided to build a factory in a remote backward area, it may have to invest in houses, road, hospitals, schools etc. The total expenditure will be treated as one single investment.

## **2.5 CAPITAL BUDGETING PROCESS**

Capital budgeting is a complex process which may be divided into five broad phases. These are :-

- Planning
- Analysis
- Selection
- Implementation
- Review

### **Planning**

The planning phase of a firm's capital budgeting process is concerned with the articulation of its broad strategy and the generation and preliminary screening of project proposals. This provides the framework which shapes, guides and circumscribes the identification of individual project opportunities.

## **Analysis**

The focus of this phase of capital budgeting is on gathering, preparing and summarising relevant information about various project proposals which are being considered for inclusion in the capital budget. Under this a detail analysis of the marketing, technical, economic and ecological aspects in undertaken.

## **Selection**

Project would be selected in the order in which they are ranked and cut off point would be reached when the cumulative total cost of the projects become equal to the size of the plan funds. A wide range of appraisal criteria have been suggested for selection of a project. They are divided into two categories viz, non-discounting criteria and discounting criteria.

## **2.6 CRITERIA OF CAPITAL BUDGETING**

There are two broad criteria of capital budgeting :

### **1. Non discounting criteria**

The method of capital budgeting are the techniques which are used to make comparative evaluation of profitability of investment.

The non-discounting methods of capital are as follows :

- Pay back period method (PBP)
- Accounting rate of return method (ARR)

### **2. Discounting Criteria**

- Net present value method (NPV)
- Internal rate of return method (IRR)
- profitability index method (PVI)

## **Non-discounting criteria**

**Pay back period method :** Under this method the pay back period of each project investment proposal is calculated. The investment proposal which has the least pay

back period is considered profitable. Actual pay back is compared with the standard one if actual pay back period is less than the standard the project will be accepted and in case, actual payback period is more than the standard payback period, the project will be rejected. So, pay back period is the number of years required for the original investment to be recouped.

For example, if the investment required for a project is Rs. 20,000 and it is likely to generate cash flow of Rs. 10,000 for 5 years. Pay back Period will be 2 years. It means that investment will be recovered in first 2 years of the project. Method of calculating payback period is

$$PB = \frac{\text{Investment}}{\text{Annual Cash in Flow}}$$

**Accounting Rate of Return :** This method is also called average rate of return method. This method is based on accounting information rather than cash flows. It can be calculated as -

$$ARR = \frac{\text{Average annual profit after taxes}}{\text{Average Investment}} \times 100$$

$$\frac{\text{Total of after but profit it of all the years}}{\text{Number of years}}$$

$$\text{Average Investment} = \frac{\text{Original Investment} + \text{Salvage value}}{2}$$

### Discounted Criteria

Under these methods the projected future cash flows are discounted by a certain rate called cost of capital. The second main feature of these methods is that they take into account all the benefits and costs accruing during the life time of the project. Discounted cash flow method are briefly described as follow :-

**Net Present Value Method (NPV) :** In this method present value of cash flow is calculated for which cash flows are discounted. The rate of discount is called cost of

capital and is equal to the minimum rate of return which must accrue from the project. NPV is the difference between present value of cash inflows and present value of cash outflows. NPV can be calculated as under :-

$$NPV = \frac{CF_1}{(1+K)^1} + \frac{CF_2}{(1+K)^2} + \frac{CF_3}{(1+K)^3} + \dots + \frac{CF_n}{(1+K)^n} - C$$

$$\sum_{t=1}^n \frac{CF_t}{(1+K)^t} = \frac{CF_1}{(1+K)^1} - C \quad \text{OR}$$

Where Cf1, Cf2..... represent cash inflows, k is the firm's cost of capital, C is cost outlay of the investment proposal and n, is the expected life of the proposal. If the project has salvage value also it should be added in the cash inflow of the last year. Similarly, if some working capital is also needed it will be added to the initial cost of the project and to the cash flow's of the last year. If the NPV of a project is more than zero, the project should be accepted and if NPV is less than zero it should be rejected. When NPV of two more projects under consideration is more than zero, the project whose NPV is the highest should be accepted.

**Internal rate of return method (IRR) :** Under this method initial cost and annual cash inflows are given. The unknown rate of return is ascertained. In other words "The internal rate of return is that rate which equates the present value of cash inflows with the present value of cash outflows of an investment project." At the internal rate of return NPV of a project is zero. Like NPV method IRR method also considers time value of money. In IRR method, the discount rate (r) depends upon initial investment expenditure and the future cash inflows. IRR is calculated as follows :

$$C = \frac{A_1}{(1+r)^1} + \frac{A_2}{(1+r)^2} + \frac{A_3}{(1+r)^3} + \dots + \frac{A_n}{(1+r)^n}$$

C = initial cash outflow

n = number of years

r = rate of return which is to be calculated.

$A_1 A_2 A_3 \dots A_n$  are cash inflows in various years.

**Profitability index/ Benefit-cost ratio :** It is the ratio of value of future cash benefits discounted at some required rate of return to the initial cash outflows of the investment. PI method should be adopted when the initial costs of projects are different. NPV method is considered good when the initial cost of different projects is the same. PI can be calculated as under :-

$$PI = \frac{\text{Present value of Cash inflows}}{\text{Present value of Cash outflows}}$$

If  $PI > 1$  the project will be accepted. If  $PI < 1$  the project will be rejected. When  $PI > 1$ , NPV will be positive, when  $PI < 1$  NPV will be negative. In case, more than one project have  $PI > 1$  then the project whose PI is the highest will be given first preference and the project with minimum PI will be given last preference.

### **Implementation**

Every entrepreneur should draw an implementation scheme or a time table for his project to ensure the timely completion of all activities involved in setting upon enterprise. Timely implementation is important because if there is delay it causes, among other things, a project cost overrun. In India delay in project implementation has become a common feature. Implementation phase for an industrial project, which involves settings up of manufacturing facilities, consists of several stages. These are :-

- Project and engineering design
- Negotiation and contracting
- Construction
- Training
- Plant and commissioning

Translating an investment proposal into a concrete projects is a complex, time consuming and risky task. Delays in implementation, which are common can lead to

substantial cost overruns. For expeditious implementation at a reasonable cost, the following are useful :

- Adequate formulation projects
- Use of the principle of responsibility accounting
- Use of network techniques

Hence, there is a need to draw up an implementation schedule for the project and then to adhere. Following is a simplified implementation schedule for a small project.

**An illustrative implementation schedule**

Task/months	1	2	3	4	5	6	7	8	9	10	11	12
1. Formulation of project report												
2. Application for term loan												
3. Term loan sanction												
4. Possession of land												
5. Construction of building												
6. Getting power and water												
7. Placing order for machinery												
8. Receipt and installation of machinery												
9. Man power recruitment												
10. Trail production												
11. Commencement of Production												

The above schedule can be broken up into scores of specific tasks involved in setting up the enterprise. Project evaluation and review technique (PERT) and critical path method (CPM) can also be used to get better in sight into all activities related to implementation of the project.

## **Review**

Once the project is commissioned, the review phase has to be set in motion. Performance review should be done periodically compare actual performance with projected performance. A feedback device is useful in several ways.

- It throws light on how realistic were the assumption underlying the project.
- It provides a documented log of experience that is highly valuable in future decision
- It suggests corrective action to be taken in the light of actual performance. It helps in uncovering judgmental basis.

## **2.7 RESOURCE ALLOCATION FRAMEWORK**

The resource allocation framework of the firm, which shapes, guides, and circumscribes individual project decisions, addresses two key issues : What should be the strategic posture of the firm ? What pattern of resource allocation sub serves the chosen strategic posture ?. It is divided into following section :

- ★ Key criteria
- ★ Elementary investment strategies
- ★ Portfolio planning tools
- ★ Strategic position and action evaluation

### **2.7.1 Key criteria**

The objective of maximising the wealth of shareholders is reflected, at the operational level, in three key criteria : profitability, risk, and growth.

**1. Profitability :** Profitability reflects the relationship between profit and investment. While there are numerous ways of measuring profitability, return on equity is one of the most widely used method. It is defined as :

$$\text{Profitability} = \frac{\text{Profit after tax}}{\text{Net Worth}}$$

**2. Risk :-** It reflects variability. How much do individual outcomes deviate from the expected value ? A simple measure of variability is the range of possible outcomes, which is simply the difference between the highest and net outcomes.

**3. Growth :-** This is manifested in the increase of revenue, assets, net worth, profits, dividends, and so on. To reflect the growth of a variable, the measure commonly employed is the compound rate of growth.

### **2.7.2 Elementary Investment Strategies**

The building blocks of the corporate resource allocation strategy are the following elementary investment strategies :

- ★ Replacement and modernisation
- ★ Capacity expansion
- ★ Vertical integration
- ★ Concentric diversification
- ★ Conglomerate diversification
- ★ Divestment

#### **Replacement and Modernisation**

It means to maintain the production capacity of the firm, improve quality, and reduce costs. Without such investments, which are undertaken more or less routinely by well-managed firms, the competitive strength of the firm in its existing line of business can be significantly impaired.

### **Capacity Expansion**

When a company anticipates growth in the market size of its product range or increase in the market share enjoyed by it in its product range, expansion of the capacity of the existing product range would have great appeal. Such an expansion offers several advantages : familiarity with technology, production methods and market conditions, lower capital costs due to the existence of surplus capacity in certain sections of the factory, reduction in unit overhead costs because of larger volume or production.

### **Vertical Integration**

Vertical integration may be of two types : backward integration and forward integration. Backward integration involves manufacture of raw materials and components required for the existing operations of the company. For example, Reliance Industries Limited set up a unit for the manufacture of polyester filament yarn required for its textile units. Forward integration involves the manufacture of products which use the existing products of the company as input. For example, Bharat Forge Company set up a automotive axles unit which uses its forgings as input.

### **Concentric Diversification**

Many companies seek to widen their product range by adding related products. For example, a soap manufacturer may enter the field of detergents; a scooter producer may add motorcycles to its product line; a truck manufacturer may go for passenger cars.

### **Conglomerate Diversification**

Conglomerate diversification involves investment in fields unrelated to the existing line of business. For example, when an engineering company like Larsen and Toubro invests in shipping it is a case of conglomerate diversification.

### **Divestment**

Divestment is the opposite of investment. It involves termination or liquidation of the plant or even a division of a firm. The disposal of the Chembur plant of Union Carbide to Oswal Agro is an example of divestment.

### 2.7.3 Portfolio Planning Tools

To guide the process of strategic planning and resource allocation, several portfolio planning tools have been developed. Two such tools highly relevant in this context are :

BCG Product Portfolio Matrix

General Electric's Stoplight Matrix

#### BCG Product Matrix

A tool for strategic (product) planning and resource allocation, the Boston Consulting Group (BCG) product portfolio matrix analyses products on the basis of (a) relative market share and (b) industry growth rate. The BCG matrix, shown in Exhibit 2.1, classifies products into four broad categories as follows :

**BCG Product Portfolio Matrix**

**Relative Market Share**

	High	Low
High	Stars	Question marks
Low	Cash cows	Dogs

Industry Growth Rate

**Fig (2.1) BCG Product Portfolio Matrix**

- ★ **Stars** Product which enjoy a high, market share and a high growth rate are referred to as stars.
- ★ **Question marks** Products with high growth potential but low present market share are called question marks.
- ★ **Cash Cows** Products which enjoy a relatively high market share but low growth potential are called cash cows.
- ★ **Dogs** Products with low markets share and limited growth potential are referred to as dogs.

From the above description, it is broadly clear that cash cows generate funds and dogs, if divested, release funds. On the other hand, stars and question marks require further commitment of funds.

### General Electric's Stoplight Matrix

The General Electric Company of US is widely respected for the sophistication maturity, and quality of its planning systems. The matrix developed by his company for guiding resource allocation is called the General Electric's Stoplight Matrix. It calls for analyzing various products of the firm in terms of two key issues.

- ★ **Business Strength** How strong is the firm vis-a-vis its competitors ?
- ★ **Industry attractiveness :-** What is the attractiveness or potential of the industry.

		Business Strength		
		Strong	Average	Weak
Industry Attractiveness	High			
	Medium			
	Low	Invest	Invest	Invest
		Invest	Hold	Divest
		Hold	Divest	Divest

Fig. No. 2.2 General Electric's Stoplight Matrix

#### 2.7.4 Strategic Position and Action Evaluation (Space)

SPACE is an approach to hammer out an appropriate strategic posture for a firm and its individual business. An extension of the two-dimensional portfolio analysis, SPACE involves a consideration of four dimensions :

- ★ Company's competitive advantage.
- ★ Company's financial strength.
- ★ Industry strength.
- ★ Environmental stability

## 2.8 CAPITAL BUDGETING DIFFICULTIES

While capital expenditure decisions are extremely important they also pose difficulties which stem from three principal sources :

★ **Measurement problems :-** Identifying and measuring the costs and benefits of a capital expenditure proposal tends to be difficult. This is more so when a capital expenditure has a bearing on some other activities of the firm (like cutting into the sales of some existing product) or has some intangible consequences (like improving the morale of workers).

★ **Uncertainty :-** A capital expenditure decision involves costs and benefits that extend far into future. It is impossible to predict exactly what will happen in future. Hence, there is usually a great deal of uncertainty characterizing the cost and benefits of a capital expenditure decision.

★ **Temporal spread :-** The costs and benefits associated with a capital expenditure decision are spread out over a long period of time, usually 10-20 years for industrial projects and 20-50 years for infrastructure projects.

Such a temporal spread creates some problems in estimating discount rates and establishing equivalence.

## 2.9 SUMMARY

NPV, IRR and PI are the discounted cash flow (DCF) criteria for appraising the worth of an investment project. The net present value (NPV) method is a process of calculating the present value of the projects cash flows, using the opportunity cost of capital as the discount rate, and finding out the net present value by subtracting the initial investment from the present value of cash flows. Under the NPV method, the investment project is accepted if its net present value is positive ( $NPV > 0$ ). The market value of the firms share is expected to increase by the project positive NPV. Between the mutually exclusive projects, the one with the highest NPV will be chosen.

The internal rate of return (IRR) is the discount rate at which the projected net present value is zero. Under the IRR rule, the project value will be accepted when its internal rate of return is higher than the opportunity cost of capital ( $IRR > k$ ). Both IRR and NPV methods account for the time value of money and are generally consistent with the wealth maximization objective.

However, under a number of situations, the IRR rule can give a misleading signal for mutually exclusive projects. The IRR rule also yields multiple rates of return for non-conventional projects and fails to work under varying cost of capital conditions. Since the IRR violates the values-activity principal it may fail to maximize wealth under certain conditions, and since it is cumbersome, the use of the NPV rule is recommended.

Profitability index (PI) is the ratio of the present value of cash inflows to initial cash outlay. It is a variation of the NPV rule. PI specifies that the project should be accepted when it has a profitability index greater than one ( $PI > 1.0$ ) since this implies a positive NPV. A conflict of ranking can arise between the NPV and IRR rules in case of mutually exclusive projects. Under such a situation, the NPV rule should be preferred since it is consistent with the wealth maximization principle.

In practice, two other methods have found favour with the business executives. They are the pay back (PB) and accounting rate of return (ARR) methods. PB is the number of years required to recoup the initial cash outlay of an investment project. The project would be accepted if its payback is less than the standard payback. The greatest limitation of this method is that it does not consider the time value of money, and does not consider cash flows after the payback period.

## **2.10 KEYWORDS**

**Capital Budgeting:** It is the firm's decision to invest its current resources most efficiently in the long-term assets in anticipation of an expected flow of benefits over a series of years.

**Net Present Value:** It is the difference between present value of cash inflows and present value of cash outflows.

**Internal Rate of Return:** internal rate of return is that rate of return which equates the present value of cash flows with the present value of cash outflows.

**Profitability Index Ratio:** It is the ratio of value of future cash benefits discounted at some required rate of return to the initial cash outflows of the investment.

**Profitability:** It reflects the relationship between profits and investment.

**Divestment:** Divestment involves termination or liquidation of the plant or even a division of a firm.

## 2.11 SELF ASSESSMENT QUESTIONS

1. What is capital expenditure ? Explain its needs and significance.
2. Explain briefly the method of evaluating investment project.
3. What is capital budgeting ? Explain its significance. What are the various kind of capital budgeting decisions ?
4. Why are the capital expenditure often the most important decisions taken by a firm?
5. Discuss the various phases of capital expenditure projects.
6. Write short notes on
  - (i) Net present value
  - (ii) Internal rate of return
  - (iii) Average rate of return
  - (iv) Mutually exclusive projects
7. The following are the net cash flows of an investment project :

Cash flows (Rs.)	<u>t<sub>0</sub></u>	<u>t<sub>1</sub></u>	<u>t<sub>2</sub></u>
	<b>-5000</b>	<b>+3000</b>	<b>4000</b>

Calculate the net present value of the project at discount rates of 10, 20, 30 and 35 percent

## **2.12 SUGGESTED READINGS**

1. I. M. Pandey : Financial Management, Vikas Publication Ed. 8
2. Prasanna Chandra : Financial Management, Tata McGraw Hill, New Delhi Ed. 2004.
3. Prasanna Chandra : Projects, Planning Analysis, Selection.
4. Van Horne, Wachowicz : Fundamental of Financial Management, PHI New Delhi, Ed. 10.

**LESSON: 3**  
**MARKET AND DEMAND ANALYSIS**

**STRUCTURE**

- 3.0 Objective
- 3.1. Introduction
- 3.2. Information required for marketing and demand analysis
- 3.3. Secondary sources of information
- 3.4. Market survey
- 3.5. Demand forecasting
- 3.6. Uncertainties in demand forecasting
- 3.7. Coping with uncertainties
- 3.8 Summary
- 3.9 Keywords
- 3.10 Self assessment questions
- 3.11 Suggested readings

**3.0 Objectives**

After reading this lesson, you should be able to

- a) Discuss the type of information required for market and demand analysis.
- b) Explain the various sources of secondary information.
- c) Describe the procedure of conducting market survey.
- d) Explain the different methods of demand forecasting.

- e) Deal with uncertainties in demand forecasting.

### **3.1 INTRODUCTION**

The exercise of project appraisal often begins with an estimation of the size of the market. Before a detailed study of a project is undertaken, it is necessary to know, at least roughly, the size of the market because the viability of the project depends critically on whether the anticipated level of sales exceeds a certain volume. Many a project has been abandoned because preliminary appraisal revealed a market of inadequate size. This chapter is divided into the following five sections dealing with various aspects of market and demand analysis.

1. Information required for market and demand analysis
2. Secondary sources of information
3. Market survey
4. Demand forecasting
5. Uncertainties in demand forecasting

### **3.2 INFORMATION REQUIRED FOR MARKET AND DEMAND ANALYSIS**

The principal types of information required for market and demand analysis relate to-

**(i) Effective demand in the past and present**

To gauge the effective demand in the past and present, the starting point typically is apparent consumption which is defined as-

Production + Imports – exports – changes in stock level

In a competitive market, effective demand and apparent consumption are equal. However, in most of the developing countries, where competitive markets do not exist for a variety of products due to exchange restrictions and controls on production and distribution, the figure of apparent consumption may have to be adjusted for market imperfections. Admittedly, this is often a difficult task.

**(ii) Breakdown of demand**

To get a deeper insight into the nature of demand, the aggregate (total) market demand may be broken down into demand for different segments of the market. Market segments may be defined by (i) nature of product, (ii) consumer group, and (iii) geographical division.

*Nature of product*— One generic name often subsumes many different products: steel covers sections, rolled products, and various semi-finished products; commercial vehicles cover trucks and buses of various capacities etc.

*Consumer groups*— Consumers of a product may be divided into industrial consumers and domestic consumers. Industrial consumers

may be sub-divided industry-wise. Domestic consumers may be further divided into different income groups.

*Geographical division*— A geographical breakdown of consumers, particularly for products which have a small value-to-weight relationship and products which require regular, efficient after-sales service is helpful.

### **(iii) Price**

Price statistics must be gathered along with statistics pertaining to physical quantities. It may be helpful to distinguish the following types of prices: (i) manufacturer's price quoted as FOB (free on board) price or CIF (cost, insurance, and freight) price, (ii) landed price for imported goods, (iii) average wholesale price, and (iv) average retail price.

### **(iv) Methods of distribution and sales promotion**

The method of distribution may vary with the nature of product. Capital goods, industrial raw materials or intermediates, and consumer products tend to have differing distribution channels. Further, for a given product, distribution methods may vary. Likewise, methods used for sales promotion (advertising, discounts, gift schemes, etc.) may vary from product to product.

The methods of distribution and sales promotion employed presently and their rationale must be studied carefully. Such a study may explain

certain patterns of consumption and highlight the difficulties that may be encountered in marketing the proposed products.

**(v) Consumers**

Two categories of information about the consumers may be required: demographic and sociological information, and attitudinal information. Under the first category, information on the following is required: age, sex, income, avocation, residence, religion, customs, beliefs, and social background. Under the second category, information on the following is required- preferences, intentions, attitudes, habits, and responses.

**(vi) Governmental policy**

The role of government in influencing the demand and market for a product may be significant. Governmental plans, policies, legislations, and fiats which have a bearing on the market and demand of the product under examination should be studied. These are reflected in: production targets in national plans, import and export trade controls, import duties, export incentives, excise duties, sales tax, industrial licensing, preferential purchases, credit controls, financial regulations, and subsidies/penalties of various kinds.

**(vii) Supply and competition**

It is necessary to know the existing sources of supply and whether they are foreign or domestic. For domestic sources of supply information along

the following lines may be gathered: location, present production capacity, planned expansion, capacity utilization level, bottlenecks in production, and cost structure.

Competition from substitutes and near-substitutes should be examined because almost any good may be replaced by some other good as a result of changes in relative prices, quality, availability, promotional strategies, consumer taste, and other factors.

### **3.3 SECONDARY SOURCES OF INFORMATION**

The information required for demand and market analysis is usually obtained partly from secondary sources and partly through a market survey. In marketing research, a distinction is usually made between primary information and secondary information. Primary information refers to information which is collected for the first time to meet the specific purpose on hand; secondary information, in contrast, is information which is in existence and which has been gathered in some other context. Secondary information provides the base and the starting point for market and demand analysis. It indicates what is known and often provides leads and cues for further investigation.

#### **General secondary sources of information**

The important sources of secondary information useful for market and demand analysis in India are mentioned below-

*Census of India*— A decennial publication of the Government of India, it provides information on population, demographic characteristics, household size and composition, and maps.

*National sample survey reports*— Issued from time to time by the Cabinet Secretariat, Government of India, these reports present information on various economic and social aspects like patterns of consumption, distribution of households by the size of consumer expenditure, distribution of industries, and characteristics of the economically active population. The information presented in these reports is obtained from a nationally representative sample by the interview method.

*Plan reports*— Issued by the Planning Commission usually at the beginning, middle, and end of the five-year plans, these reports and documents provide a wealth of information on plan proposals, physical and financial targets, actual outlays, accomplishments, etc.

*Statistical abstract of the Indian Union*— An annual publication of the Central Statistical Organisation, it provides, *inter alia*, demographic information, estimates of national income, and agricultural and industrial statistics.

*India Year Book*— An annual publication of the Ministry of Information and Broadcasting, it provides wide ranging information on economic and other aspects.

*Other publications*— Among other publications mention may be made of the following: (i) Weekly Bulletin of Industrial Licences, Import Licences and Export Licences (published by the Government of India); (ii) studies of the economic division of the State Trading Corporation; (iii) commodity reports and other studies of the Indian institute of Foreign Trade; (iv) studies and reports of export promotion councils and commodity boards; and (v) Annual report on Currency and Finance (issued by Reserve Bank of India).

### **Evaluation of secondary information**

While secondary information is available economically and readily (provided the market analyst is able to locate it) its reliability, accuracy, and relevance for the purpose under consideration must be carefully examined. The market analyst should seek to know (i) Who gathered the information? What was the objective? (ii) When was information gathered? When was it published? (iii) How representative was the period for which information was gathered? (iv) Have the terms in the study been carefully and unambiguously gathered? (v) What was the target population? (vi) How was the sample chosen? (vii) How representative was the sample? (viii) How satisfactory was the process of information gathering? (ix) What was the degree of sampling bias and non-response bias in the information gathered? (x) What was the degree of misrepresentation by respondents? (xi) How properly was the information by respondents? (xii) Was statistical analysis properly applied?

### **3.4 MARKET SURVEY**

Secondary information, though useful, often does not provide a comprehensive basis for demand and market analysis. It needs to be supplemented with primary information gathered through a market survey, specific for the project being appraised.

The market survey may be a census survey or a sample survey. In a census survey the entire population is covered. (The word 'population' is used here in a particular sense. It refers to the totality of all units under consideration in a specific study. Examples are- all industries using milling machines, all readers of the *Economic Times*). Census surveys are employed principally for intermediate goods and investment goods when such goods are used by a small number of firms. In other cases, a census survey is prohibitively costly and may also be infeasible. For example, it would be inordinately expensive to cover every user of Lifebuoy or every person in the income bracket Rs. 10,000-Rs. 15,000.

Due to the above mentioned limitations of the census survey, the market survey, in practice, is typically a sample survey. In such a survey a sample of the population is contacted/observed and relevant information is gathered. On the basis of such information, inferences about the population may be drawn.

The information sought in a market survey may relate to one or more of the following (i) Total demand and rate of growth of demand; (ii) Demand

in different segments of the market; (iii) Income and price elasticity of demand; (iv) Motives for buying; (v) Purchasing plans and intentions; (vi) Satisfaction with existing products; (vii) Unsatisfied needs; (viii) Attitudes toward various products (ix) Distributive trade practices and preferences; (x) Socio-economic characteristics of buyers.

### **Steps in a sample survey**

Typically, a sample survey consists of the following steps:

1. *Definition of the target population*— In defining the target population the important terms should be carefully and unambiguously defined. The target population may be divided into various segments which may have differing characteristics. For example, all television owners may be divided into three to four income brackets.

2. *Selection of sampling scheme and sample size*— There are several sampling schemes- simple random sampling, cluster sampling, sequential sampling, stratified sampling, systematic sampling, and non-probability sampling. Each scheme has its advantages and limitations. The sample size, other things being equal, has a bearing on the reliability of the estimates— the larger the sample size, the greater the reliability.

3. *Preparation of the questionnaire*— The questionnaire is the principal instrument for eliciting information from the sample of the respondents. The effectiveness of the questionnaire as a device for

eliciting the desired information depends on its length, the types of questions, and the wording of questions. Developing the questionnaire requires thorough understanding of the product/service and its usage, imagination, insights into human behaviour, appreciation of subtle linguistic nuances, and familiarity with the tools of descriptive and inferential statistics to be used later for analysis. It also requires knowledge of psychological scaling techniques if the same are employed for obtaining information relating to attitudes, motivations, and psychological traits. Industry and trade market surveys, in comparison to consumer surveys, generally involve more technical and specialized questions.

Since the quality of the questionnaire has an important bearing on the results of market survey, the questionnaire should be tried out in a pilot survey and modified in the light of problems/difficulties noted.

4. *Recruiting and training of field investigators* must be planned well since it can be time-consuming. Great care must be taken for recruiting the right kinds of investigators and imparting the proper kind of training to them. Investigators involved in industry and trade market survey need intimate knowledge of the product and technical background particularly for products based on sophisticated technologies.

5. *Obtaining information as per the questionnaire from the sample of respondents*— Respondents may be interviewed personally, telephonically

or by mail for obtaining information. Personal interviews ensure a high rate of response. They are, however, expensive and likely to result in biased responses because of the presence of the interviewer. Mail surveys are economical and evoke fairly candid responses. The response rate, however, is often low. Telephonic interviews, common in western countries, have very limited applicability in India because telephone tariffs are high and telephone connections few.

6. *Scrutiny of information gathered*— Information gathered should be thoroughly scrutinized to eliminate data which is internally inconsistent and which is of dubious validity. For example, a respondent with a high income and large family may say that he lives in a one-room tenement. Such information, probably inaccurate, should be deleted. Sometimes data inconsistencies may be revealed only after some analysis.

7. *Analysis and interpretation of data*— Data gathered in the survey needs to be analysed and interpreted with care and imagination. After tabulating it as per a plan of analysis, suitable statistical investigation may be conducted, wherever possible and necessary. For purposes of statistical analysis, a variety of methods are available. They may be divided into two broad categories: parametric methods and non-parametric methods. Parametric methods assume that the variable or attribute under study conforms to some known distribution. Non-parametric methods do not presuppose any particular distribution.

Results of data based on sample survey will have to be extrapolated for the target population. For this purpose, appropriate inflatory factors, based on the ratio of the size of the target population and the size of the sample studied, will have to be used.

The statistical analysis of data should be directed by a person who has a good background in statistics as well as economics.

It may be emphasized that the results of the market survey can be vitiated by- (i) non-representativeness of the sample, (ii) imprecision and inadequacies in the questions, (iii) failure of the respondents to comprehend the questions, (iv) deliberate distortions in the answers given by the respondents, (v) inept handling of the interviews by the investigators, (vi) cheating on the part of the investigators, (vii) slipshod scrutiny of data, and (viii) incorrect and inappropriate analysis and interpretation of data.

### **3.5 DEMAND FORECASTING**

After gathering information about various aspects of the market and demand from primary and secondary sources, an attempt may be made to estimate future demand. Several methods are available for demand forecasting. The important ones are—

**(i) Trend projection method**

It consists of (i) determining the trend of consumption by analyzing past consumption statistics, and (ii) projecting future consumption by extrapolating the trend.

The trend of consumption may be represented by one of the following relationships:

Linear Relationship:  $Y_t = a + bt$  ... (1)

Exponential Relationship:  $Y_t = ae^{bt}$  ... (2)

On logarithmic transformation this becomes:

$\text{Log } Y_t = \log a + bt$

Polynomial Relationship:  $Y_t = a_0 + a_1t + a_2t^2 + \dots + a_nt^n$  ... (3)

Cobb Douglas Relationship:  $Y_t = at^b$  ... (4)

On logarithmic transformation this becomes:

$\text{Log } Y_t = \log a + b \log t$

In the above equations  $Y_t$  represents demand for year  $t$ ,  $t$  is the time variable,  $a$ ,  $b$  and  $a_j$ 's are constants.

Out of the above relationships the most commonly used relationship is-

$Y_t = a + bt$

This relationship may be estimated by using one of the following methods: (i) visual curve fitting method, and (ii) least squares method.

*Evaluation*— The basic assumption underlying the trend projection method is that the factors which influenced the behaviour of consumption in the past would continue to influence the behaviour of consumption in the future. This hypothesis is sometimes referred to as the hypothesis of “mutually compensating effects”. Clearly, this is a deterministic hypothesis of questionable validity. Notwithstanding this weakness, the trend projection method is used popularly in practice. Often a starting point in the forecasting exercise, it is likely to be relied upon heavily when no other viable method seems available. The ease with which it can be applied may induce a sense of complacency.

## **(ii) Consumption level method**

Useful for a product which is directly consumed, this method estimates consumption level on the basis of elasticity coefficients, the important ones being the income elasticity of demand and the price elasticity of demand.

*Income elasticity of demand*— The income elasticity of demand reflects the responsiveness of demand to variations in income. It is measured as follows:

$$E_1 = \frac{Q_2 - Q_1}{I_2 - I_1} \times \frac{I_1 + I_2}{Q_2 + Q_1}$$

Where  $E_1$  = income elasticity of demand

$Q_1$  = quantity demanded in the base year

$Q_2$  = quantity demanded in the following year

$I_1$  = income level in the base year

$I_2$  = income level in the following year

*Example*— The following information is available on quantity demanded and income level:  $Q_1 = 50$ ,  $Q_2 = 55$ ,  $I_1 = 1,000$ , and  $I_2 = 1,020$ . The income elasticity of demand is-

$$E_1 = \frac{55 - 50}{1,020 - 1,000} \times \frac{1,000 + 1,020}{55 + 50} = 4.81$$

The information on income elasticity of demand along with projected income may be used to obtain a demand forecast. To illustrate, suppose the present per capita annual demand for paper is 1 kg and the present per capita annual income is Rs. 1,2000. The income elasticity of demand for paper is 2. The projected per capita annual income three years hence is expected to be 10 per cent higher than what it is now. The projected per capita demand for paper three years hence will be-

$$\left( \begin{array}{c} \text{Present per} \\ \text{capita income} \end{array} \right) \left( \begin{array}{c} 1 + \text{per capital change} \\ \text{in income level} \end{array} \right) \left( \begin{array}{c} \text{income elasticity} \\ \text{of demand} \end{array} \right)$$

$$= (1) (1 + 0.10 \times 2) = 1.2 \text{ kg.}$$

The aggregate demand projection for paper will simply be-

Projected per capita demand × Projected population

The income elasticity of demand differs from one product to another. Further, for a given product, it tends to vary from one income group to another and from one region to another. Hence, wherever possible, disaggregative analysis should be attempted.

*Price elasticity of demand*— The price elasticity of demand measures the responsiveness of demand to variations in price. It is defined as—

$$E_p = \frac{Q_2 - Q_1}{P_2 - P_1} \times \frac{P_1 + P_2}{Q_2 + Q_1}$$

Where,  $E_p$  = price elasticity of demand

$Q_1$  = quantity demanded in the base year

$Q_2$  quantity demanded in the following year

$P_1$  = price per unit in the base year

$P_2$  = price per unit in the following year

*Example*— The following information is available about a certain product:

$P_1$  = Rs. 600,  $Q_1$  = 10,000,  $P_2$  = Rs. 800,  $Q_2$  = 9,000. The price elasticity of demand is:

$$E_p = \frac{9000 - 10,000}{800 - 500} \times \frac{600 + 800}{9,000 + 10,000} = - 0.37$$

The price elasticity of demand is a useful tool in demand analysis. The future volume of demand may be estimated on the basis of the price elasticity coefficient and expected price change. The price elasticity

coefficient may also be used to study the impact of variable price that may obtain in future on the economic viability of the project. In using the price elasticity measure, however, the following considerations should be borne in mind: (i) the price elasticity coefficient is applicable to only small variations. (ii) The price elasticity measure is based on the assumption that the structure and behaviour remain constant.

**(iii) End use method**

Suitable for estimating the demand for intermediate products, the end use method, also referred to as the consumption coefficient method involves the following steps:

1. Identify the possible uses of the product.
2. Define the consumption coefficient of the product for various uses.
3. Project the output levels for the consuming industries.
4. Derive the demand for the product.

This method may be illustrated with an example. A certain industrial chemical is used by four industries, Alpha, Beta, Gamma, and Kappa. The consumption coefficients for these industries, the projected output levels for these industries for the year X, and the projected demand are shown in Exhibit 1.

## **Exhibit 1**

### **Projected Demand**

	Consumption coefficient*	Projected output in Year X	Projected demand in Year X
Alpha	2.0	10,000	20,000
Beta	1.2	15,000	18,000
Kappa	0.8	20,000	16,000
Gamma	0.5	30,000	15,000

Total = 69,000 tones

\*This is expressed in tones per unit of output of the consuming industry.

As is clear from the foregoing discussion, the key inputs required for the application of the end-use method are— (i) projected output levels of consuming industries (units), and (ii) consumption coefficients. It may be difficult to estimate the projected output levels of consuming industries (units). More important, the consumption coefficients may vary from one period to another in the wake of technological changes and improvements in the methods of manufacturing. Hence, the end-use method should be used judiciously.

#### **(iv) Leading Indicator Method**

Leading indicators are variables which change ahead of other variables, the lagging variables. Hence, observed changes in leading indicators may be used to predict the changes in lagging variables. For example, the change in the level of urbanization a leading indicator may be used to predict the change in the demand for air conditioners a lagging variable.

Two basic steps are involved in using the leading indicator method: (i) First, identify the appropriate leading indicator(s). (ii) Second, establish the relationship between the leading indicator(s) and the variable to be forecast.

The principal merit of this method is that it does not require a forecast of an explanatory variable. It, however, is characterized by certain problems. (i) It may be difficult to find an appropriate leading indicator(s). (ii) The lead-lag relationship may not remain stable over time. In view of these problems this method has limited use.

#### **(v) Econometric method**

An econometric model is a mathematical representation of economic relationship/s derived from economic theory. The primary objective of econometric analysis is to forecast the future behaviour of the economic variables incorporated in the model.

Two types of econometric models are employed: the single equation model and the simultaneous equation model. The single equation model assumes that one variable, the dependent variable (also referred to as the explained variable), is influenced by one or more independent variables (also referred to as the explanatory variables). In other words, one-way causality is postulated. An example of the single equation model is given below:

$$D_t = a_0 + a_1P_t + a_2N_t$$

Where,  $D_t$  = demand for a certain product in year t

$P_t$  = price for the product in year t

$N_t$  = income in year t

The simultaneous equation model portrays economic relationships in terms of two or more equations. Consider a highly simplified three-equation econometric model of Indian economy.

$$GNP_t = G_t + I_t + C_t \quad \dots (5)$$

$$I_t = a_0 + a_1 GNP_t \quad \dots (6)$$

$$C_t = b_0 + b_1 GNP_t \quad \dots (7)$$

Where  $GNP_t$  = gross national product for year t

$G_t$  = governmental purchases for year t

$I_t$  = gross investment for year t

$C_t$  = consumption for year t

In the above model, Eq. (5) is just a definitional equation which says that the gross national product is equal to the sum of government purchases, gross investment and consumption. Eq. (6) postulates that investment is a linear function of gross national product; Eq. (7) posits that consumption is a linear function of gross national product.

The construction and use of an econometric model involves four broad steps.

1. *Specification*— This refers to the expression of an economic relationship in mathematical form. Equation (6), for example, posits that investments is a linear function of gross national product.
2. *Estimation*— This involves the determination of the parameter values and other statistics by a suitable method. The principal methods of estimation are the least squares method and the maximum likelihood method, the former being the most popular method in practice.
3. *Verification*— This step is concerned with accepting or rejecting the specification as a reasonable approximation to truth on the basis of the results of estimation and appropriate statistical tests applied to them.
4. *Prediction*— This involves projection of the value of the explained variable(s).

*Evaluation*— The econometric method offers certain advantages- (i) The process of econometric analysis sharpens the understanding of complex cause-effect relationships, (ii) the econometric model provides a basis for testing assumptions and for judging how sensitive the results are to changes in assumptions.

The limitations of the econometric method are— (i) it is expensive and data-demanding. (ii) to forecast the behaviour of the dependent variable, one needs the projected values of independent variable (s). The difficulty in obtaining these may be the main limiting factor in employing econometric method for forecasting purposes.

**Market penetration for the product**— Once a reasonably good handle over the aggregate demand is obtained, the next logical question is: What will be the likely demand for the product of the project under examination? The answer to this question depends on—

1. Aggregate potential supply
2. Nature of competition
3. Consumer preferences
4. Sales promotion efforts

If the aggregate potential domestic supply is likely to be significantly less than the aggregate potential domestic demand, the demand for the product of the project under examination is likely to be very strong, provided liberal imports which may hurt domestic manufacturers are not allowed. The nature of competition and market-sharing arrangement (if any) has a bearing on the demand for the product of the project under examination. Consumer preferences for competing products and the sales promotional efforts of various competitors obviously influence the relative market shares enjoyed by them.

### **3.6 UNCERTAINTIES IN DEMAND FORECASTING**

Demand forecasts are subject to error and uncertainty which arise from three principal sources:

#### **(i) Data about past and present market**

The analysis of past and present market, which serves as the springboard for the projection exercise, may be vitiated by the following inadequacies of data:

*Lack of standardization*— Data pertaining to market features like product, price, quantity, cost, income etc. may not reflect uniform concepts and measures.

*Few observations*— Not enough observations may be available to conduct meaningful analysis.

*Influence of abnormal factors*— Some of the observations may be influenced by abnormal factors like war or natural calamity.

#### **(ii) Methods of forecasting**

Methods used for demand forecasting are characterized by limitations.

*Inability to handle unquantifiable factors*— Most of the forecasting methods, quantitative in nature, cannot handle unquantifiable factors which sometimes can be of immense significance.

*Unrealistic assumptions*— Each forecasting method is based on certain assumptions. For example, the trend projection method is based on the ‘mutually compensation effects’ premise and the end-use method is based on the constancy of technical coefficients. Uncertainty arises when the assumptions underlying the chosen method tend to be unrealistic and erroneous.

*Excessive data requirement*— In general, the more advanced a method, the greater the data requirement. For example, to use an econometric model one has to forecast the future values of explanatory variables in order to project the explained variable. Clearly, predicting the future value of explanatory variables is a difficult and uncertain exercise.

### **(iii) Environmental changes**

The environment in which a business functions is characterized by numerous uncertainties. The important sources of uncertainty are mentioned below:

*Technological change*— This is a very important but hard-to-predict factor which influences business prospects. A technological advancement may create a new product which performs the same function more efficiently and economically, thereby cutting into the market for the existing product. For example, electronic watches have encroached on the market for mechanical watches.

*Shift in governmental policy*— In India, governmental regulation of business is extensive. Changes in governmental policy, which may be difficult to anticipate, may have a telling effect on business environment, e.g. granting of licenses to new companies, particularly foreign companies, may alter the market situation significantly.; banning the import of a certain product may create a sheltered market for the existing producers; liberalizing the import of some product may lead to stiff competition in the market place; relaxation of price and distribution controls may widen the market considerably.

*Developments on the international scene*— Developments on the international scene may have a profound effect on industries. The most classic example of recent times is the OPEC price hike, which led to near-stagnation in the Indian automobile industry.

*Discovery of new sources of raw material*— Discovery of new sources of raw materials, particularly hydrocarbons, can have a significant impact on the market situation of several products.

*Vagaries of monsoon*— Monsoon, which plays an important role in the Indian economy, is somewhat unpredictable. The behaviour of monsoon influences, directly or indirectly, the demand for a wide range of products.

### **3.7 COPING WITH UNCERTAINTIES**

Given the uncertainties in demand forecasting, adequate efforts, along the following lines may be made to cope with uncertainties.

1. Conduct analysis with data based on uniform and standard definitions.
2. In identifying trends, coefficients, and relationships, ignore the abnormal or out-of-the-ordinary observations.
3. Critically evaluate the assumptions of the forecasting methods and choose a method which is appropriate to the situation.
4. Adjust the projections derived from quantitative analysis in the light of a due consideration of unquantifiable, but significant influences.
5. Monitor the environment imaginatively to identify important changes.
6. Consider likely alternative scenarios and their impact on market and competition.
7. Conduct sensitivity analysis to assess the impact on the size of demand for unfavourable and favourable variations of the determining factors from their most likely levels.

### **3.8 SUMMARY**

An estimation of the size of the market is the first step in project appraisal. In many cases, a project has been abandoned because

preliminary appraisal revealed a inadequate size of market. The information required for market and demand analysis relate to effective demand in the past and present, breakdown of demand, price, consumers, methods of distribution and sales promotion, government policy and supply and competition. The information required for demand and market analysis is generally obtained partly from secondary sources and partly through a market survey. The important sources of national sample survey reports, plan reports, India year book, statistical abstract of the Indian Union. Sometimes, secondary information does not provide a comprehensive basis for demand and market analysis. It needs to be supplemented with primary information gathered through a market survey. After collecting information about various aspects of the market and demand from primary and secondary sources, it is essential to make an estimate of future demand. The various methods of demand forecasting include trend projection method, consumption level method, end use method, leading indicator method econometric method. Given the uncertainties in demand forecasting adequate efforts are to be made to cope with uncertainties.

### **3.9 KEYWORDS**

**Market Survey:** It refers to the systematic collection, recording and analysis of data in order to develop an appropriate information base for decision-making.

**Trend Projection Method:** It consists of determining the trend of consumption by analyzing past consumption statistics and projecting future consumption by extrapolating the trend.

**Survey:** A survey consists of gathering data by interviewing a limited number of people selected from a larger group.

**Econometric Method:** It is a mathematical representation of economic relationship (s) derived from economic theory.

### **3.10 SELF ASSESSMENT QUESTIONS**

1. What types of information are required for market and demand analysis?
2. Discuss the steps involved in constructing and using an econometric model.
3. What are the sources of uncertainties in demand forecasting? Discuss them.
4. “Often secondary information is not adequate for market and demand analysis”. Comment.

### **3.11 SUGGESTED READINGS**

1. Projects Preparation, Appraisal, Budgeting and Implementation by Prasanna Chandra, Tata McGraw Hill Publishing Company Ltd., New Delhi.

2. Project Management by Vasant Desai, Himalaya Publishing House, New Delhi.
3. Project Management by C. Chaudhary, Tata McGraw Hill, New Delhi.
4. Project Management and Control by C. Keshava Rao, Sultan Chand and Sons, New Delhi.

**LESSON: 4**  
**TECHNICAL AND FINANCIAL ANALYSIS**

**STRUCTURE**

- 4.0 Objective
- 4.1 Introduction
- 4.2 Technical analysis
- 4.3 Financial analysis
- 4.4 Summary
- 4.5 Keywords
- 4.6 Self assessment questions
- 4.7 Suggested readings

**4.0 OBJECTIVES**

After reading this lesson, you will become familiar with

- a) Various aspects to be considered for technical analysis of the project.
- b) Considerations involved in financial analysis of the project.

## **4.1 INTRODUCTION**

The success of an enterprise depends upon the entrepreneur doing the right thing at the right time. Starting a new venture is a very challenging and rewarding task. A businessman has to take numerous decisions, right from the conception of a business idea, upon the start of production. Hence, the identification of the project to be undertaken, requires an analysis of the project in depth. Therefore, a technical and financial analysis of the project has to be undertaken.

## **4.2 TECHNICAL ANALYSIS**

Analysis of technical and engineering aspects is done continually when a project is being examined and formulated. Other types of analyses are dependent and closely intertwined with technical analysis. Technical analysis is concerned primarily with:

### **4.2.1 Materials and inputs**

An important aspect of technical appraisal is concerned with defining the materials and inputs required, specifying their properties in some detail, and setting up their supply programme. There is an intimate relationship between the study of materials and inputs and other aspects of project formulation, particularly those concerned with location, technology, and equipment.

Materials and inputs may be classified into four broad categories: (i) raw materials, (ii) processed industrial materials and components, (iii) auxiliary materials and factory supplies, and (iv) utilities.

**(i) Raw materials—** Raw materials (processed and /or semi-processed) may be classified into four types: (i) agricultural products, (ii) mineral products, (iii) livestock and forest products, and (iv) marine products.

**(ii) Processed industrial materials and components—** Processed industrial materials and components (base metals, semi-processed materials, manufactured parts, components, and sub-assembly represent an important input for a number of industries. In studying them the following questions need to be answered: In the case of industrial materials, what are their properties? What is the total requirement of the project? What quantity would be available from domestic source? What quantity would be available from foreign sources? How dependable are the supplies? What has been the past trend in prices? What is the likely future behaviour of prices?

**(iii) Auxiliary materials and factory supplies—** In addition to the basic raw materials and processed industrial materials and components, a manufacturing project requires various auxiliary materials and factory supplies, like chemicals, additives, packaging

materials, paints, varnishes, oils, grease, cleaning materials, etc. The requirements of such auxiliary materials and supplies should be taken into account in the feasibility study.

**(iv) Utilities—** A broad assessment of utilizes (power, water, steam, fuel, etc.) may be made at the time of input study though a detailed assessment can be made only after formulating the project with respect to location, technology, and plant selection. Since the successful operation of a project critically depends on adequate availability of utilities the following points should be raised whiled conducting the input study: What quantities are required? What are the sources of supply? What would be the potential availability? What are the likely shortages/bottlenecks? What measures may be taken to augment supplies.

#### **4.2.2 Production technology**

For manufacturing a product/service often two or more alternative technologies are available. For example:

- Steel can be made either by the Bessemer process or the open hearth process.
- Cement can be made either by the dry process or the wet process.
- Soda can be made by the electrolysis method or the chemical method.

- Paper, using bagasse as the raw material, can be manufactured by the kraft process or the soda process or the simon cusi process.
- Vinyl chloride can be manufactured by using one of the following reactions: acetylene on hydrochloric acid or ethylene or chlorine.

#### **4.2.3 Choice of technology**

The choice of technology is influenced by a variety of considerations:

- (i) Principal inputs—** The choice of technology depends on the principal inputs available for the project. In some cases, the raw materials available influences the technology chosen. For example, the quality of limestones determines whether the wet or dry process should be used for a cement plant. It may be emphasized that a technology based on indigenous inputs may be preferable to one based on imported inputs because of uncertainties characterizing imports, particularly in a country like India.
- (ii) Investment outlay and production cost—** The effect of alternative technologies of investment outlay and production cost over a period of time should be carefully assessed.
- (iii) Use by other units—** The technology adopted must be proven by successful use by other units, preferably in India.

- (iv) **Product mix**— The technology chosen must be judged in terms of the total product-mix generated by it, including saleable by-products.
- (v) **Latest developments**— The technology adopted must be based on latest development in order to ensure that the likelihood of technological obsolescence in the near future, at least, is minimized.
- (vi) **Ease of absorption**— The ease with which a particular technology can be absorbed can influence the choice of technology. Sometimes a high-level technology may be beyond the absorptive capacity of a developing country which may lack trained personnel to handle that technology.

#### **4.2.4 Product Mix**

The choice of product mix is guided primarily by market requirements. In the production of most of the items variations in size and quality are aimed the production of most of the items, variations in size and quality are aimed at satisfying a broad range of customers. For example, production of shoes to different customers. It may be noted that sometimes slight variations in quality can enable a company to expand its market and enjoy higher profitability. For example, a toilet soap manufacturing unit may by minor variation in raw material, packaging,

and sales promotion offer a high profit margin soap to consumers in upper-income brackets.

While planning the production facilities of the firm, some flexibility with respect to the product mix must be sought. Such flexibility enables the firm to alter its product mix in response to changing market conditions and enhances the power of the firm to survive and grow under different situations. The degree of flexibility chosen may be based on a careful analysis of the additional investment requirements for different degrees of flexibility.

#### **4.2.5 Plant capacity**

Plant capacity (also referred to as production as capacity) refers to the volume or number of units that can be manufactured during a given period. Several factors have a bearing on the capacity decision.

**(i) Technological requirement—** For many industrial projects, particularly in process type industries, there is a certain minimum economic size determined by the technological factor. For example, a cement plant should have a capacity of at least 300 tonnes per day in order to use the rotary kiln method; otherwise, it has to employ the vertical shaft method which is suitable for lower capacity.

**(ii) Input constraints—** In a developing country like India, there may be constraints on the availability of certain inputs. Power supply may be limited; basic raw materials may be scarce; foreign exchange available for imports may be inadequate. Constraints of these kinds should be borne in mind while choosing the plant capacity.

**(iii) Investment cost—** When serious input constraints do not obtain, the relationship between capacity and investment cost is an important consideration. Typically, the investment cost per unit of capacity decreases as the plant capacity increases. This relationship may be expressed as follows:

$$C_1 = C_2 \left( \frac{Q_1}{Q_2} \right)^\alpha$$

Where  $C_1$  = derived cost for  $Q_1$  units of capacity

$C_2$  = known cost for  $Q_2$  units of capacity

$\alpha$  = a factor reflecting capacity-cost relationship. This is usually between 0.2 and 0.9.

**(iv) Market conditions—** The anticipated market for the product/service has an important bearing on plant capacity. If the market for the product is likely to be very strong, a plant of higher capacity is preferable. If the market is likely to be uncertain, it

might be advantageous to start with a smaller capacity. If the market, starting from a small base, is expected to grow rapidly, the initial capacity may be higher than the initial level of demand—further additions to capacity may be affected with the growth of market.

**(v) Resources of the firm—** The resources, both managerial and financial, available to a firm define a limit on its capacity decision. Obviously, a firm cannot choose a scale of operations beyond its financial resources and managerial capability.

**(vi) Governmental policy—** The capacity level may be constrained by governmental policy. Given the level of additional capacity to be created in an industry, within the licensing framework of the government the government may decide to distribute the additional capacity among several firms.

#### **4.2.6 Location and site**

The choice of location and site follows an assessment of demand, size, and input requirement. Though often used synonymously, the terms 'location' and 'site' should be distinguished. Location refers to a fairly broad area like a city, an industrial zone, or a coastal area; site refers to a specific piece of land where the project would be set up.

The choice of location is influenced by a variety of considerations: proximity to raw materials and markets, availability of infrastructure, governmental policies, and other factors.

**(i) Proximity to raw materials and markets—** An important consideration for location is the proximity to sources of raw materials and nearness to the market for final products. In terms of a basic locational model, the optimal location is one where the total cost (raw material transportation cost plus production cost plus distribution cost for final product) is minimized. This generally implies that: (i) a resource-based project like a cement plant or a steel mill should be located close the source of basic material (for example, limestone in the case of a cement plant and iron-ore in the case of a steel plant); (ii) a project based on imported material may be located near a port; and (iii) a project manufacturing a perishable product should be close to the center of consumption.

However, for many industrial products proximity to the source of raw material or the center of consumption may not be very important. Petro-chemical units or refineries, for example, may be located close to the source of raw material, or close to the center of consumption, or at some intermediate point.

**(ii) Availability of infrastructure—** Availability of power, transportation, water, and communications should be carefully assessed before a location decision is made.

Adequate supply of power is a very important condition for location— insufficient power can be a major constraint, particularly in the case of an electricity-intensive project like an aluminium plant. In evaluating power supply the following should be looked into: the quantum of power available, the stability of power supply, the structure of power tariff, and the investment required by the project for a tie-up in the network of the power supplying agency.

For transporting the inputs of the project and distributing the outputs of the project, adequate transport connections—whether by rail, road, sea, inland water, or air— are required. The availability, reliability and cost of transportation for various alternative locations should be assessed.

Given the plant capacity and the type of technology, the water requirement for the project can be assessed. Once the required quantity is estimated, the amount to be drawn from the public utility system and the amount to be provided by the project from surface or sub-surface sources may be determined. For doing this the following factors may be examined: relative costs, relative dependabilities, and relative qualities.

In addition to power, transport, and water, the project should have adequate communication facilities like telephone and fax etc.

**(iii) Governmental policies—** Governmental policies have a bearing on location. In the case of public sector projects, location is directly decided by the government. It may be based on a wider policy for regional dispersion of industries.

In the case of private sector projects, location is influenced by certain governmental restrictions and inducements. The government may prohibit the setting up of industrial projects in certain areas which suffer from urban congestion. More positively, the government offers inducements for establishing industries in backward areas. These inducements consist of outright subsidies, concessional finance, tax relief, and other benefits.

**(iv) Other factors—** Several other factors have to be assessed before reaching a location decision: ease in coping with environmental pollution, labour situation, climatic conditions, and general living conditions.

A project may cause environmental pollution in various ways: it may throw gaseous emission; it may produce liquid and solid discharges; it may cause noise, heat, and vibrations. The location study should analyse the costs of mitigating environmental pollution to tolerable levels at alternative locations.

The labour situation at alternative locations may be assessed in terms of: (i) the availability of labour, skilled, semi-skilled, and unskilled; (ii) the past trends in labour rates, the prevailing labour rates, and the projected labour rates; and (iii) the state of industrial relations judged in terms of the frequency and severity of strikes and lockouts and the attitudes of labour and management.

The climatic conditions (like temperature, humidity, wind, sunshine, rainfall, snowfall, dust and fumes, flooding, and earthquakes) have an important influence on location. They have a bearing on cost as they determine the extent of air-conditioning, de-humidification, refrigeration, special drainage, etc., required for the project.

General living conditions, judged in terms of cost of living, housing situation, and facilities for education, recreation, transport, and medical care, need to be assessed at alternative locations.

#### **4.2.7 Machinery and equipment**

The requirement of machinery and equipment is dependent on production technology and plant capacity. It is also influenced by the type of project. For a process-oriented industry, like a petrochemical unit, machinery and equipment required should be such that the various stages have to be matched well. The choice of machinery and equipment for a manufacturing industry is somewhat wider as various machines can

perform the same function with varying degrees of accuracy. For example, the configuration of machines required for the manufacture of refrigerators could take various forms. To determine the kinds of machinery and equipment requirement for a manufacturing industry, the following procedure may be followed: (i) Estimate the likely levels of production over time. (ii) Define the various machining and other operations. (iii) Calculate the machine hours required for each type of operation. (iv) Select machinery and equipment required for each function.

The equipment required for the project may be classified into the following types: (i) plant (process) equipment, (ii) mechanical equipment, (iii) electrical equipment, (iv) instruments, (v) controls, (vi) internal transportation system, and (vii) other machinery and equipment.

In addition to the machinery and equipment, a list should be prepared of spare parts and tools required. This may be divided into: (i) spare parts and tools to be purchased with original equipment, and (ii) spare parts and tools required for operational wear and tear.

*Constraints in selecting machinery and equipment*— In selecting the machinery and equipment, certain constraints should be borne in mind: (i) there may be a limited availability of power to set up an electricity intensive plant like, for example, a large electric furnace; (ii) there may be difficulty in transporting a heavy equipment to a remote location; (iii)

workers may not be able to operate, at least in the initial periods, certain sophisticated equipment such as numerically controlled machines; (iv) the import policy of the government may preclude the import of certain types of machinery and equipment.

#### **4.2.8 Structures and civil works**

Structures and civil works may be divided into three categories: (i) site preparation and development, (ii) buildings and structures, and (iii) outdoor works.

- (i) Site preparation and development—** This covers the following:
  - (i) grading and leveling of the site, (ii) demolition and removal of existing structures, (iii) relocation of existing pipelines cables, roads, powerlines, etc., (iv) reclamation of swamps, draining and removal of standing water, (v) connections for the following utilities from the site to the public network: electric power (high tension and low tension), water (use water and drinking water), communications (telephone, fax, etc.), roads, railway sidings, and (vi) other site preparation and developmental work.
  
- (ii) Buildings—** Buildings and structures may be divided into: (i) factory or process buildings; (ii) ancillary buildings required for stores, warehouses, laboratories, utility supply centers, maintenance services, and others; (iii) administrative buildings; (iv)

staff welfare buildings, cafeteria, and medical service buildings; and (v) residential buildings.

**(iii) Outdoor works—** Outdoor works cover (i) supply and distribution of utilities (water, electric power, communication, steam and gas); (ii) handling and treatment of emissions, wastages, and effluents; (iii) transportation and traffic arrangements (roads, railway tracks, paths, parking areas, sheds, garages, traffic signals, etc.): (iv) outdoor lighting; (v) landscaping; and (vi) enclosure and supervision (boundary wall, fencing, barriers, gates, doors, security posts, etc.).

#### **4.2.9 Project charts and layouts**

Once data is available on the principal dimension of the project— market size, plant capacity, required technology, equipment and civil works, conditions obtaining at plant site, and supply of inputs to the project— project charts and layouts may be prepared. These define the scope of the project and provide the basis for detailed project engineering and estimation of investment and production costs.

#### **4.2.10 Work Schedule**

The work schedule, as its name suggests, reflects the plan of work concerning installation as well as initial operation. The purpose of the work schedule is:

- To anticipate problems likely to arise during the installation phase and suggest possible means for coping with them.
- To establish the phasing of investments taking into account availability of finances.
- To develop a plant of operations covering the initial period (the running in period).

Often, it is found that the required inputs like raw material and power are not available in adequate quantity when the plant is ready for commissioning, or the plant is not ready when the raw material arrives.

### **4.3 FINANCIAL ANALYSIS**

Financial analysis is defined as the process of discovering economic facts about an enterprise and/or a project on the basis of an interpretation of financial data. Financial analysis also seeks to look at the capital cost, operations cost and operating revenue. The analysis decisively establishes a relationship between the various factors of a project and helps in maneuvering the project's activities. It also serves as a common measure of value for obtaining a clear-cut understanding about the project from the financial point of view.

An analysis of several financial tools provide an important basis for valuing securities and appraising managerial programmes. Financial analysis is vital in the interpretation of financial statements. It can

provide an insight into two important areas of management— return on investment and soundness of the company's financial position.

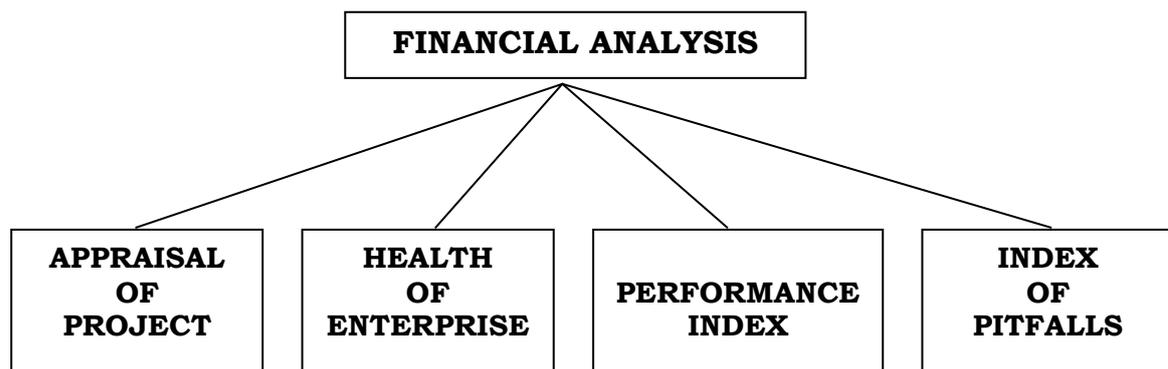
Internal management accounts provide information which is valuable for the purpose of control. The information is made available in the form of accounting data, which may be manifested as financial and accounting statements. A financial analysis reveals where the company stands with respect to profitability, liquidity, leverage and an efficient use of its assets. Financial reports provide the framework within which business planning takes place. They are the key through which an effective control of a business enterprise is exercised. It is the process of determining the significant financial characteristics of a firm. It may be external or internal. The external analysis is performed by creditors, stockholders and investment analysis. The internal analysis is performed by various departments of a firm.

#### **4.3.1 Significance of financial analysis**

Financial analysis primarily deals with the interpretation of the data incorporated in the proforma financial statements of a project and the presentation of the data in a form in which it can be utilized for a comparative appraisal of the projects. It is, in effect, concerned with the development of the financial profile of the project. Its purpose is to find out whether the project is attractive enough to secure funds needed for its various constituent activities and once having secured the funds,

whether the project will be able to generate enough economic values to achieve the objectives for which it is sought to be implemented. It deals not only with the financial aspects of a project but also with its operational aspects. As such, it is necessary to undertake such an analysis not only in the case of industrial projects but also in the case of non-industrial projects.

Analysis of financial statements has become very significant due to the widespread interest of various parties in the financial results of a company. In recent years, the ownership of capital of most public companies has become broad-based. A number of parties and bodies, including creditors, potential suppliers, debenture-holders, credit institutions like banks, industrial finance corporations, potential investors, employees, trade unions, important customers, economists, investment analysts, taxation authorities and government have a stake in the financial results of a company. Various people look at the financial statements from various angles. A number of techniques have been developed to undertake analysis of financial statements in order to reach conclusions about the financial health, profitability and efficiency of an enterprise and also to compare an enterprise with other similar undertakings. The technique of ratio analysis is the most important tool of financial analysis. It helps in comparing the performance of various companies and judge their financial soundness.



**Fig. 1. Utility of financial analysis**

#### **4.3.2 Utility of financial and accounting statements**

Financial statements play a vital role in the internal financial control of an enterprise. These should, therefore, be properly constructed, analyzed and interpreted by executives, bankers, creditors and investors.

The entire future of a company hinges on the manager's ability to decide relevant financial data with a view to planning profit ability moves. Learning to read financial statements is the first essential element in any businessman's attempt to acquire financial management skills. The change in the elitism of stock ownership to broad public ownership has necessitated a concomitant change in the entire process of reporting corporate financial results. The role of management in the matter of preparation of financial statements is to add understanding to these statements, the fairness of which is to be viewed through the eye of the user, while that of the accountant is to close the communication gap and of the auditor to add credibility to them. For evolving a good economic information system, accounting innovations are of great economic

information system. Without these, communication with the financial community would be difficult, the interest of present and future potential investors would not be served, the ability of the company to raise additional capital would be impaired and the government's regulatory measures and policies would not serve the best interest of society. Though a financial statement reveals less than it conceals, it provides the indicators of the enterprise's performance during the year.

Financial analysis seeks to spotlight the significant facts and relationships concerning managerial performance, viz., corporate efficiency, financial strengths and weaknesses and creditworthiness of the enterprise.

#### **4.4 SUMMARY**

Technical analysis is done continually when a project is being formulated. Technical analysis is concerned with materials and inputs, production technology, choice of technology, product mix, plant capacity, location, machinery and equipment, structure and civil works and project charts and layouts. Financial analysis seeks to look at the operating cost, operating revenue and capital cost. The purpose of financial analysis is to find out whether the project is attraction enough to secure funds needed for its various constituent activities and once having secured the funds, whether the project will be able to generate enough economic values to achieve the objectives for which it is sought to be implemented. The

future of a company depends on the manager's ability to decide relevant financial data with a view to profitability planning. A financial statement reveals less than it conceals, it provides the indicators of the performance of the enterprise during the year.

#### **4.5 KEYWORDS**

**Technical Analysis:** It establishes whether the project is technically feasible or not.

**Plant Capacity:** Plant capacity refers to the volume or number of units that can be manufactured during a given period.

**Site:** It refers to a specific piece of land where the project would be set-up.

**Financial Analysis:** It is the process of discovering economic facts about an enterprise and/or a project on the basis of interpretation of financial data.

#### **4.6 SELF ASSESSMENT QUESTIONS**

1. What aspects are considered in technical analysis?
2. Discuss the different aspects to be studied for making financial analysis of the project.
3. What factors have a bearing on choice of technology?

4. What considerations influence the choice of location of the project?

#### **4.7 SUGGESTED READINGS**

1. Projects Preparation, Appraisal, Budgeting and Implementation by Prasanna Chandra, Tata McGraw Hill Publishing Company Ltd., New Delhi.
2. Project Management by Vasant Desai, Himalaya Publishing House, New Delhi.
3. Dileep Kumar and Prabhu A.K.J., Project Management, Kalyani Publishers, Ludhiana.

## **LESSON: 5**

### **ANALYSIS OF PROJECT RISK, MARKET RISK AND FIRM RISK**

#### **STRUCTURE**

- 5.0 Objective
- 5.1 Introduction
- 5.2 Analysis of project risks
- 5.3 Market risk
- 5.4 Firm risk
- 5.5 Summary
- 5.6 Keywords
- 5.7 Self assessment questions
- 5.8 Suggested readings

#### **5.0 OBJECTIVES**

After reading this lesson, you should be able to

- (a) Describe the procedure for analyzing the project risk.
- (b) Explain the various forms of market risk.
- (c) Discuss about firm risk and its types.

## **5.1 INTRODUCTION**

It is a well established fact that every project involves risk. Moreover, it is a practice to include a short summary of project risks in the project appraisal report. There are certain projects for which economic benefits can be quantified while for others, such quantification is not possible. Firm risk stem from technological change in production process, managerial inefficiency, availability of raw material, labour problems and changes in consumer preferences. The financial risk considers the difference between EBIT and EBT while business risk causes the variations between revenue and EBIT. These are ways and means to reduce the project risks.

## **5.2 ANALYSIS OF PROJECT RISKS**

It is the normal practice to include a short summary of project risks in each appraisal report. The purpose of this chapter is to provide a summary of project risks in order to help ensure uniformity and consistency in appraisal reports. Section-1 relates to projects for which economic benefits can be quantified and section-2 deals with projects for which such quantification is not possible.

### **5.2.1 Projects with quantified benefits**

The economic internal rate of return (EIRR) is the measure most often used to indicate the economic viability of financed projects. Calculation of

the EIRR requires a set of assumptions regarding the conditions faced by the project which in the judgement of the appraisal mission are most likely to prevail during its life. However, since bank financed projects normally have a very long life, the conditions faced by the project may change for a variety of reasons. Sensitivity analysis is, therefore, carried out to determine the effects of possible changes in the values of key variables (costs, yields, and price of inputs and outputs) on the project's EIRR.

The number of risks facing a project could be large, and it is neither possible nor desirable to identify all possible risks associated with a project. The risks discussed in the appraisal report should essentially be those which entail major economic consequences. These should be identified from the sensitivity analysis and described in descending order of importance with regard to their impact on the EIRR.

Particular attention should be paid to risks that would substantially reduce the project's EIRR or render the project uneconomic by reducing its EIRR below the opportunity cost of capital. In this context, both the base-case EIRR and the sensitivity indicators are relevant. If the base-case EIRR is high, the discussion of project risks should generally include risks to which the project is highly sensitive. For example, the EIRR of most projects is highly sensitive to changes in project output, which may in turn depend on a number of factors. A discussion of the safeguards employed to minimize the risk of the outputs falling

substantially below the level expected should therefore be included. For example, in an irrigation project, apart from the availability of water, output may depend on the supply of other inputs, provision of extension services, effectiveness of water management by farmer's groups, and availability of adequate infrastructure and storage facilities. Measures taken to ensure adequate and timely availability of each should be briefly explained.

Risks are obviously greater in projects for which the base-case EIRR is only marginally higher than the opportunity cost of capital. These larger risks are even greater if the EIRR is highly sensitive to changes in key variables since even a small reduction in the EIRR would render the project unviable. Even when the EIRR is relatively insensitive to changes in key variables, combinations of adverse changes might easily affect the project's viability. Thus, in such cases, the remedial action proposed or adopted should be fully explained.

If the project output is traded internationally, one risk may be future changes in the price of the output, particularly if the share of a project or the country's output is small relative to the world market. In such cases, a review of world demand and supply forecasts for the good in question should be included.

By their very nature, certain types of projects such as gas and oil exploration involve very high risks. For such projects, it is necessary to

supplement the sensitivity analysis with a probability analysis. The latter provides a range of possible outcomes in terms of a probability distribution and based on that project related decision could be made more intelligently. But the analysis is more complex and requires more information about events affecting the project. Due to the considerable work involved,, probability analysis of risks is usually undertaken only for project carrying a high degree of risk or for large projects where miscalculations could lead to a major loss to the economy. For such projects, the nature of the risks involved and the measures taken or recommended to minimize the risks, together with the results of the analyses, should be discussed in the appraisal report.

### **5.2.2 Projects for which benefits are not quantifiable**

For projects in certain sectors or sub-sectors such as education, health, sanitation and family planning, project benefits cannot be quantified and the risks cannot be measured by sensitivity analysis. In such cases, the relationship of project risks to the project's objectives should be explained. The eventualities that might impede the realization of the objectives should be discussed in relation to the project cost and output, and also in relation to the socio-economic objectives sought by the project.

In such projects, the risks are greater on the benefit side than on the cost side. For instance, in education projects, school buildings and equipment

are provided to help achieve a prescribed annual output of graduates with a certain skill level. However, provision of the facilities alone may not ensure achievement of the project objectives. Their achievement may depend more upon the availability of trained teachers, provision of sufficient funds for the recurring expenditures of the institutions, curriculum and admission standards, and motivation of the students.

While it is not possible to eliminate all such risks, it is essential to minimize them. Major risks of this type should be identified and explained along with the remedial measures proposed in the section in which project risks are discussed.

The real benefits of this type of project relate to broad socio-economic goals. For education projects, these may include increased income level for the trainees and a higher level of industrial and agricultural productive. For family planning projects, the broad goals may be an increased number of acceptors and a consequent reduction in the rate of population growth. The success of these projects depends not merely on the facilities provided, but also on the continued favourable conditions assumed by the appraisal mission. For such projects, the assumptions made regarding the relationship between the facilities provided and project's long-term objectives should be clearly explained. The conditions or facilities necessary but external to the project should also be identified, together with relevant assurances received from the

government. For projects such as these, this is one of the most important aspects to be discussed in the section dealing with project risks.

### **5.3 MARKET RISK**

The market risk affects all the projects in an industry and not a particular project. In this section, the concept of market risk has been explained with respect to factors which are beyond the control of individual corporates. The market risk is further sub-divided into:

**(i) Security market risk:** Often we read in the newspaper that the stock market is in the bear hug or in the bull grip. This indicates that the entire market is moving in a particular direction either downward or upward. The economic conditions, political situations and the sociological changes affect the security market. The recession in the economy affects the profit prospect of the industry and the stock market. The 1998 recession experienced by developed and developing countries has affected the stock markets all over the world. The South East Asian crisis has affected the stock market world wide. These factors are beyond the control of the corporate and the investor. They cannot be entirely avoided by the investor. It drives home the point that the market risk is unavoidable.

Jack Clark Francis has defined market risk as that portion of total variability of return caused by the alternating forces of bull and

bear markets. When the security index moves upward haltingly for a significant period of time, it is known as bull market. In the bull market, the index moves from a low level to the peak. Bear market is just a reverse to the bull market; the index declines haltingly from the peak to a market low point called trough for a significant period of time. During the bull and bear market more than 80 per cent of the securities' prices rise or fall along with the stock market indices.

The forces that affect the stock market are tangible and intangible events. The tangible events are real events such as earthquake, war, political uncertainty and fall in the value of currency. Another example that can be cited is the Pokhran blast on May 13, 1998, and the fall of BSE sensx by 162 points. Impending sanctions, dampened sentiments and FIIs selling of stocks set a bear phase. Several examples like fall in the value of rupee and post-budget blue can be cited for triggering the bear phase.

Intangible events are related to market psychology. The market psychology is affected by the real events. But reactions to the tangible events become over reactions and they push the market in a particular direction. Take for instance, the bull run in 1994 FII's investment and liberalization policies gave buoyancy to the market. The market psychology was positive. Small investors entered the market and prices of stocks without adequate supportive

fundamental factors soared up. In 1996, the political turmoil and recession in the economy resulted in the fall of share prices and the small investors lost faith in the market. There was a rush to sell the shares and the stocks that were floated in the primary market were not received well.

Thus, any untoward political or economic event would lead to a fall in the price of the security which would be further accentuated by the over reactions and the herd like behaviour of the investors. If some financial institutions start disposing the stocks, the fear grips in and spreads to other investors. This results in a rush to sell the stocks. The actions of the financial institutions would have a snowballing effect. This type of over reaction affects the market adversely and the prices of the scrips' fall below their intrinsic values. This is beyond the control of the corporate.

- (ii) Interest rate risk:** Interest rate risk is the variation in the single period rates of return caused by the fluctuations in the market interest rate. Most commonly interest rate risk affects the price of bonds, debentures and stocks. The fluctuations in the interest rates are caused by the changes in the government monetary policy and the changes that occur in the interest rates of treasury bills and the government bonds. The bonds issued by the government and quasi-government are considered to be risk free. If higher interest rates are offered, investor would like to switch his

investments from private sector bonds to public sector bonds. If the government to tide over the deficit in the budget floats a new loan/bond of a higher rate of interest, there would be a definite shift in the funds from low yielding bonds to high yielding bonds and from stocks to bonds.

Likewise, if the stock market is in a depressed condition, investors would like to shift their money to the bond market, to have an assured rate of return. The best example is that in April 1996, most of the initial public offerings of many companies remained under subscribed but IDBI and IFC bonds were oversubscribed. The assured rate of return attracted the investors from the stock market to the bond market.

The rise or fall in the interest rate affects the cost of borrowing. When the call money market rate changes, it affects the badla rate too. Most of the stock traders trade in the stock market with the borrowed funds. The increase in the cost of margin affects the profitability of the traders. This would dampen the spirit of the speculative traders who use the borrowed funds. The fall in the demand for securities would lead to a fall in the value of the stock index.

Interest rates not only affect the security traders but also the corporate bodies who carry their business with borrowed funds.

The cost of borrowing would increase and a heavy outflow of profit would take place in the form of interest t the capital borrowed. This would lead to a reduction in earnings per share and a consequent fall in the price of share.

**(iii) Purchasing Power Risk:** Variations in the returns are caused also by the loss of purchasing power of currency. Inflation, is the reason behind the loss of purchasing power. The level of inflation proceeds faster than the increase in capital value. Purchasing power risk is the probable loss in the purchasing power of the returns to be received. The rise in price penalizes the returns to the investor, and every potential rise in price is a risk to the investor.

The inflation may be demand-pull or cost-push inflation. In the demand pull inflation, the demand for goods and services are in excess of their supply. At full employment level of factors of production, the economy would not be able to supply more goods in the short run and the demand for products pushes the price upward.d the supply cannot be increased unless there is an expansion of labour force or machinery for production. The equilibrium between demand and supply is attained at a higher price level.

The cost-push inflation, as the name itself indicates that the inflation or the rise in price is caused by the increase in the cost.

The increase in the cost of raw material, labour and equipment makes the cost of production high and ends in high price level. The producer tries to pass the higher cost of production to the consumer. The labourers or the working force try to make the corporate to share the increase in the cost of living by demanding higher wages. Thus, the cost push inflation has a spiraling effect on price level.

#### **5.4 FIRM RISK**

Firm risk is unique and peculiar to a firm or an industry. Firm risk stems from managerial inefficiency, technological change in the production process, availability of raw material, changes in the consumer preference, and labour problems. The nature and magnitude of the above mentioned factors differ from industry to industry, and company to company. They have to be analysed separately for each industry and firm. The changes in the consumer preference affect the consumer products like television sets, washing machine, refrigerators, etc. more than they affect the iron and steel industry. Technological changes affect the information technology industry more than that of consumer product industry. Thus, it differs from industry to industry. Financial leverage of the companies that is debt-equity portion of the companies differs from each other. The nature and mode of raising finance and paying back the loans, involve a risk element. All these factors from the firm risk and contribute a portion

in the total variability of the return. Broadly, firm risk can be classified into:

1. Business risk
2. Financial risk

**1. Business risk:** Business risk is that portion of the firm risk caused by the operating environment of the business. Business risk arises from the inability of a firm to maintain its competitive edge and the growth or stability of the earnings. Variation that occurs in the operating environment is reflected on the operating income and expected dividends. The variation in the expected operating income indicates the business risk. For example take ABC and XYZ companies. In ABC company, operating income could grow as much as 15 per cent and as low as 7 per cent. In XYZ company, the operating income can be either 12 per cent or 9 per cent. When both the companies are compared, ABC company's business risk is higher because of its high variability in operating income compared to XYZ company. Thus, business risk is concerned with the difference between revenue and earnings before interest and tax. Business risk can be divided into external business risk and internal business risk.

**(a) Internal Business Risk:** Internal business risk is associated with the operational efficiency of the firm. The operational efficiency differs from company to company. The efficiency of operation is

reflected on the company's achievement of its pre-set goals and the fulfillment of the promises to its investors. The various reasons of internal business risk are discussed below:

- (i) Fluctuations in the sales—** The sales level has to be maintained. It is common in business to lose customers abruptly because of competition. Loss of customers will lead to a loss in operational income. Hence, the company has to build a wide customer base through various distribution channels. Diversified sales force may help to tide over this problem. Big corporate bodies have long chain of distribution channel. Small firms often lack this diversified customer base.
- (ii) Research and development (R&D)—** Sometimes the product may go out of style or become obsolescent. It is the management, who has to overcome the problem obsolescence by concentrating on the in-house research and development program. For example, if Maruti Udyog has to survive the competition, it has to keep its Research and Development section active and introduce consumer oriented technological changes in the automobile sector. This is often carried out by introducing sleekness, seating comfort and break efficiency in their automobiles. New products have to be produced to replace the old one. Short sighted cutting of R & D budget would reduce the operational efficiency of any firm.

- (iii) Personnel management—** The personnel management of the company also contributes to the operational efficiency of the firm. Frequent strikes and lock outs result in loss of production and high fixed capital cost. The labour productivity also would suffer. The risk of labour management is present in all the firms. It is up to the company to solve the problems at the table level and provide adequate incentives to encourage the increase in labour productivity. Encouragement given to the labourers at the floor level would boost morale of the labour force and leads to higher productivity and less wastage of raw materials and time.
- (iv) Fixed cost—** The cost components also generate internal risk if the fixed cost is higher in the cost component. During the period of recession or low demand for product, the company cannot reduce the fixed cost. At the same time in the boom period also the fixed factor cannot vary immediately. Thus, the high fixed cost component in a firm would become a burden to the firm. The fixed cost component has to be kept always in a reasonable size, so that it may not affect the profitability of the company.
- (v) Single product—** The internal business risk is higher in the case of firm producing a single product. The fall in the demand for a single product would be fatal for the firm. Further, some products are more vulnerable to the business cycle while some products resist and grow against the tide. Hence, the company has to

diversify the products if it has to face the competition and the business cycle successfully. Take for instance, Hindustan Lever Ltd., which is producing a wide range of consumer cosmetics is thriving successfully in the business. Even in diversification, diversifying the product in the unknown path of the company may lead to an internal risk. Unwidely diversification is as dangerous as producing a single good.

**(b) External risk—** External risk is the result of operating conditions imposed on the firm by circumstances beyond its control. The external environments in which it operates exert some pressure on the firm. The external factors are social and regulatory factors, monetary and fiscal policies of the government, business cycle and the general economic environment within which a firm or an industry operates. A government policy that favours a particular industry could result in the rise in the stock price of the particular industry. For instance, the Indian sugar and fertilizer industry depend much on external factors. The various external factors are being discussed below:

**(i) Social and regulatory factors—** Harsh regulatory climate and legislation against the environmental degradation may impair the profitability of the industry. Price control, volume control, import/export control and environment control reduce the profitability of the firm. This risk is more in industries related to

public utility sectors such as telecom, banking and transportation. The governments' tariff policy of the telecom sector has a direct bearing on its earnings. Likewise, the interest rates and the directions given in the lending policies affect the profitability of the banks. Calcutta Electric and Supply Company (CESC) has not been able to increase its power tariff due to the stiff resistance by the West Bengal government. The Pollution Control Board has asked to close most of the tanneries in Tamil Nadu, which has affected the leather industry.

**(ii) Political risk—** Political risk arises out of the change in the government policy. With a change in the ruling party, the policy also changes. When Sri. Manmohan Singh was the finance minister, liberalization policy was introduced. During the Bharathiya Janta Party government, even though efforts are taken to augment the foreign investment, more stress is given to Swadeshi. Political risk arises mainly in the case of foreign investment. The host government may change its rules and regulations regarding the foreign investment. From the past, an example can be cited. In 1977, the government decided that the multinationals must dilute their equity and share their growth with the Indian investors. This forced many multinationals to liquidate their holdings in the Indian companies.

**(iii) Business cycle**— The fluctuations of the business cycle lead to fluctuations in the earnings of the company. Recession in the economy leads to a drop in the output of many industries. Steel and white consumer goods industries tend to move in tandem with the business cycle. During the boom period, there would be hectic demand for steel products and white consumer goods. But at the same time, they would be hit much during the recession period. At present, the information technology industry has resisted the business cycle and moved counter cyclically during the recession period. The effects of the business cycle vary from one company to another. Sometimes, companies with inadequate capital and consumer base may be forced to close down. In some other case, there may be a fall in the profit and the growth rate may decline. This risk factor is external to the corporate bodies and they may not be able to control it.

## **2. Financial risk**

It refers to the variability of the income to the equity capital due to the debt capital. Financial risk in a company is associated with the capital structure of the company. Capital structure of the company consists of equity funds and borrowed funds. The presence of debt and preference capital results in a commitment of paying interest or pre fixed rate of dividend. The residual income alone would be available to the equity holders. The interest payment affects the payments that are due to the

equity investors. The debt financing increases the variability of the returns to the common stock holders and affects their expectations regarding the return. The use of debt with the owned funds to increase the return to the share holders is known as financial leverage.

Debt financing enables the corporate to have funds at a low cost and financial leverage to the shareholders. As long as the earnings of a company are higher than the cost of borrowed funds, shareholders' earnings are increased. At the same time when the earnings are low, it may lead to bankruptcy to equity holders. This can be illustrated with the help of the following example:

	Years		
	1996	1997	1998
<b>Company A</b>			
Equity capital Rs. 10 per share	20,00,000	20,00,000	20,00,000
Debt fund (10% interest)	10,00,000	10,00,000	10,00,000
Operating income	30,00,000	40,00,000	20,00,000
Earning per share	1.0	1.5	0.5
<b>Company B</b>			
Equity capital Rs. 10 per share	10,00,000	10,00,000	10,00,000
Debt fund (10% interest)	20,00,000	20,00,000	20,00,000
Operating income	30,00,000	40,00,000	20,00,000
Earnings per share	1.0	2.0	Nil

The above example deals with three different situations. In the year 1996, both the companies earned the same amount and the earnings per share were same. But, in the year 1997 there was 33.33 per cent hike in the earnings of the two companies. In company A 33.33 per cent rise in operating income has resulted in a 50 per cent increase in earnings per share. In the company B, earnings per share has increased by cent per cent i.e. from Rs. 1 to Rs. 2, because the bond holders receive only the fixed interest whether the company fared well or not. The increase in earnings per share would cause a change in the capital appreciation in the shares of the “B” company during a good year.

In the year 1998, the economic climate has changed and there is a fall in the operating profit by 33.33 per cent for both the companies. This has caused 50 per cent fall in earnings per share for company a compared to 1996. But company “B”s earnings per share has fallen to zero and the shareholders are affected adversely in the bad year,. If we assume another situation of negative earnings, the situation would be worse in company B and the shareholders will be affected much. A few years of persistent negative earnings will erode the shareholders’ equity. Fixed return on borrowed capital either enhances or reduces the return to shareholders.

The financial risk considers the difference between EBIT and EBT (earnings before tax). The business risk causes the variations between revenue and EBIT. The payment of interest affects the eventual earnings

of the company stock. Thus, volatility in the rates of return on the stock is magnified by the borrowed money. The variations in income caused by the borrowed funds in highly levered firms are greater compared to the companies with low leverage. The financial leverage or financial risk is an avoidable risk because it is the management who has to decide, how much to be funded with the equity capital and borrowed capital.

## **5.5 SUMMARY**

As the problems and risk facing each project are unique, it is not possible to prescribe a standard format. The selection of project risks to be presented must thus be based on the appraisal mission's judgement. Nevertheless, the discussion of the project risks in the appraisal report should be concise, and should normally not exceed two or three paragraphs.

## **5.6 KEYWORDS**

**Market Risk:** It is that portion of total variability of return caused by the alternating forces of bull and bear markets.

**Interest Rate Risk:** Interest rate risk is the variation in the single period rates of return caused by the fluctuation in the market interest rate.

**Business Risk:** It is that portion of the firm risk caused by the operating environment of the business.

**External Risk:** It is the result of operating conditions imposed on the firm by circumstances beyond its control.

**Political Risk:** Political risk arises out of the change in the government policy.

### **5.7 SELF ASSESSMENT QUESTIONS**

1. Discuss the procedure for analyzing the project risk.
2. Explain the various forms of market risks.
3. “Market risks are not firm specific”. Elucidate.
4. Discuss the various reasons of internal business risks.

### **5.8 SUGGESTED READINGS**

1. Projects Preparation, Appraisal, Budgeting and Implementation by Prasanna Chandra, Tata McGraw Hill Publishing Company Ltd., New Delhi.
2. Project Management by Vasant Desai, Himalaya Publishing House, New Delhi.
3. Project Management by C. Chaudhary, Tata McGraw Hill, New Delhi.

**LESSON: 6**  
**SOCIAL COST-BENEFIT ANALYSIS**

**STRUCTURE**

- 6.0 Objective
- 6.1 Introduction
- 6.2 Need for social cost benefit analysis
- 6.3 Procedure of social cost benefit analysis
- 6.4 Main feature of social cost benefit analysis
- 6.5 UNIDO approach
- 6.6 Little-Mirrless approach
- 6.7 SCBA in India
- 6.8 Public investment decision making in India
- 6.9 Limitation of SCBA
- 6.10 Summary
- 6.11 Keywords
- 6.12 Self assessment questions
- 6.13 Suggested readings

**6.0 OBJECTIVES**

After reading this lesson, you should be able to

- (a) Highlight the importance for conducting social-cost benefit analysis.
- (b) Explain the features of social-cost benefit analysis.
- (c) Discuss the UNIDO approach and Little-Mirrlees approach to social-cost benefit analysis.
- (d) Explain the social-cost benefit analysis in India.

**6.1 INTRODUCTION**

The term “social costs” refers to all those harmful consequences and damages which the community on the whole sustains as a result of productive processes and for which private entrepreneurs are not held responsible. The definition of the concept is comprehensive enough to include even certain “social opportunity costs”, avoidable wastes and social inefficiencies of various kinds. Implicit in such an appraisal is the assumption that the principal objective of investment decision-making is to maximize the net present value of monetary flow or some variant of it.

The social cost-benefit analysis is a tool for evaluating the value of money, particularly of public investments in many economies. It aids in making decisions with respect to the various aspects of a project and the design programs of closely interrelated projects. Cost benefit analysis has become important among economists and consultants in recent years.

## **6.2 NEED FOR COST-BENEFIT ANALYSIS**

The essence of the theory of social cost-benefit analysis is that it does not accept that the actual receipts of a project adequately measure social benefits and actual expenditures measure social costs. The reason is that actual prices may be an inadequate indicator of economic benefits and costs. For example, in developing countries like India, the prices of necessities are set low, despite their economic importance, while the prices of less essential goods are set high (through a system of taxes and duties). As a result, some projects which appear very profitable when

their outputs and inputs are valued at actual prices are, in fact, unattractive from the viewpoint of the national economy, while other apparently unprofitable projects have high economic returns. But the theory accepts that actual receipts and expenditures can be suitably adjusted so that the difference between them, closely analogous to ordinary profit, will properly reflect the social gain.

In Social-Cost Benefit Analysis (SCBA) the focus is on social costs and benefits of a project. These often tend to differ from the costs incurred in monetary terms and benefits earned in monetary terms by the project. The principal reasons for discrepancy are:

- (i) *Market imperfections:* Market prices, which form the basis for computing the monetary costs and benefits from the point of view of project sponsor, reflect social values only under conditions of perfect competition, which are rarely, if ever, realized by developing countries. When imperfections obtain, market prices do not reflect social values.

The common market imperfections found in developing countries are: (i) rationing, (ii) prescription of minimum wage rates, and (iii) foreign exchange regulation. Rationing of a commodity means control over its price and distribution. The price paid by a consumer under rationing is often significantly less than the price that would prevail in a competitive market. When minimum wage

rates are prescribed, the wages paid to labour are usually more than what the wages would be in a competitive labour market free from such wage legislations. The official rate of foreign exchange in most of the developing countries, which exercise close regulation over foreign exchange, is typically less than the rate that would prevail in the absence of foreign exchange regulation. This is why foreign exchange usually commands premium in unofficial transactions.

- (ii) *Externalities*: A project may have beneficial external effects. For example, it may create certain infrastructural facilities like roads which benefit the neighbouring areas. Such benefits are considered in SCBA, though they are ignored in assessing the monetary benefits to the project sponsors because they do not receive any monetary compensation from those who enjoy this external benefit created by the project. Likewise, a project may have a harmful external effect like environmental pollution. In SCBA, the cost of such environmental pollution is relevant, though the project sponsors do not incur any monetary costs.

It may be emphasized that externalities are relevant in SCBA because in such analysis all costs and benefits, irrespective to whom they accrue and whether they are paid for or not, are relevant.

- (iii) *Taxes and subsidies:* From the private point of view, taxes are definite monetary costs and subsidies are definite monetary gains. From the social point of view, however, taxes and subsidies are generally regarded as transfer payments and hence considered irrelevant.
- (iv) *Concern for savings:* Unconcerned about how its benefits are divided between consumption and savings, a private firm does not put differential valuation on savings and consumption. From a social point of view, however, the division of benefits between consumption and savings (which leads to investment) is relevant particularly in capital-scarce developing countries. A rupee of benefits saved is deemed more valuable than a rupee of benefits consumed. The concern of society for savings and investment is duly reflected in SCBA wherein a higher valuation is placed on savings and lower valuation is put on consumption.
- (v) *Concern for redistribution:* A private firm does not bother how its benefits are distributed across various groups in the society. The society, however, is concerned about the distribution of benefits across different groups. A rupee of benefit going to a poor section is considered more valuable than a rupee of benefit going to an affluent section.

- (vi) *Merit wants*: Goals and preferences not expressed in the market place, but believed by policy makers to be in the larger social interest, may be referred to as merit wants. For example, the government may prefer to promote adult education or a balanced nutrition programme for school-going children even though these are not sought by consumers in the market place. While merit wants are not relevant from the private point of view, they are important from the social point of view.

### **6.3 PROCEDURE OF SCBA**

The objective of social cost-benefit analysis is, in its widest sense, to secure and achieve the value of money in economic life by simply evaluating the costs and benefits of alternative economic choices and selecting an alternative which offers the largest net benefit, i.e. the highest margin of benefit over cost.

Very broadly, social-cost benefit analysis involves the following steps:

1. Estimates of costs and benefits which will accrue to the project-implementing body.
2. Estimates of costs and benefits which will accrue to individual members of society as consumers or as suppliers of factor input.
3. Estimates of costs and benefits which will accrue to the community.

4. Estimates of costs and benefits which will accrue to the National Exchequer.
5. Discounting the costs and benefits which accrue over a period of time to determine the feasibility of the project.

Here again, the non-quantifiable benefits are stated only in descriptive terms. These strategies will work towards the appropriate calculation of the profitability ratio. While this is the general approach to project formulation, implementation and evaluation, the same may be modified to suit the circumstances.

#### **6.4 MAIN FEATURES OF SOCIAL COST-BENEFIT ANALYSIS**

Prest and Turvey defined cost-benefit analysis as “a practical way of assessing the desirability of projects, where it is important to take a long view in the sense (looking at repercussions in the future as well as the near future and a wide view in the sense of allowing side-effects of many decisions relating to industries, regions etc.), i.e., it implies the enumeration and evaluation of all the relevant cost and benefits”. This definition focuses attention on the main features of cost-benefit analysis. It covers five distinct issues:

1. Assessing the desirability of projects in the public, as opposed to the private sector.
2. Identification of costs and benefits.

3. Measurement of costs and benefits.
4. The effect of (risk and uncertainty) time in investment appraisal.
5. Presentation of results– the investment criterion.

## **6.5 UNITED NATIONS INDUSTRIAL DEVELOPMENT**

### **ORGANISATION (UNIDO) APPROACH**

Towards the end of the sixties and in the early seventies two principal approaches for SCBA emerged: the UNIDO approach and the Little-Mirrlees approach. This section discusses the UNIDO approach; the following discusses the Little-Mirrlees approach.

The UNIDO method of project appraisal involves five stages:

1. Calculation of financial profitability of the project measured at market prices.
2. Obtaining the net benefit of project measured in terms of economic (efficiency) prices.
3. Adjustment for the impact of the project on savings and investment.
4. Adjustment for the impact of the project on income distribution.
5. Adjustment for the impact of project on merit goods and demerit goods whose social values differ from their economic values.

Each stage of appraisal measures the desirability of the project from a different angle.

The measurement of financial profitability of the project in the first stage is similar to the financial evaluation. So, skipping the first stage, the remaining stages are being discussed here.

### ***Net benefit in terms of economic (efficiency) prices***

Stage two of the UNIDO approach is concerned with the determination of the net benefit of the project in terms of economic (efficiency) prices, also referred to as shadow prices.

The UNIDO approach suggests three sources of shadow pricing, depending on the impact of the project on national economy. A project as it uses and produces resources may for any given input or output (i) increase or decrease the total consumption in the economy, (ii) decrease or increase production in the economy, (iii) decrease imports or increase imports, or (iv) increase exports or decrease exports.

If the impact of the project is on consumption in the economy the basis of shadow pricing is consumer willingness to pay. If the impact of the project is on production in the economy, the basis of shadow pricing is the cost of production. If the impact of project is on international trade— increase in exports, decrease in imports, increase in imports, or decrease in exports— the basis of shadow pricing is the foreign exchange value.

*Shadow pricing of tradable inputs and outputs:* A good is fully traded when an increase in its consumption results in a corresponding increase in import or decrease in export or when an increase in its production results in a corresponding increase in export or decrease in import. For fully traded goods, the shadow price is the border price, translated in domestic currency at market exchange rate. The above definition of a fully traded good implies that domestic changes in demand or supply affect just the level of imports or exports.

*Non-tradable inputs and outputs:* A good is non-tradable when the following conditions are satisfied: I) its import price (CIF price) is greater than its domestic cost of production and (ii) its export price (FOB price) is less than its domestic cost of production.

The valuation of non-tradables is done as per the principles of shadow pricing discussed earlier. On the output side, if the impact of the project is to increase the consumption of the product in the economy, the measure of value is the marginal consumers' willingness to pay; if the impact of the project is to substitute other production of the same non-tradable in the economy, the measure of value is the saving in cost of production. On the input side, if the impact of the project is to reduce the availability of the input to other users, their willingness to pay for the input represents social value; if the project's input requirement is met by additional production of it, the production cost of it is the measure of social value.

*Externalities:* An externality, also referred to as an external effect, is a special class of good which has the following characteristics: (i) It is not deliberately created by the project sponsor but is an incidental outcome of legitimate economic activity, (ii) It is beyond the control of the persons who are affected by it, for better or for worse. (iii) It is not traded in the market place.

An external effect may be beneficial or harmful. Examples of beneficial external effects are:

- (i) An oil company drilling in its own fields may generate useful information about oil potential in the neighbouring fields.
- (ii) The approach roads built by a company may improve the transport system in that area.
- (iii) The training programme of a firm may upgrade the skills of its workers thereby enhancing their earning power in subsequent employments.

Examples of harmful external effects are:

- (i) A factory may cause environmental pollution by emitting large volume of smoke and dirt. People living in the neighbourhood may be exposed to health hazards and put to inconvenience.
- (ii) The location of an airport in a certain area may raise noise levels considerably in the neighbourhood.

- (iii) A highway may cut a farmer's holding in two, separating his grazing land and his cowsheds, thereby adversely affecting his physical output.

Since SCBA seeks to consider all costs and benefits, to whomsoever they may affect, external effects need to be taken into account. The valuation of external effects is rather difficult because they are often intangible in nature and there is no market price, which can be used as a starting point. Their values are estimated by indirect means.

The above examples serve to emphasize the difficulties in measuring external effects. In view of this, some economists have suggested that these effects be ignored. In order to justify their suggestion, they argue that since a project is likely to have both beneficial and harmful external effects, one may not err much in assuming that the net effect would be zero. This argument, seemingly a rationalization for one's ignorance, lacks validity. External effects must be taken into account wherever it is possible to do so. Even if these effects cannot be measured in monetary terms, some qualitative evaluation must be attempted.

### **Measurement of the impact on distribution**

Stages three and four of the UNIDO method are concerned with measuring the value of a project in terms of its contribution to savings and income redistribution. To facilitate such assessments we must first

measure the income gained or lost by individual groups within the society.

For income distribution analysis, the society may be divided into various groups. The UNIDO approach seeks to identify income gains and losses by the following: (i) Project, (ii) Other private business, (iii) Government, (iv) Workers, (v) Consumers, (vi) External sector.

There are, however, other equally valid groupings.

The gain or loss to an individual group within the society as a result of the project is equal to the difference between shadow price and market price of each input or output in the case of physical resources or the difference between price paid and value received in the case of financial transaction.

**Savings impact and its value—** Most of the developing countries face scarcity of capital. Hence the governments of these countries are concerned about the impact of a project on savings and its value thereof. Stage three of the UNIDO method, concerned with this, seeks to answer the following questions:

- (i) Given the income distribution impact of the project what would be its effect on savings?
- (ii) What is the value of such savings to the society?

*Impact on savings* of a project is equal to

$$\sum \Delta Y_i \text{MPS}_i$$

where,  $\Delta Y_i$  = change in income of group i as a result of the project

$\text{MPS}_i$  = marginal propensity to save of group i

*Value of savings* of a rupee is the present value of the additional consumption stream produced when that rupee of savings is invested at the margin. The additional stream of consumption generated by a rupee of investment depends on the marginal productivity of capital and the rate of reinvestment from additional income. If the marginal productivity of capital is  $r$  and the rate of reinvestment from additional income  $a$ , the additional stream of consumption generated by a rupee of investment can be worked out. The consumption stream starts with  $r(1 - a)$  and grows annually at the rate of  $ar$  forever. Its present value when discounted at the social discount rate  $k$  is:

$$I = \frac{r(1-a)}{(1+k)} + \frac{r(1-a)(1+ar)}{(1+k)^2} + \dots + \frac{r(1-a)(1+ar)^{n-1}}{(1+k)^n} + \dots$$

$$= \frac{\frac{r(1-a)}{(1+k)}}{1 - \frac{(1+ar)}{(1+k)}} = \frac{r(1-a)}{(k-ar)}$$

where,  $I$  = social value of a rupee of savings (investment)

$r$  = marginal productivity of capital

$a$  = reinvestment rate on additional income arising from investment

$k$  = social discount rate.

**Income distribution impact**— Many governments regard redistribution of income in favour of economically weaker sections or economically backward regions as a socially desirable objective. Due to practical difficulties in pursuing the objective of redistribution entirely through the tax, subsidy, and transfer measures of the government, investment projects are also considered as instruments for income redistribution and their contribution toward this goal is considered in their evaluation. This calls for suitably weighing the net gain or loss by each groups, measured earlier, to reflect the relative value of income for different groups and summing them.

#### **Adjustment for merit and demerit goods**

In some case, the analysis has to be extended beyond stage four to reflect the difference between the economic value and social value of resources. This difference exists in the case of merit goods and demerit goods. A merit good is one for which the social value exceeds the economic value. For example, a country may place a higher social value than economic value on production of oil because it reduces dependence on foreign supplies. The concept of merit goods can be extended to include a socially desirable outcome like creation of employment. In the absence of the project, the government perhaps would be willing to pay unemployment compensation or provide mere make-work jobs.

In the case of a demerit good, the social value of the good is less than its economic value. For example, a country may regard alcoholic products as having social value less than economic value.

The procedure for adjusting for the difference between social value and economic value is as follows: (i) Estimate the economic value. (ii) Calculate the adjustment factor as difference between the ratio of social value to economic value and unity. (iii) Multiply the economic value by the adjustment factor to obtain the adjustment. (iv) Add the adjustment to the net present value of the project as calculated in stage four.

## **6.6 LITTLE-MIRRLEES APPROACH**

I.M.D. Little and J.A. Mirrlees have developed an approach (hereafter referred to as the L-M approach) to social cost benefit analysis. The LM technique assumes that a country can buy and sell any quantity of a particular good at a given world price. Hence, all traded inputs and outputs are valued at their international prices (CIF for importables and FOB for exportables) which is the opportunity cost/value of the particular good to the country. Every input is treated as a forex outgo and every output is treated as a forex inflow. All non-tradable inputs are valued at accounting prices. These costs are broken up into tradable goods and other non-traded goods. Following this chain of production, commodities that are either exported or imported are determined for application of

accounting prices. The theory assumes that non-tradables form an insignificant part of operating costs

Despite considerable similarities there are certain differences between the two approaches:

1. The UNIDO approach measures costs and benefits in terms of domestic rupees whereas the L-M approach measures costs and benefits in terms of international prices, also referred to as border prices.
2. The UNIDO approach measures costs and benefits in terms of consumption whereas the Little-Mirrlees approach measures costs and benefits in terms of uncommitted social income.
3. The stage-by-stage analysis recommended by the UNIDO approach focuses on efficiency, savings and redistribution considerations in different stages. The Little-Mirrlees approach, however, tends to view these considerations together.

## **6.7 SCBA IN INDIA**

In India, SCBA of projects is carried out mainly by the Project Appraisal Division of Planning Commission and the Central financial institutions.

## **Project Appraisal Division**

The Project Appraisal Division (PAD, hereafter) of the Planning Commission, set up in April 1972, was entrusted with the following functions:

1. To suggest standard formats for submission of projects and procedures for their techno-economic evaluation;
2. To conduct actual techno-economic evaluation of selected major projects and programmes posed to the Planning Commission;
3. To assist state government and central ministries in giving effect to standardized formats and procedures for project evaluation; and
4. To undertake and support research leading to progressive refinement of methodology and procedure of project evaluation.

The Project Appraisal Division follows a modified version of the L-M methodology. In order to eliminate the trade-offs between growth (efficiency) and equity, PAD divides investments into three categories: (i) capital-intensive industrial projects, (ii) infrastructural investments, and (iii) agriculture, rural development and related projects. The procedure followed by PAD for evaluating capital intensive industrial projects is described briefly below:

**Capital Intensive Industrial Projects**— Efficiency is the key criterion in the evaluation of capital intensive industrial projects which represent

about 20 per cent of the total projects appraised by PAD. The methodology followed for evaluating these projects is as follows:

1. All tradeable inputs and outputs are valued at border prices.
2. Transfer cost items (taxes, duties, etc.) are ignored.
3. All non-tradeable items, especially power and transport, are evaluated in terms of marginal cost.
4. Foreign exchange involved in the inputs and outputs are valued at specified premia.
5. Saving in domestic rupees rather than foreign exchange.

### **Central Financial Institution**

The Central financial institutions—ICICI, IFCI, and IDBI—appraise investment proposals primarily from the financial point of view. However, in recent years they have recognized the need for scrutinizing projects from the larger social point of view. ICICI was perhaps the first financial institution to introduce a system of economic analysis as distinct from financial profitability analysis. IFCI adopted a system of economic appraisal in 1979. Finally, IDBI also introduced a system for economic appraisal of projects financed by them. Though there are some minor variations, the three institutions follow essentially a similar approach which is a simplified version of the L-M approach. The appraisal procedure followed by IDBI is described below:

IDBI, in its economic appraisal of industrial projects, considers three aspects:

- Economic rate of return
- Effective rate of protection
- Domestic resource cost

**Economic rate of return—** The method followed by IDBI to calculate economic rate of return may be described as ‘partial Little-Mirrlees’ method because while international prices are used for valuation of tradeable inputs and outputs, L-M method is not followed in its entirety. The significant elements of IDBI’s method are described below:

1. International prices are regarded as the relevant economic prices and, hence, it is necessary to substitute market prices with international prices for all non-labour inputs and outputs.
2. For tradeable items, where international prices are directly available, CIF prices are used for inputs and FOB prices are used for outputs.
3. For tradeable items where international prices are not directly available and for non-tradeable items (like electricity, transportation, etc.) social conversion factors are used to convert actual rupee cost into social cost. In some cases (like land) a social conversion factor is applied directly to the actual rupee cost. In other cases (like transport) the actual rupee cost is broken down

into three components— tradeable component, labour component, and residual component— and these components are valued in social terms. Generally, the social cost of the tradeable component is obtained by multiplying it by a factor of 1/1.5; the social cost of labour component is obtained by multiplying it by a factor of 0.5 (shadow price of labour is considered to be 50 per cent of the actual); the social cost of the residual component is obtained by multiplying it by a factor of 0.5.

**Effective rate of protection—** The effective rate of protection (ERP) is calculated as follows:

$$\frac{\text{Value added at domestic prices} - \text{Value added at world prices}}{\text{Value added at world prices}} \times 100$$

**Domestic resource cost—** The domestic resource cost (DRC) is calculated as follows:

$$\frac{\text{Value added at domestic prices}}{\text{Value added at world prices}} \times \text{Exchange Rate}$$

## **6.8 PUBLIC INVESTMENT DECISION MAKING IN INDIA**

The public sector has been assigned a pre-eminent role in the Indian economy. Though public investment was made in the infrastructure even before independence, the bulk of the investment in the public sector has been made after independence. The public sector today commands a predominant position in many basic industries: coal, crude oil and

refining, steel, copper, basic drugs, locomotives, fertilizers, earth movers, machine tools, etc.

The public investment board (PIB) appraises and recommends the projects coming under the purview of the central government. The PIB is assisted by various agencies in its appraisal work. The criteria adopted by the PIB are as follows:

1. Conformity of the project with the priorities specified in the plan for allocation of funds.
2. Advisability of undertaking the project in the public sector or joint sector.
3. Adequacy of financial internal rate of return.
4. Adequacy of economic internal rate of return. (This is the internal rate of return of the stream of social costs and benefits.)
5. Contribution of the project to foreign exchange earnings.
6. Availability of plan funds and convenience of budgetary allocation.
7. Logical sequencing of project schedule.
8. Adequacy of safety and anti-pollution measures.
9. Soundness of marketing strategy.

## **6.9 LIMITATION OF SOCIAL COST-BENEFIT ANALYSIS**

The nature of social benefits and costs are such that there cannot be any standard method or technique applicable to all types of investment projects. A bridge, a road, a housing colony, or an industrial project will each require a different approach while identifying and measuring its social benefits and costs. For one thing, the nature of inputs and outputs of projects involving very large investment— and their impact on the ecology and people of the particular region and the country as a whole are bound to differ from case to case.

At another level too, the problems of qualification and measurement of social costs and benefits are formidable. This is because many of these costs and benefits are intangible and their evaluation in terms of money is bound to be subjective. Even with honesty of purpose, assessment of social good and social evil is likely to be tainted by the analyst's own ideas and subjective preferences and the resulting decision may not serve the socio-economic goals which might have been initially formulated.

Moreover, a successful application of the techniques of analysis depends upon the accuracy and reliability of forecasts. Even when evaluation of social costs and benefits has been completed for one project, it may be difficult to judge whether any other project would yield better results from the social point of view. If all possible alternative investments are sought to be socially assessed, the costs would be prohibitive.

However, the limitations of analysis should not deter one from applying the techniques so far evolved. The element of subjectivity can be reduced by cross-checks. Even economic assessments suffer from certain drawbacks due to distortions in the price-mechanism caused by imperfections in the labour market, government controls, tariffs and quotas, and price inflation. Finally, while the limitations should not be ignored, it would be a folly to disregard the gains of social evaluation of investments.

## **6.10 SUMMARY**

The social cost-benefit analysis is a very significant tool to assess the overall feasibility of a project, both in the private and public sectors by providing a useful framework for clarifying important issues and separating factors and judgements. Although the process is bound by limitation, its value is not diminished. Broadly, it is applicable to tactical decision-making within the broad planning framework that is based on a wider range of considerations, which are usually socio-political and socio-cultural in nature. As for the entrepreneurs, an awareness of social cost-benefit will enhance their contribution to society. In the coming years, efforts will be made by social scientists to perfect this analytical process by removing or overcoming the limitations and universally accepting it in deciding on a project. As in all matters of social evaluation, we would be on safer grounds if we could rely on objective standards of social minima and measure social costs in terms of shortfalls or deficiencies from such

minima. In short, economic science would then be said to deal with the problem of social economy and would finally prove its status as a system of knowledge concerned with the study of the nature and causes of wealth of nations. Thus, social costs, social returns and social values are important dimensions in project analysis.

### **6.11 KEYWORDS**

**Social Cost:** It refers to all those harmful consequences and damages which the community on the whole, sustains as a result of productive processes and for which private entrepreneurs are not held responsible.

**Social-Cost Benefit Analysis:** It is a tool for evaluating the value of money particularly of public investments.

**Non-tradable:** A good is non-tradable when its import price is greater than its domestic cost of production and its export price is less than its domestic cost of production.

### **6.12 SELF ASSESSMENT QUESTIONS**

1. Discuss the need for conducting social-cost benefit analysis.
2. Explain the UNIDO approach to conduct social-cost benefit analysis.
3. Write a detailed note on social-cost benefit analysis in India.
4. Discuss the limitations of social cost benefit analysis.

### **6.13 SUGGESTED READINGS**

1. Projects Preparation, Appraisal, Budgeting and Implementation by Prasanna Chandra, Tata McGraw Hill Publishing Company Ltd., New Delhi.
2. Project Management by Vasant Desai, Himalaya Publishing House, New Delhi.
3. Project Management and Control by C. Keshava Rao, Sultan Chand and Sons, New Delhi.

## Lesson - 7

# MULTIPLE PROJECTS AND CONSTRAINTS

### STRUCTURE

- 7.0 Objective
- 7.1 Introduction
- 7.2 Constraints
- 7.3 Method of ranking
- 7.4 Mathematical programming approach
- 7.5 Linear programming model
- 7.6 Integer linear programming modal
- 7.7 Summary
- 7.8 Keywords
- 7.9 Self assessment questions
- 7.10 Suggested Readings

### 7.0 OBJECTIVE

After reading this lesson, you should be able to

- a) Understand the constraints in the selection of new projects.
- b) Explain the techniques of mathematical programming that may be applied in project management.

### 7.1 INTRODUCTION

When investment projects are considered individually, any of the discounted cash flow technique may be applied for obtaining a correct accept or reject criteria. In an existing organisation, however, capital investment projects often cannot be considered individually or in isolation. This is because the pre-conditions for viewing projects

individually- project independence, lack of capital rationing, and project divisibility- are rarely, if ever, fulfilled. Under the constraints obtained in the real world, the so-called rational criteria per se may not necessarily signal the correct decision.

## 7.2 CONSTRAINTS

**Project Dependence :** Project A and B are economically dependent if the acceptance or rejection of one changes the cash flow stream of the other or affects the acceptance or rejection of the other. The most conspicuous kind of economic dependency occurs when projects are mutually exclusive. If two or more projects are mutually exclusive, acceptance of any one project out of the set of mutually exclusive project automatically precludes the acceptance of all other projects in the set. From an economic point of view, mutually exclusive projects are substitutes for each other. For example, the alternative possible uses of a building represent a set of mutually exclusive projects. Clearly if the building is put to one use, it cannot be put to any other use.

Economic dependency also exists when projects, even though not mutually exclusive, negatively influence each other's cash flows if they are accepted together. Bierman and Smidt have given an excellent illustration of this kind of economic dependency: a project for building a toll bridge and a project for operating a toll ferry. These two project are such that when they are undertaken together, the revenues of one will be negatively influenced by the other.

Further, the projects are said to have positive when there is complementarity between projects. If undertaking a project influences favourably the cash flows of another project, the two projects are complementary projects. Complementarity may be of two types: asymmetric complementarity and symmetric complementarity. In asymmetric complementarity, the favourable effect extends only in one direction.

**Capital Rationing:** Capital rationing exists when funds available for investment are inadequate to undertake all projects which are otherwise acceptable. Capital rationing may arise because of an internal limitation or an external constraint. Internal capital rationing is caused by a decision taken by the management to set a limit to its capital

expenditure outlays; or, it may be caused by a choice of hurdle rate higher than the cost of capital of the firm. Internal capital rationing, in either case, results in rejection of some investment projects which otherwise are acceptable.

External capital rationing arises out of the inability of the firm to raise sufficient amounts of funds at a given cost of capital. In a perfect market, a firm can obtain all its funds requirement at a given cost of capital. In the real world, however, the firm can raise only a limited amount of funds at a given cost of capital. Beyond a certain point, the cost of capital tends to increase.

**Project Indivisibility :** Capital projects are considered indivisible, i.e. a capital project has to be accepted or rejected in toto - a project cannot be accepted partially.

Given the indivisibility of capital projects and the existence of capital rationing, the need arises for comparing projects. To illustrate this point, consider an example. A firm is evaluating three projects A, B, and C which involve an outlays of Rs. 0.5 million, Rs. 0.4 million, and Rs. 0.3 million respectively. The net present value of these projects are Rs. 0.2 million, Rs. 0.15 million, Rs. 0.1 million respectively. The funds available to the firm for investment are Rs. 0.7 million. In this situation, acceptance of project A (project with the highest net present value) which yields a net present value of Rs. 0.2 million results in the rejection of projects B and C which together yield a combined net present value of Rs. 0.25 million. Hence, because of the indivisibility of projects, there is a need for the comparison of projects before the acceptance/rejection decisions are taken.

### **7.3 METHOD OF RANKING**

Two approaches are available for determining which project to accept and which projects to reject : (i) the method of ranking, and (ii) the method of mathematical programming. This section discusses the method of ranking ; the following section discusses the method of mathematical programming.

The method of ranking consists of two steps : (i) Rank all projects in a decreasing order according to their individual NPV's, IRR's or BCR's. (ii) Accept project in that order until the capital budget is exhausted.

The method of ranking, originally proposed by Joel Dean is seriously impaired by two problems: (i) conflict in ranking as per discounted cash flow criteria, and (ii) project indivisibility.

### **Conflict in Ranking**

In a given set of projects, preference ranking tends to differ from one criterion to another. For example, NPV and IRR criteria may yield different preference rankings. Likewise, there may be a discrepancy between the preference rankings of NPV and BCR (benefit cost ratio) criteria. When preference rankings differ, the set of projects selected as per one criterion tends to differ from the set of projects selected as per some other criterion. This may be illustrated by an example.

Consider a set of five projects, A, B, C, D, and E, for which the investment outlay, expected annual cash flow, and project life are as shown below:

Project	Investment outlay	Expected annual cash flow	Project life
	(Rs)	(Rs)	(Years)
A	10,000	4,000	12
B	25,000	10,000	4
C	30,000	6,000	20
D	38,000	12,000	16
E	35,000	12,000	9

The NPV, IRR and BCR for the five projects and the ranking along these dimensions are shown in Exhibit 7.1

**Exhibit 7.1 NPV, IRR and BCR for the Five Projects**

Project	NPV	NPV	IRR	IRR	BCR	BCR
	(Rs)	Ranking	(Per cent)	Ranking		Ranking
A	14,776	4	39	1	2.48	1
B	5,370	5	22	4	1.21	5
C	14,814	3	19	5	1.49	4
D	45,688	1	30	2	2.20	2
E	28,936	2	29	3	1.83	3

It is clear that in the above case the three criteria rank the projects differently. If there is no capital rationing, all the projects would be accepted under all the three criteria though internal ranking may differ across criteria. However, if the funds available are limited, the set of projects accepted would depend on the criterion adopted.

What causes ranking conflicts? Ranking conflicts are traceable to differing assumptions made about the rate of return at which intermediate cash flows are re-invested.

**Project Indivisibility**

A problem in choosing the capital budget on the basis of individual ranking arises because of indivisibility of capital expenditure projects. To illustrate, consider the following set of projects (ranked according to their NPV) being evaluated by a firm which has a capital budget constraint of Rs. 2,500, 000.

Project	Outlay	NPV
	Rs.	Rs.
A	1,500,000	400,000
B	1,000,000	350,000
C	800,000	300,000
D	700,000	300,000
E	600,000	250,000

If the selection is based on individual NPV ranking, projects A and B would be included in the capital budget- these projects exhaust the capital budget. A cursory examination, however, would suggest that it is more desirable to select projects B, C, and D. These three projects can be accommodated within the capital budget of Rs. 2,500,000, and have a combined NPV of Rs. 850,000, which is greater than the combined NPV of projects A and B.

### **Feasible Combinations Approach**

The above example suggests that the following procedure may be used for selecting the set of investments under capital rationing.

1. Define all combinations of projects which are feasible, given the capital budget restriction and project interdependencies.
2. Choose the feasible combination that has the highest NPV.

To illustrate this procedure, consider the following projects that are being evaluated by a firm which has a capital budget constraint of Rs. 3,000,000.

Project	Outlay	NPV
	Rs.	Rs.
A	1,800,000	750,000
B	1,500,000	600,000
C	1,200,000	500,000
D	750,000	360,000
E	600,000	300,000

Projects B and C are mutually exclusive. Other projects are independent

Given the above information the feasible combinations and their NPV are shown below:

Feasible combination	Outlay	NPV
	Rs.	Rs.
A	1,800,000	750,000
B	1,500,000	600,000
C	1,200,000	500,000
D	750,000	360,000
E	600,000	300,000
A and C	3,000,000	1,250,000
A and D	2,550,000	1,110,000
A and E	2,400,000	1,050,000
B and D	2,250,000	960,000
B and E	2,100,000	900,000
C and D	1,950,000	860,000
C and E	1,800,000	800,000
B,D and E	2,850,000	1,260,000
C, D and E	2,550,000	1,160,000

The most desirable feasible combination consists of projects B, D and E as it has the highest NPV.

#### **7.4 MATHEMATICAL PROGRAMMING APPROACH**

The ranking procedure described above becomes cumbersome as the number of projects increases and as the number of years in the planning horizon increases. To cope with a problem of this kind, it is helpful to use mathematical programming models. The advantage of mathematical programming models is that they help in determining the optimal solution without explicitly evaluating all feasible combinations.

A mathematical programming model is formulated in terms of two broad categories of equations: (i) the objective function, and (ii) the constraint equations. The objective function represents the goal or objective the decision maker seeks to achieve. Constraint equations represent restrictions-arising out of limitations of resources,

environmental restrictions, and managerial policies-which have to be observed. The mathematical model seeks to optimize the objective function subject to various constraints.

Though a wide variety of mathematical programming models is available, but we should discuss two types:

- Linear programming model.
- Integer programming model.

### 7.5 LINEAR PROGRAMMING MODEL

The linear programming model is based on the following assumptions :

- The objective functions and the constraint equations are linear.
- All the coefficients in the objective function and constraint equations are defined with certainty.
- The objective function is unidimensional.
- The decision variables are considered to be continuous.
- Resources are homogeneous. This means that if 100 hours of direct labour are available, each of these hours is equally productive.

#### Linear Programming Model of a Capital Rationing Problem

The general formulation of a linear programming model for a capital rationing problem is:

$$\text{Maximize} \quad \sum_{j=1}^n \text{NPV}_j X_j \quad (7.1)$$

$$\text{Subject to} \quad \sum_{j=1}^n \text{CF}_{jt} X_j \leq K_t \quad (t = 0, 1, \dots, m) \quad (7.2)$$

$$0 \leq X_j \leq 1 \quad (7.3)$$

where  $\text{NPV}_j$  = net present value of projects j  
 $X_j$  = amount of projects j accepted

$$CF_{jt} = \text{cash outflow required for project } j \text{ in period } t$$

$$K_t = \text{capital budget available in period } t$$

The following features of the model may be noted.

1. All the input parameters- $NPV_j, CF_{jt}, K_t$ - are assumed to be known with certainty.
2. The  $X_j$  decision variables are assumed to be continuous but limited by a lower restriction (0) and an upper restriction (1).
3. The NPV calculation is based on a cost of capital figure which is known with certainty.

### Lorie and Savage Problem

In their classic paper, "Three Problems in Rationing Capital," Lorie and Savage discussed the following nine-project, two-period problem:

Project	Net present value ( $NPV_j$ )	Cash outflow in period ( $CF_{j1}$ )	Cash outflow in period 2 ( $CF_{j2}$ )
1.	14	12	3
2.	17	54	7
3.	17	6	6
4.	15	6	2
5.	40	30	35
6.	12	6	6
7.	14	48	4
8.	10	36	3
9.	12	18	3

The linear programming formulation of this problem is as follows :

$$\text{Maximize } 14X_1 + 17X_2 + 17X_3 + 15X_4 + 40X_5 + 12X_6 + 14X_7 + 10X_8 + 12X_9$$

Subject to

$$12X_1 + 54X_2 + 6X_3 + 6X_4 + 30X_5 + 6X_6 + 48X_7 + 36X_8 + 18X_9 + S_1 = 50 \text{ Funds constraint for year 1}$$

$$\begin{array}{rcl}
3X_1 + 7X_2 + 6X_3 + 2X_4 + 35X_5 + 6X_6 & & \\
+ 4X_7 + 3X_8 + 3X_9 + S_2 & & = 20 \text{ Funds constraint for year 2} \\
X_1 + S_3 = 1 & X_4 + S_6 = 1 & X_7 + S_9 = 1 \\
X_1 + S_3 = 1 & X_4 + S_6 = 1 & X_7 + S_9 = 1 \\
X_2 + S_4 = 1 & X_5 + S_7 = 1 & X_8 + S_{10} = 1 \\
X_3 + S_5 = 1 & X_6 + S_8 = 1 & X_9 + S_{11} = 1
\end{array}
\left. \vphantom{\begin{array}{rcl} \\ \\ \\ \\ \end{array}} \right\} \begin{array}{l} \text{Upper limit} \\ \text{Upper limit} \\ \text{on project} \\ \text{acceptance} \end{array}$$

$$\begin{array}{l}
X_j \geq 0 \quad (j = 1, 2, \dots, 9) \\
S_i \geq 0 \quad (i = 1, 2, \dots, 11)
\end{array}$$

The linear programming solution for the above problem is shown in Exhibit 7.2 . From Exhibit 7.2 we find that

1. The basic variables (variables which take a positive value in the optimal solution) are  $X_1, X_3, X_4, X_6, X_7, X_9, S_4, S_7, S_8, S_9,$  and  $S_{10}$ . Their values are shown in the last coloumn of the tableau ( $X_1 = 1.0; X_3 = 1.0; X_4 = 1.0; X_6 = .969697,$  and so on).
2. The rest of the variables ( $X_2, X_5, X_8, S_1, S_2, S_3, S_5, S_6,$  and  $S_{11}$ ) are non-basic variables, which means that they take a zero value. A value of zero for  $X_1, X_3,$  and  $X_8$  means that these three projects are completely rejected in the optimal solution. A value of zero for  $S_1$  and  $S_2$  implies that the budgets of 50 in year 1 and 20 in year 2 are fully exhausted on the six accepted projects.

## 7.6 INTEGER LINEAR PROGRAMMING MODEL

Weingartner discussed the integer linear programming approach. The principal motivation for the use of integer linear programming approach are : (i) It overcomes the problem of partial projects which besets the linear programming model because it permits only 0 or 1 value for the decision variables. (ii) It is capable of handling virtually any kind of project interdependency.

The basic integer linear programming model for capital budgeting under capital rationing is as follows :

**Exhibit 7.2 Linear Programming Formulation of Optimum Lorie-Savage Nine-Project Problem**

	$X_1$	$X_2$	$X_3$	$X_4$	$X_5$	$X_6$	$X_7$	$X_8$	$X_9$	$S_1$	$S_2$	$S_3$	$S_4$	$S_5$	$S_6$	$S_7$	$S_8$	$S_9$	$S_{10}$	$S_{11}$	RHS		
$X_1$	1.0											1.0										1.00	
$X_2$		1.0												1.0									1.00
$X_3$			1.0												1.0								1.00
$X_4$				1.0																			1.00
B	.455			5.91	1.0					-.015	.1818	-3.64			-2.73								.96969
a	1.068			-1.44			1.0	.75		.023	-.023	-2.05		-1.0	-0.91								.04545
s									1.0				1.0								1.0		1.00
i																							1.00
c																1.0							1.00
V																							1.00
a																							1.00
r																							1.00
i																							1.00
a	-455			5.91						0.15	.1818	.364		-1.0	.273		1.0				.273	.03030	
b	-1.068			.114						-.023	.023	.205			.091			1.0			.341	.95454	
I																							1.00
e																							1.00
s																							1.00
Z	0	3.41	0	0	29.32	0	0	.50	0	.1364	1.864	6.77	0	5.0	10.45	0	0	0	0	0	3.957	0.273	
$\mu_1$		$\mu_2$	$\mu_3$	$\mu_4$	$\mu_5$	$\mu_6$	$\mu_7$	$\mu_8$	$\mu_9$	$P_1$	$P_2$	$\gamma_1$	$\gamma_2$	$\gamma_3$	$\gamma_4$	$\gamma_5$	$\gamma_6$	$\gamma_7$	$\gamma_8$	$\gamma_9$			

$$\text{Maximize} \quad \sum_{j=1}^n X_j \text{NPV}_j \quad (7.4)$$

$$\text{Subject to} \quad \sum_{j=1}^n \text{CF}_{jt} X_j \leq \mathbf{K}_t(t=0,1,\dots,m) \quad (7.5)$$

$$X_j = (0, 1) \quad (7.6)$$

It may be noted that the only difference between this integer linear programming model and the basic linear programming model discussed earlier is that the integer linear programming model ensures that a project is either completely accepted ( $X_j = 1$ ) or completely rejected ( $X_j = 0$ ).

### **Incorporating Project Interdependencies in the Model**

By constraining the decision variables to 0 and 1, the integer linear programming model can handle almost any kind of project interdependency. To illustrate, let us see how the following kinds of projects interdependencies are incorporated in the integer linear programming model :

- Mutual exclusiveness
- Contingency
- Complementariness

*Mutual Exclusiveness* If two or more projects are mutually exclusive, acceptance of any one project out of the set of mutually exclusive projects, automatically precludes the acceptance of all other projects in the set. From an economic point of view, mutually exclusive projects are substitutes for each other. Mutual exclusiveness is reflected in the integer programming model by the following constraint :

$$\sum_{J \in J} X_j \leq 1 \quad (7.7)$$

where  $J =$  the set of mutually exclusive projects under consideration

$J \in J =$  an expression which means that project J belongs to set J

Constraint (7.7) means that the upper limit on the number of projects that can be selected from the set J is 1. This, of course, means that the firm may not select any project from the set J. If it is necessary to choose one project but only one project, constraint (7.11) would become :

$$\sum_{J \in J} X_j = 1 \quad (7.8)$$

An important variant of the mutual exclusiveness condition is one in which the firm may delay a projects for one or more years. Consider, for example, projects X :

Time	Cash flow
0	-10,000
1	3,000
2	3,000
3	3,000
4	3,000
5	3,000

The NPV of this project, given a cost of capital of 12 percent, is 814. If the firm can delay this project by 1 or 2 years, two new projects X' and X'' can be defined :

Time	Cash flow of X'	Cash flow of X''
0	-	-
1	-10,000	-
2	3,000	-10,000
3	3,000	3,000
4	3,000	3,000
5	3,000	3,000
6	3,000	3,000
7	-	3,000

The NPV's of projects X' and X'' to be included in the objective function are respectively 727 and 649. These values naturally differ from the NPV of X because of delays in cash flows associated with X' and X''. Since at best only one of the projects-X, X' and X''-can be accepted, the following constraint is incorporated in the integer linear programming model :

$$X + X' + X'' \leq 1 \quad (7.9)$$

*Contingency:* A contingency relationship between two or more projects implies that the acceptance of one project is contingent on the acceptance of some other project (s). For example, if project B cannot be accepted without accepting project A, we say that project B is contingent on project A. Put differently, project A is a prerequisite project for project B. Such a relationship is represented by the following constraint in the integer linear programming model.

$$X_B \leq X_A \quad (7.10)$$

It may be noted that as per constraint (7.10), project B can be accepted only when project A is accepted; project A however, can be accepted independently.

A project may be contingent on not one but two (or even more) projects. Suppose, the acceptance of project R is contingent on the acceptance of projects P and Q. Such a contingency relationship is reflected in the following constraint.

$$2X_R \leq X_P + X_Q \quad (7.11)$$

*Mutual Exclusiveness and Contingency :* Project dependency may reflect both mutual exclusiveness and contingency requirements. Some examples are described below :

1. P and Q are mutually exclusive projects; a third project, Z, is contingent on the acceptance of either P or Q. This condition is reflected in the following constraints:

$$X_P + X_Q \leq 1 \quad (7.12)$$

$$X_Z \leq X_P + X_Q \quad (7.13)$$

2. Out of the set of projects, A, B, C and D, only three projects can be accepted. Further, for accepting project E at least two projects out of the above set should be accepted. This condition is reflected in the following constraints :

$$X_A + X_B + X_C + X_D \leq 3 \quad (7.14)$$

$$2X_E \leq X_A + X_B + X_C + X_D \quad (7.15)$$

*Complementariness* If undertaking a project influences favourably the cash flows of an other project, the two projects are complementary projects. To illustrate how complementarity is reflected in the integer linear programming model, consider two projects R and S. Either of them can be accepted individually. However, if both are accepted together the following benefits will accrue : (i) The cost will reduce by 5 percent. (ii) The net cash inflow will increase by 10 percent. To reflect a complementary relationship of this kind, a composite project *RS* representing the combination of R and S is set up; the cash inflows of RS would be 10 percent higher than the sum of the cash inflows of R and S. Further, since it is not possible to accept R and S as well as RS, because the latter is the composite project consisting of R and S, the following constraint is incorporated in the integer linear programming formulation:

$$X_R + X_S + X_{RS} \leq 1 \quad (7.16)$$

### **Integer Linear Programming Formulation : An Illustration**

Consider the following projects.

Project	Net present value (NPV <sub>j</sub> )	Cash outflow in year 1 (CF <sub>j1</sub> )	Cash outflow in year 2 (CF <sub>j2</sub> )
1	44	50	48
2	30	40	22
3	20	10	40
4	25	36	5
5	35	25	60
6	24	43	15
7	42	40	0
8	28	33	14
9	60	75	48

The budget constraints for the two years are 150 and 180 respectively. The following project interdependencies obtain:

1. Projects 1 and 2 are mutually exclusive.
2. Out of the set of projects 4, 5, and 6 at least two must be accepted.
3. Project 9 cannot be accepted unless projects 4 and 6 are accepted.
4. Project 7 can be delayed by one year. Such a delay would not change the cash outflows but reduce NPV to 35.
5. Project 8 and 9 are complementary. If the two are accepted together, the total outflows will be less by 8 percent whereas the NPV will be more by 10 percent.

Given the nature of the problem, in addition to the decision variables  $X_1$  through  $X_9$  for the original 9 projects, few additional decision variables are required as follows:

$X_{10}$  is the decision variable to represent the delay of project 7 by one year.

$X_{11}$  is the decision variable for the composite project which represents the combination of projects 8 and 9.

The integer linear programming formulation is as follows:

$$\begin{aligned} \text{Maximize} \quad & 44X_1 + 30X_2 + 20X_3 + 25X_4 + 35X_5 + 24X_6 \\ & + 42X_7 + 28X_8 + 60X_9 + 35X_{10} + 96.8X_{11} \end{aligned}$$

Subject to

$$\begin{aligned} & 50X_1 + 40X_2 + 10X_3 + 36X_4 + 25X_5 + 43X_6 \\ & + 40X_7 + 33X_8 + 75X_9 + 0X_{10} + 99.4X_{11} \leq 150 \\ & 48X_1 + 22X_2 + 40X_3 + 5X_4 + 60X_5 + 15X_6 \\ & + 0X_7 + 14X_8 + 48X_9 + 40X_{10} + 47.88X_{11} \leq 180 \\ & X_1 + X_2 \leq 1 \\ & 2X_9 \leq X_4 + X_6 \\ & X_7 + X_{10} \leq 1 \end{aligned}$$

$$X_8 + X_9 + X_{11} \leq 1$$

$$X_j = \{0,1\} \quad j = 1, 2, \dots, 11$$

## **Evaluation**

The merits of the integer linear programming model are :

1. It overcomes the problem of partial projects which besets the linear programming model.
2. It is capable of handling virtually any kind of project interdependency.

The main limitations of the integer linear programming model are :

1. The solution of linear programming model takes considerably more time than the solution of the integer of the linear programming model. Pettway reported that for an integer linear programming model with 28 projects and 15 budget constraints, four out of six algorithms that he tried failed to reach an optimal solution in 5 minutes in CPU time on an IBM 360-65 system; the two algorithms which located the optimal solution took 118 seconds and 181 seconds. By contrast, the solution time for the linear programming model of the same problem would take just one to two seconds.
2. Meaningful shadow prices are not available for the integer programming formulation. This happens because the integer linear programming model permits only discrete variation, not continuous variation, of the decision variable. In the integer linear programming model, constraints which are not binding in the optimal solution are assigned zero shadow prices though the objective function would decrease when the availability of resources representing non-binding constraints, is diminished.

## **7.7 SUMMARY**

In the selection of new projects, there are many constraints which include project dependence, capital rationing and project indivisibility. Capital rationing exists when funds available for investment are inadequate to undertake all projects which are otherwise acceptable. Method of ranking and method of mathematical programming are the two approaches available for determining the acceptance or rejection of projects.

The method of ranking consists of ranking of all projects in a decreasing order according to their individual NPV or IRR or BCR and acceptance of projects in that order until the capital budget is exhausted. Mathematical programming models help in determining the optimal solution without explicitly evaluating all feasible combinations. The mathematical model seeks to optimize the objective function subject to various constraints. Linear programming model and integer programming model are the important types of mathematical programming model.

### **7.8 KEYWORDS**

**Capital Rationing:** It exists when funds available for investment are inadequate to undertake all project which are otherwise acceptable.

**Project Indivisibility:** When a capital project is to accepted or rejected in toto and cannot be accepted partially it is said to be project in divisibility.

**Mathematical Programming Model:** It is a model which helps in determining the optimal solution without explicitly evaluating all feasible combinations.

### **7.9 SELF ASSESSMENT QUESTIONS**

1. Discuss the sources of capital rationing.
2. Construct a set of five projects for which there is conflict in ranking as per the NPV, IRR, and BCR criteria.
3. Describe the feasible combinations approach. Illustrate it with a numerical example.
4. What assumptions underlie the linear programming model?
5. Critically evaluate the integer linear programming model as a tool for capital budgeting.
6. Discuss the following in the context of a goal programming model: objective function, economic constraints, and goal constraints.

## **7.10 SUGGESTED READING**

J.H. Lorie and L.J.Savage, “Three Problems in Rationing Capital,” Journal of Business, vol. 28 (Oct 1955), pp. 227-239.

Prasanna Chandra : Project, Tata Mc Graw Hills

Joel Dean : Capital Budgeting, Columbia University Press.

Martin H.Weingartner : Mathematical Programming and Analysis of Capital Budgeting Problems, Prentice Hall.

## **Lesson - 8**

# **NETWORK TECHNIQUES FOR PROJECT MANAGEMENT**

### **STRUCTURE**

- 8.0 Objective
- 8.1 Introduction
- 8.2 PERT/CPM : Background and Development
- 8.3 Development of Project Network
- 8.4 Time Analysis
  - 8.4.1 Time Estimation
  - 8.4.2 Determination of Critical Path
    - 8.4.2.1 Calculate the Earliest Occurrence Time (EOT) for each Event
    - 8.4.2.2 Calculate the Latest Occurrence Time (LOT) for each Event
    - 8.4.2.3 Calculate the Slack for each Event
    - 8.4.2.4 Obtain the Critical and Slack Paths
    - 8.4.2.5 Calculate the Activity Floats
    - 8.4.2.6 Scheduling
    - 8.4.2.7 Variability in Time Estimates :PERT Analysis
  - 8.5 Resource Analysis and Allocation
    - 8.5.1 Scheduling in view of Resource Constraints
    - 8.5.2 Project Crashing and Time-Cost Trade-offs: CPM Analysis
  - 8.6 Summary
  - 8.7 Keywords
  - 8.8 Self assessment questions
  - 8.9 Suggested Readings

### **8.0 OBJECTIVE**

After reading this lesson, you should be able to

- a) Explain the role of network techniques in project management.
- b) Make use of the network techniques for planning scheduling and controlling the different activities of the project.

## 8.1 INTRODUCTION

Projects are successful if they are completed on time, within budget, and to performance requirements. Management of any project involves planning, coordination and control of a number of interrelated activities with limited resources, namely men, machines, money and time. Furthermore, it becomes necessary to incorporate any change from the initial plan as they occur, and immediately know the effects of the change. Therefore the managers are compelled to look for and depend on a dynamic planning and schedule system which will not only produce the best possible initial plan and schedule, but will also sufficiently dynamic to react instantaneously to changes in the original plan and schedule. The question of such a dynamic system/ technique led to the development of *network analysis*. It provides a framework which :

- defines the job to be done,
- integrates them in a logical time sequence and finally,
- affords a system of dynamic control over the progress of the plan.

Network analysis is a generic name for a number of associated project planning and control procedures that are all based on the concept of network. PERT, an acronym for Program Evaluation and Review Technique and CPM, an acronym for Critical Path Method are the two widely used techniques of project management that were developed, independently and simultaneously, during the 1950s. The network analysis underlying PERT and CPM helps to support the three phases of effective project management.

### **Planning**

- identify the distinct activities,
- determine their durations and interdependencies,
- construct a network diagram,
- determine minimum overall project duration (using the network diagram),  
and
- identify the tasks critical (i.e. essential) to this minimum duration.

## **Scheduling**

- construct schedule ('time chart'),
- schedule contains start and finish times for each activity, and
- evaluate cost-time trade-offs (evaluate effects of putting extra money, people or machines in a particular task in order to shorten project duration).

## **Controlling**

- monitor/control project by use of network diagram,
- follow progress of the various activities ; and
- make adjustment where appropriate.

### **8.2 PERT/CPM : BACKGROUND and DEVELOPMENT**

PERT and CPM- both techniques use similar network models and methods and have the same general purpose. They were developed during the late 1950s. PERT was originally developed by the U S Navy's Special Product Office in cooperation with the consulting firm of Booz, Allen and Hamilton. It was developed as a network flow chart to facilitate the planning and scheduling of the Polaris Fleet Ballistic Missile Project, a massive project with about 250 contractors and about 9000 sub contractors and its application is credited with saving two years from the original of five years required to complete the project. Designed to handle risk and uncertainty, PERT is eminently suitable for research and development and programmes, aerospace projects, and other projects involving new technology. In such projects the time required for completing various jobs or activities can be highly variable. Hence the orientation of PERT is 'probabilistic'. CPM, is akin to PERT. It was developed (Independently) in 1956-57 by the Du Pont Company in the US to solve scheduling problems in industrial settings. CPM is primarily concerned with the trade-off between cost and time. It has been applied mostly to projects that employ fairly stable technology and are relatively risk free. Hence its orientation is 'deterministic'.

As both PERT and CPM approaches to Project Management use similar network models and methods, the term PERT and CPM are sometimes used interchangeably or collectively as PERT-CPM methods. The differences between those tools come from

how they treat the activity time. PERT treats activity time as a random variable whereas CPM requires a single deterministic time value for each activity. Another difference is that PERT focuses exclusively on the time variable whereas CPM includes the analysis of the time/Cost trade-off.

The PERT/CPM is capable of giving answers to the following questions to the project manager :

- when will the project be finished ?
- when is each individual part of the scheduled to start and finish ?
- of the numerous jobs in the project, which one must be timed to avoid being late ?
- is it possible to shift resources to critical jobs of the project from other non-critical jobs of the project without affecting the overall completion time of the project ?
- among all the jobs in the project, where should management concentrate its efforts at one time ?

Methodologically, PERT/CPM were developed from traditional GANTT Charts used for scheduling and reviewing the progress of activities. Developed by Harry Gantt in 1916, these charts give a time line for each activity. They are used for planning, scheduling and then recording progress against these schedules.

Basically there are two basic types of Gantt Charts : Load Charts and Project Planning Charts.

**Load Charts :** This type of chart is useful for manufacturing projects during peak or heavy load periods. The format of the Gantt Load Chart is very similar to the Gantt Project Planning Chart, but, Load Chart, uses time as well as departments, machines or employees that have been scheduled.

### **Project Planning Chart**

It addresses the time of individual work elements giving a time line for each activity of a project. This type of chart is the predecessor of the PERT. As it can be seen in the Figure, it is really easy to understand the graph, but in developing it you need to take

into consideration certain precedence relationship between the different activities of the project. On the chart, everyone is able to see when each activity start and finishes but there is no possibility to determine when each activity may start or if we can start a particular activity before finishing the immediate predecessor activity. Therefore, we need somehow know the precedence relationship between activities. This is the main reason for using the PERT/CPM tools instead of using exclusively Gantt Charts. Widely diverse kind of projects can be analyzed by the techniques of PERT/CPM. In fact they are suitable for any situation where :

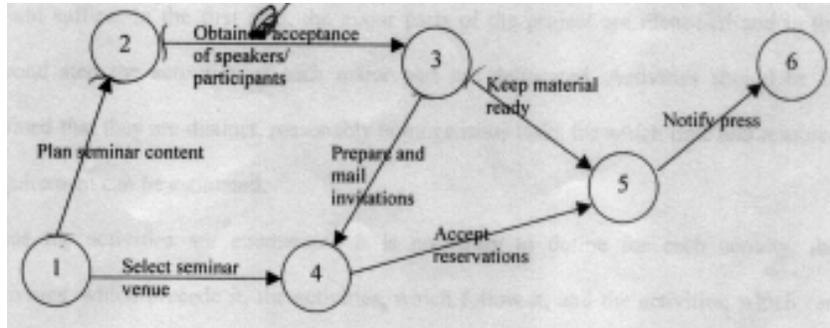
- (a) the project consists of well-defined collection of activities or tasks.
- (b) the activities can be started and terminated independently of each other, even if the resources employed on the various activities are not independent.
- (c) the activities are ordered so that they can be performed in a technological sequence. Thus precedence relationships exist which preclude the start of certain activities until other are completed. For instance, road levelling cannot start unless the roadbed is laid.

We now proceed to discuss the techniques to provide answers to the types of questions stated earlier. The initial step in each of these is to portray the given project graphically by means of network, which provide the basic tool for analysis.

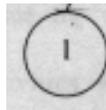
### **8.3 DEVELOPMENT OF PROJECT NETWORK**

Basic to network analysis is the networks diagram. Both the methods of PERT and CPM graphic representation of a project that it is called “Project Network” or “Project Diagram” or “CPM Diagram”, and it is used to portray graphically the interrelationships of the elements of a project and to show the order in which the activities must be performed. A simple network chart for a ‘Seminar Planning Project’ is shown in Figure 8.1 as an example.

**Figure 8.1 Project Network**



In order to represent a project network, two basic elements are used :



A circle called “**node**”, represents an event. An event describes a checkpoint. It does not symbolize the performance of work, but it represents the point in time in which the event is accomplished.



An arrow, called “**arc**”, represents an activity—a recognizable part of the project involving mental or physical work and requiring time and resources for its completion. The network will try to reflect all the relationships between the activities.

Since activities are the basic building blocks of a network diagram, it is necessary to enumerate all the activities of the project. For this purpose, it is helpful to break the project in several steps. The number of steps, of course, would depend on the magnitude and complexity of the project. For industrial projects generally a two-step procedure would suffice. In the first step, the major parts of the project are identified and in the second step the activities of each major part are delineated. Activities should be so defined that they are distinct, reasonably homogeneous tasks for which time and resources requirement can be estimated.

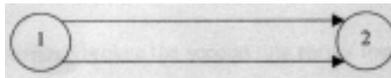
Once the activities are enumerated it is necessary to define for each activity, the activities, which precede it, the activities which follow it, and the activities which can take place concurrently. Given this information, the network diagram, showing the logical relationship between activities and events may be developed following either the forward method or the backward method.

The forward method begins with the initial events, marking the beginning of the project, and proceeds forward till the end event is reached. The backward method begins with the end event and works backwards till the beginning event is reached.

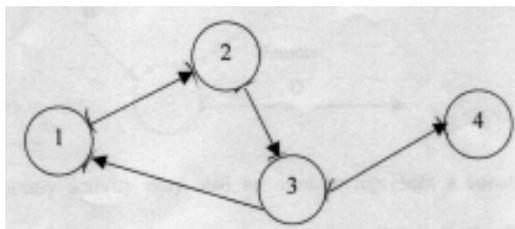
**Rules for constructing a project network :**

Three simple rules govern the construction of a project network :

- 1) Each activity must be represented by only one directed arc or arrow.
- 2) No two activities can begin and end on the same two nodes circle. A situation like the one shown in the following figure is not permissible.



- 3) There should be no loops in the network. A situation like the one shown in the figure given below is not permissible.

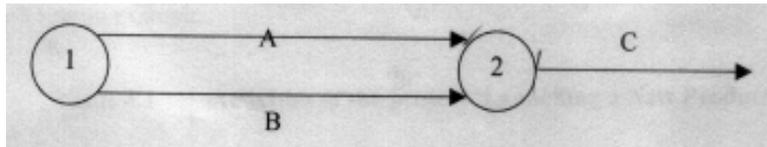


Another element to represent a project network is a “*dummy activity*”.

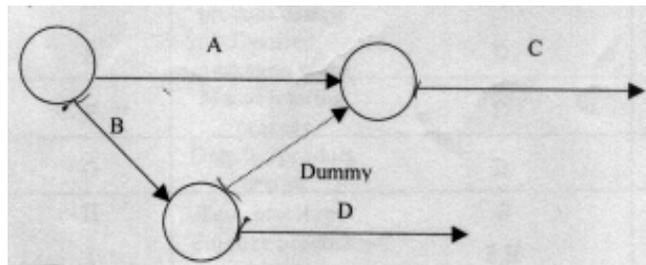
Tasks that must be completed in sequence but that don't require resources or completion time are considered to have event dependency. These are represented by dotted lines with arrows and are called dummy activities. To explain it, we will consider the following example :

ACTIVITY	IMMEDIATE PREDECESSOR
A	.....
B	.....
C	A,B
D	B

The temptation is to represent these relationships as :



But then we have broken the second earlier mentioned. To show that activities A and B precede C, whereas activity B precedes activity D, we use a dummy activity as shown in the following figure.



A dummy activity may also be used to represent a constraint necessary to show the proper relationship between activities. As shown in the following figure, activities A and B must be completed before activity C can be start, only activity B must be completed before activity D can start.

To construct a project network, first of all, we need a list of activities, showing the precedence relationships between the different activities involved is shown in Table 8.1 as an example.

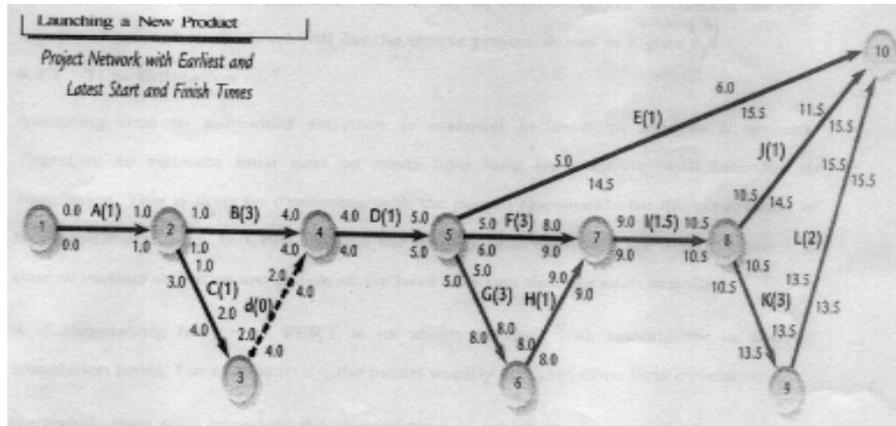
**Table 8.1 Activities of the Project ‘Launching a New Product’**

<b>ACTIVITY</b>	<b>NAME</b>	<b>IMMEDIATE PREDECESSOR</b>	<b>DURATION (months)</b>
A	Market analysis	.....	1
B	Product Design	A	3
C	Manufacturing study	A	1
D	Select best product design	B, C	1
E	Detailed marketing plans	D	1
F	Manufacturing process	D	3
G	Detailed project design	D	3
H	Test prototype	G	1
I	Finalize product design	F, H	1,5
J	Order components	I	1
K	Order production equipment	I	3
L	Install production equipment	K	2

Figure 8.2 shows the network with the Earliest Start time, Earliest Finish time, Latest Start time and Latest Finish time of the activities (these will be discussed later in the lesson).

Because each activity must have a unique pair of starting and ending nodes, we must use a dummy activity to draw the first four activities, as shown in the figure. Constructing a project network is a trial-and-error process. It usually takes two or three attempts to produce a neatly constructed network.

**Figure 8.2 Network of the Project ‘Launching a New Product’**



## 8.4 TIME ANALYSIS

Once the logic and details of the project network have been established, time estimates must be assigned to each activity. With this representation we can determine the minimum completion time for the project i.e. the critical path and the critical activities and the slack or float of other activities, so that we can find the activity schedule i.e. when each activity should start and when it may be completed. For discussing these aspects of network analysis we will use the simple project shown in Figure 8.3.

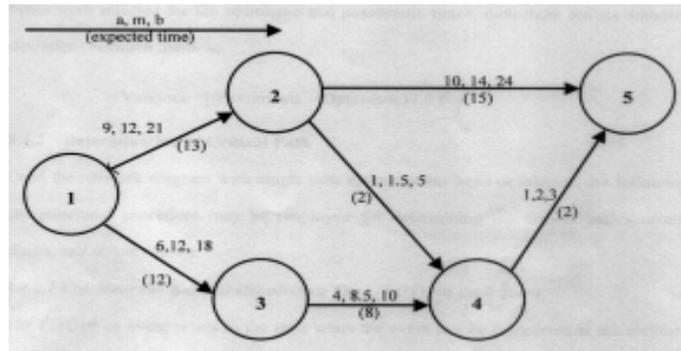
### 8.4.1 Time Estimation

Assigning time to individual activities is essential in order to analyze a network. Therefore an estimate must next be made how long each activity will take for its completion. This is done by discussing with the people responsible for the completion of the specific activities. In CPM analysis the activity time estimates are deterministic i.e. time of various activities are known so we have only one time for each activity.

A distinguishing feature of PERT is its ability to deal with uncertainty in activity completion times. For each activity, the model usually includes three times estimates: *Optimistic time (a)* - generally the shortest time in which the activity can be completed under ideal, favorable conditions. It is common practice to specify optimistic times to be three standard deviations from the mean so that there is approximately a 1% chance that the activity will be completed within the optimistic time.

*Most likely time (m)* - the completion time under the normal conditions, having the highest probability. Note that this time is different from the expected time.

**Figure 8.3 Network with Three Time Estimates (in weeks)**



*Pessimistic time (b)* - the longest time under worst, externally unfavorable conditions, which an activity might require. Three standard deviations from the mean is commonly used for the pessimistic time.

PERT assumes a beta probability distribution for the time estimates. For a beta distribution, the expected time for each activity can be approximated using the following weighted average :

$$\text{Expected time} = (\text{Optimistic} + 4 \times \text{Most likely} + \text{Pessimistic}) / 6$$

$$te=(a+4m+b)/6$$

This expected time might be displayed on the network diagram as shown in Figure 8.3

### 8.4.2 Determination of Critical Path

Once the network diagram with single time estimates has been developed, the following computational procedure may be employed for determining the critical path/s, event slacks, and activity floats.

#### 8.4.2.1 Calculate the Earliest Occurrence Time (EOT) for each Event.

The EOT of an event refers to the time when the event can be completed at the earliest. Looking at event we find that the since the paths leading to it, viz, (1-2-4) and (1-3-4) take 15 weeks and 20 weeks, respectively, the EOT of event 4 is 20 weeks. In general

terms, the EOT of an event is the duration of the longest path (from the beginning event whose EOT is set at 0) leading to that event. The EOTs of various events in our illustrative project are shown in Figure 8.4. It may be noted that in Figure 8.4 a circle represents an event. The upper half of the circle denotes the event number, the left quarter in the lower half denotes the EOT, and the right quarter in the lower half denotes the Latest Occurrence Time, (LOT) a term described the later.

The EOT of the end event obviously represents the minimum time required for completing the project. To obtain the EOT of various events we start from the beginning event and move forward towards the end event. This computational procedure is referred to as the *forward pass*. In this computation we assume that each activity starts immediately on the occurrence of the event preceding it. Hence the starting and finishing time for various activities obtained from this computation are the Earliest Starting Time (EST) and the Earliest Finishing Time (EFT).

The general formula for EOT is :

$$\mathbf{EOT (i) = Max [Eot(k) + d(k-i)]}$$

where EOT (i) = earliest occurrence time of event i

EOT (k)=earliest occurrence time of event k (k precedes i and there may be several k's)

d (k-i) = duration of activity (k-i)

The maximisation shown is done considering all activities (k-i) leading to event node i have been completed.

The formulae for EST and EFT are :

$$\mathbf{EST (i-j) = EOT (i)}$$

$$\mathbf{EFT (i-j) = EST (i-j)+d(i-j)}$$

where EST (i-j) = earliest starting time for activity (i-j)

EOT (i) = earliest occurrence time of event (i)

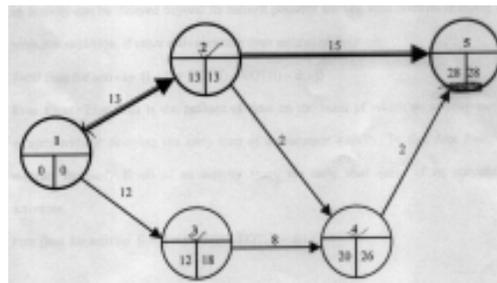
EFT (i-j) = earliest finishing time for activity (i-j)

d(i-j) = duration of activity (i-j)

#### 8.4.2.2 Calculate the Latest Occurrence Time (LOT) for each Event.

The LOT for an event represents the latest allowable time by which the event can occur, given the time that is allowed for the completion of the project (occurrence of end event). Normally the time allowed for the completion of the project is set equal to the EOT of the end event (In other words, the project is supposed to be completed at the earliest possible time). This means that for the end event the LOT and EOT are set equal. The LOT for various events is obtained by working backward for the end event. This procedure is known as the *backward pass*. The LOT for event 4 in our illustrative project, for example, is equal to the LOT for event 5, the end event, minus the duration of the activity (4-5), which connects event 4 with 5. Since the LOT for event 5 is 28 weeks and duration of activity (4-5) is 2 week the LOT for event 4 is 26 weeks (28-2). This represents the latest time by which event 4 should occur to enable the project to be completed in 28 weeks. Likewise, the LOT for other events can be calculated by moving backward. The LOT for various events is shown (in the right quarter of the lower half of event nodes) in Figure 8.4

**Figure 8.4 Network with EOT and LOT of Events**



The general formula for LOT is :

$$\text{LOT}(i) = \text{Min} [\text{LOT}(i) - d(i-j)]$$

where LOT(i) = latest occurrence time of event i

LOT(i) = latest occurrence time of event j (ij follows i & there may be several j's)

d(i-j) = duration of activity (i-j).

The minimization shown here is done with respect to all activities (i-j) starting from i  
 Given the LOT for various events we can calculate the Latest Finishing Time (LFT) and  
 Latest Starting Time (LST) for various activities

The formulae for LFT and LST are :

$$\mathbf{LFT (i-j) = LOT (i)}$$

$$\mathbf{LST (i-j) = LFT (i-j) -d (i-j)}$$

where LFT (i-j) = latest finishing time for activity (i-j)

LOT (j) = latest occurrence time of event (j)

LST (i-j) = latest starting time for activity (i-j)

d (i-j) = duration of activity (i-j)

#### ***8.4.2.3 Calculate the Slack for each Event***

The slack for an event is the difference between its LOT and EOT. The slacks for various  
 events of our illustrative project are shown in Table 8.2

**Table 8.2    Event Slack**

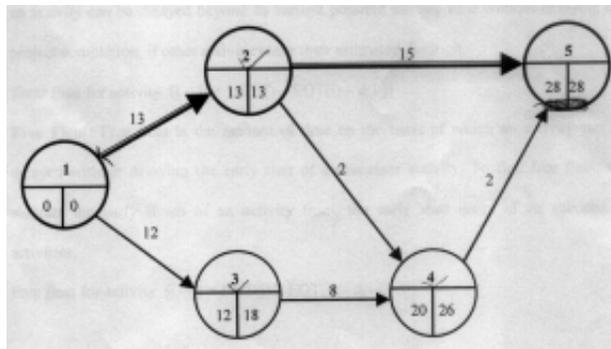
Event	LOT	EOT	Slack = LOT - EOT
1	0	0	0
2	13	13	0
3	18	12	6
4	26	20	6
5	28	28	0

#### ***8.4.2.4 Obtain the Critical and Slack Paths***

A path is a sequence of activities that leads from the starting node to the finishing  
 node. The critical path parts with the beginning event, terminates with the end event,  
 and is marked by events, which have a zero slack. This is obviously the path on which  
 here is no slack, no cushion. Other paths are slack paths with some cushion. The critical  
 path for our illustrative project is (1-2-5). Dark arrows in Figure 8.5 indicate it.

<b>Table 8.3 Critical and Slack Paths</b>			
Path	Activities	Duration	Path Slack
1-2-4-5	1-2, 2-4, 4-5	17	28 - 17 = 11
1-3-4-5	1-3, 3-4, 4-5	22	28-22 = 6
1-2-5	1-2, 2-5	28	0

**Figure 8.6 Critical Path in the Network**



The critical path is the longest path from the beginning event to the end event. Since the end can be reached, i.e., project completed, only when this longest path is traversed, the minimum time required for completing the project is the duration on the critical path. The duration on the critical path of our project is 28 weeks; this is the minimum time required completing the project. (It is already indicated by the EOT of event 5, the end event.)

#### **8.4.2.5 Calculate the Activity Floats**

Activity float analysis provides the information on the margin on allowance available for the commencement and completion of various activities. Activities with zero slack value represent activities on the critical path. Three types of activities floats are identified:

- Total float
- Free float
- Independent float

**Total Float :**Total float usually referred to as simply float or slack, is the amount of time an activity can be delayed beyond its earliest possible starting time without delaying the project completion, if other activities take their estimated duration.

$$\text{Total float for activity (i-j)} = \text{LOT}(i) - \text{EOT}(i) - d(i-j)$$

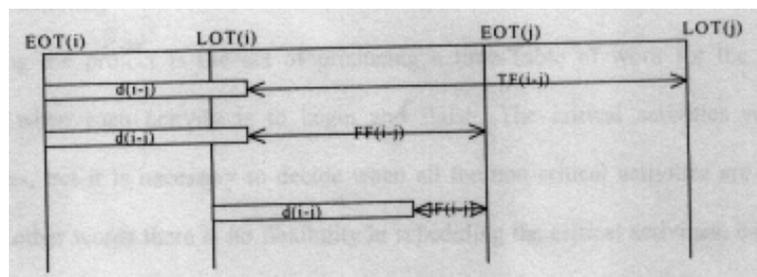
**Free Float :** Free float is the amount of time on the basis of which an activity can be delayed without delaying the early start of a successor activity. To find free float, we subtract the early finish of an activity from the early start times of its succeeding activities.

$$\text{Free float for activity (i-j)} = \text{EOT}(i) - \text{EOT}(i) - d(i-j)$$

**Independent Float :**This indicates the time span by which the activity (i-j) can be expanded or shifted if, for the event (i) the LOT and for the event (j) the EOT shall be maintained. A shifting of activity in this area has no influence on the further progress of the project. Independent float is taken as zero is negative.

$$\text{Independent float for activity (i-j)} = \text{EOT}(i) - \text{LOT}(i) - d(i-j)$$

The floats of various activities of our illustrative project are shown in Table 8.4



**Table 8.4 Activities Floats**

Activity	Duration	EST	EFT	LST	LFT	Total	Free	Independent
1-2	13	0	13	0	13	0	0	0
1-3	12	0	12	6	18	6	0	0
2-4	2	13	15	24	26	11	5	5
3-4	8	12	20	18	26	6	0	-6 i.e. 0
2-5	15	13	28	13	28	0	0	0
4-5	2	20	22	26	28	6	6	0

### 8.4.2.6 Scheduling

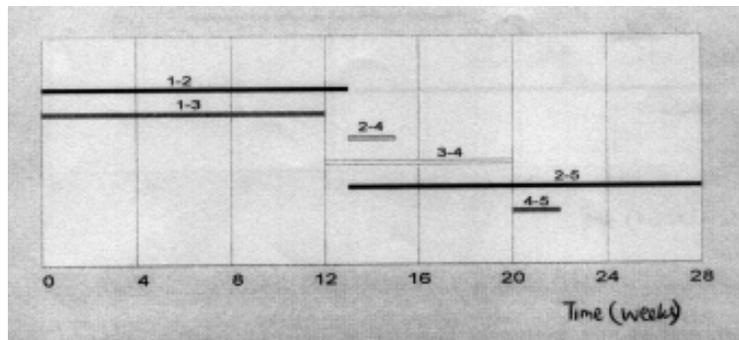
Scheduling the project is the act of producing a time-table of work for the project showing when each activity is to begin and finish. The critical activities schedule themselves, but it is necessary to decide when all the non-critical activities are to take place. In other words there is no flexibility in scheduling the critical activities, but floats available with non-critical activities provide flexibility in scheduling them. The choice available in this respect is bounded by two schedules: Early Start Schedule and Late Start Schedule

#### Early Start Schedule

The early start schedule refers to the schedule in which all activities start as possible. In this schedule

- all events occur at their earliest because all activities start at their earliest starting time and finish at their earliest finishing time;

**Figure 8.6: Early Start Schedule**



- there may be time lags between the completion of certain activities and the occurrence of events which these activities lead to; and
- all activities emanating from an event begin at the same time.

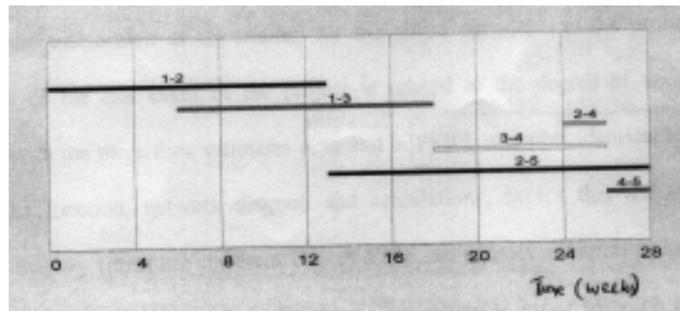
The early start schedule suggests a caution attitude towards the project and a desire to minimize the possibility of delay. It provides a greater measure of protection against uncertainties and adverse circumstances. Such a schedule, however, calls for an earlier application of resources.

## Late Start Schedule

The late start schedule refers to the schedule arrived at when all activities started as late as possible. In this schedule

- all events occur at their latest because all activities start at their latest finishing time;
- some activities may start after a time lag subsequent to the occurrence of the preceding events; and
- all activities leading to an event are completed at the same time.

**Figure 8.7: Late Start Schedule**



The late start schedule reflects a desire to commit resources late-as late as possible. However, such a schedule provides no elbow room in the wake of adverse developments. Any anticipated delay results in increased project duration.

The early start schedule and the late start schedule for our illustrative project are shown in Figure 8.6 and 8.7 respectively. Here the project schedules are shown as graphs with a horizontal time scale.

### **8.4.2.7 PERT Analysis Variability in Time Estimates :**

So far, we have discussed the procedure for determining the project completion time, the earliest and latest times for the start and completion of activities and the occurrence of events. In CPM analysis, activity duration are assumed to be known where as, in PERT, the activity duration is given by probability distributions.

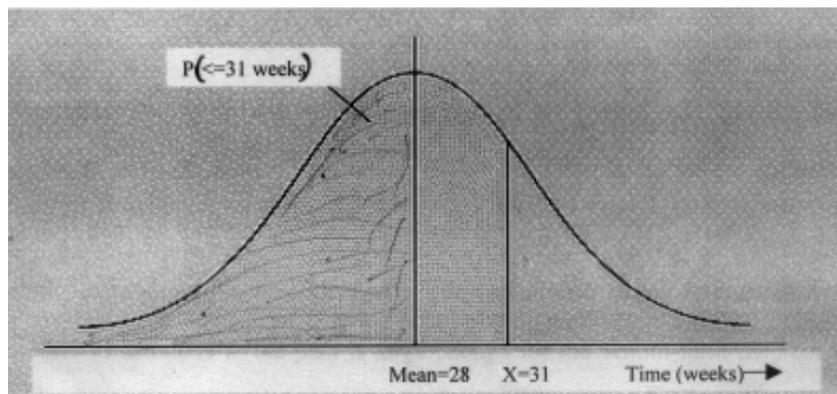
PERT calculates the expected duration of an activity as a weighted average of the three time estimates-optimistic (a), most likely (m) and pessimistic (b) The PERT network

provides a measure of the probability of completing the project by the scheduled date. The probability concept is only associated with PERT and not CPM, because, the activity time estimates in CPM are deterministic (i.e. known) and not probabilistic. In PERT, the assessment of uncertainty for the entire network i.e. the probability of occurrences of the end event of the project is related to the degree of uncertainty - associated with the three time estimates  $a, m$  and  $b$ .

PERT is almost identical to CPM to regard to its function, network diagram and calculations, except that the method of estimating activities times are different i.e., in CPM, an activity duration is based on a single time estimate, whereas, there are three time estimates made for each activity in PERT, which is converted into one time estimate (i.e., expected time  $t_e$ ) using the formula  $t_e = (a+4m+b)/6$

Variability in PERT analysis is measured by standard deviation or its square, variance. The variance in the project completion time can be calculated by summing the variances in the completion of the time activities in the critical path. Given the expected time and the variance, one can calculate the probability that the project will be completed by a certain time assuming a normal probability distribution for the critical path. The normal distribution assumption holds if the number of activities in the path is large enough for the central limit theorem to be applied.

**Figure 8.8 Normal Distribution of Critical Path Duration**



### Variance and Standard Deviation of activities :

To calculate the variance for each activity completion time, if three standard deviation times were selected for the optimistic and pessimistic times, then there are six standard deviations between them, so

$$\text{Variance} = [(\text{Pessimistic} - \text{Optimistic}) / 6]^2$$

$$\text{Standard Deviation} = [(\text{Pessimistic} - \text{Optimistic}) / 6]$$

**Table 8.5 Variance of activities**

Activity	b	A	Var = [(b-a) /6] <sup>2</sup>
1-2	21	9	4.00
2-5	24	10	5.44

### Variance and Standard Deviation of Critical Path :

$$\text{Variance} = [(\text{Pessimistic} - \text{Optimistic}) / 6 ]^2$$

$$= 4.00+5.44$$

$$= 9.44$$

$$\text{S.D} = (9.44)^{1/2}$$

$$= 3.07$$

Now we know that mean and standard deviation of the critical path duration for our project are 28 and 3.07 weeks, respectively. Given this information, we can calculate the probability that the project will be completed by a certain date.

### Probability of Completion by a Specified Date

- Convert our specific normal distribution into standard normal distribution (with mean and standard deviation equal to 0 and 1 restrictively) i.e.

$$\text{Find } z = (X - \text{mean}) / \text{s.d.}$$

- Obtain cumulative probability up to z looking at the probability distribution of the standard normal variate (see Figure 8.8)

**Example 1:** Find the probability of completing the project by 31 weeks

$$\begin{aligned}\text{Solution : } Z &= (31-28)/3.07 \\ &= 0.97\end{aligned}$$

Required probability

$$(P \leq 31 \text{ weeks}) = 0.8340$$

**Example 2 :** Find the probability of completing the project by 20 weeks

$$\begin{aligned}\text{Solution } Z &= (20-28)/3.07 \\ &= -2.6\end{aligned}$$

Required probability

$$(P \leq 20 \text{ weeks}) = 0.0197$$

## **8.5 RESOURCE ANALYSIS AND ALLOCATION**

In our discussion on the scheduling of activities in determining the scheduling timings, we have considered only the technological restriction, which lay that an activity in a project can not start unless all its predecessors have been scheduled and ignored the question of resource required the performing various activities. Now we will consider the question of resource requirement for different activities, the availability of resources and their allocation.

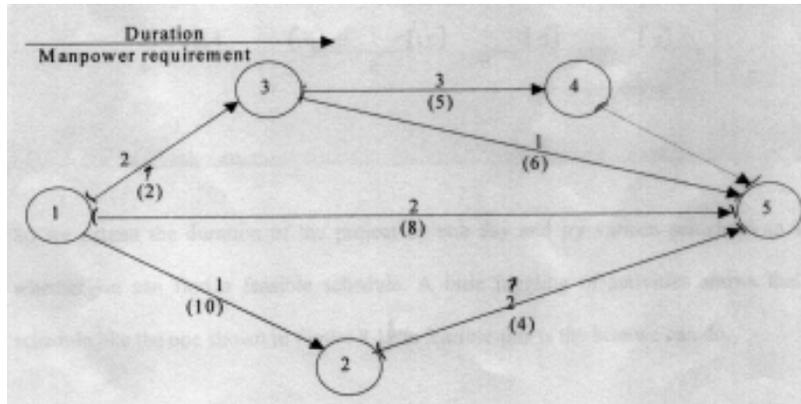
### **8.5.1 Scheduling in view of Resource Constraints**

In real life situations, there may be restrictions on the availability of resource. For example, manpower supply may be limited or funds made available period wise may be rigidly budgeted. When restrictions exist various schedules may have to be considered to find out which one is most appropriate in the light of these restrictions. We shall discuss two example to indicate the broad approach to scheduling in the face of resource constraints.

#### **Example 1: Scheduling to Match Availability of Manpower**

Let us consider a small project for which the network diagram is shown in Figure 8.9. In this project network, activity duration is shown above the activity arrow and manpower requirement is shown below the activity arrow.

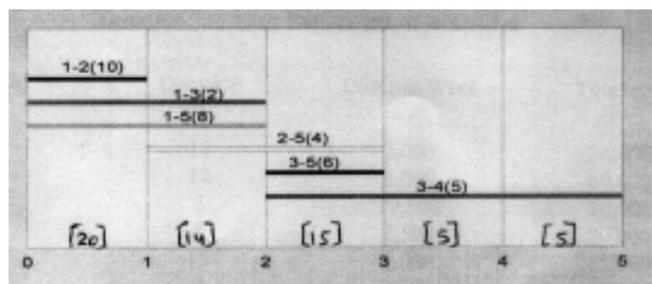
**Figure 8.9 Network with Manpower Requirement of Activities**



Only 12 men are available for the project (a manpower resource constraint). The early start schedule of this project is shown in Figure 8.10

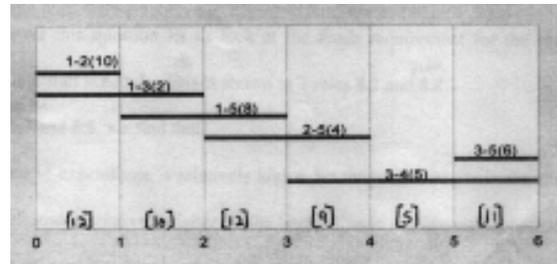
Looking at the manpower requirement for the early start schedule we find that it is 20 for the first day, 14 for the second day, 5 for the fourth day, and 5 for the fifth day. Obviously, this schedule is unacceptable in view of the manpower constraint. So, we explore the possibility of shifting activities. Our efforts of shifting activities, keeping the project duration at five days, soon reveals that no schedule is feasible with only 12 men.

**Figure 8.10 Early Start Schedule and Manpower Requirement**



So we extend the duration of the project by one day and try various schedules to see whether we can find a feasible schedule. A little juggling of activities shown that a schedule like one shown in Figure 8.11 is feasible-this is the best we can do.

**Figure 8.11 Schedule to Match Manpower Supply**



**Example 2 : Scheduling to Match the Release of Funds**

The cost estimates for various activities of our illustrative project are given in Table 8.6

**Table 8.6 Cost Estimates of Activities**

Activity	Duration	Cost per week	Total cost
1-2	13	2,000	26,000
1-3	12	5,000	60,000
2-4	2	10,000	20,000
3-4	8	2,500	20,000
2-5	15	1,000	15,000
4-5	2	7,500	15,000
<b>Total Cost</b>			<b>156,000</b>

The Management has decided to release Rs 156,000 required for the project, in the following manner :

Rs 69,000 in the first 12 weeks; Rs 68,000 in the next 12 weeks, and Rs 19,000 in the 12 weeks. It has also stipulated that the unspent amount would lapse and hence cannot be carried forward.

Before we develop the project schedule, a preliminary question may be asked: Is it possible *prima facie* to schedule this project without extending its duration beyond 28 weeks, which is the minimum time required given the network logic and activity duration? To answer question let us look at the funds requirement for the early start schedule and late start schedule. As shown in Table 8.7 and Table 8.8

From the tables, we find that :

- The rate of expenditure is relatively higher for the earlier stages in the early start schedule and is relatively higher for the later stages in the late start schedule.
- A rate of spending greater than that of the early start schedule is not possible. (This is so because in the early start schedule all activities start as early as possible.) Any release of funds above the early start schedule requirement curve is beyond the capacity of the project to spend.

**Table 8.7 Funds Requirements for ESS**

Weeks	Activities	Funds Required	Cumulative Total
1-12	1-2, 1-3	7*12	84
13	1-2, 3-4	4.5*1	88.5
14-15	2-4, 3-4, 2-5	13.5*5	115.5
16-20	3-4, 2-5	8.5*2	150
21-22	2-5, 4-5	1 * 1	151
23	2-5, 4-5	1 * 1	152
25-27	2-5	1 * 3	155
28	2-5	1 * 1	156

**Table 8.8 Funds Requirements for LSS**

Rs (in thousand)

Weeks	Activities	Funds Required	Cumulative Total
1-6	1-2,	2*6	12
1-12	1-2,1-3	7*6	54
13	1-2,1-3	7*1	61
14-18	1-3,2-5	6*5	91
19-24	3-4,2-5	3.5*6	112
25-26	2-4,3-4,2-5	13.5*2	139
27-28	2-5,4-5	8.5*2	156

- The rate of spending corresponding to the late start schedule is the absolute minimum necessary to complete the project on time. If the rate of spending is less than that corresponding to the late start schedule the project duration will have to be necessarily extended.
- A pattern of funds release lying between the two bounds, early start schedule requirements and late start schedule requirement, '*prima facie*' suggests that a schedule can be worked out without extending project duration.

Let us now look at the cumulative funds release pattern for our illustrative project. This lies between the early start schedule requirement and late start requirement. So '*prima facie*' it suggests that a feasible schedule without extending the project duration can be developed. Let us proceed further and consider scheduling to match the release of funds. The activities that begin in first 12 weeks, according to the early start schedule are (1-2) and (1-3). If both these activities are commenced as early as possible, the fund requirement for this period would be Rs 84,000. Since this amount exceeds Rs 69,000 (the amount to be released in first 12 weeks), the expenditure in this period has to be reduced by Rs 15,000. For this we consider the possibility of shifting activities to subsequent periods. Looking at activities (1-2) and (1-3) we find that (1-2) is on the critical path, so there is no flexibility available with respect to it. Activity (1-3), however, can be shifted, as it is not on the critical path. Since activity (1-3) requires Rs 5,000 per week, it has to be shifted by three weeks so that the amount spent in first 12 weeks is equal to the amount released in first 12 weeks. Since there is a free float of six weeks for activity (1-3), we shift it by three weeks.

We now go to the next period of 12 weeks. The effects of shifting activity (1-3) by three weeks are as follows.

- (a) The funds requirement for the next period of 12 weeks on account of activity (1-3) increases by Rs 15,000 over and above what it is for the early start schedule.
- (b) The earliest starting time for activity (3-4) moves to 15 weeks from 12 weeks and the earliest finishing time moves to 23 weeks from 20 weeks. Since this shift.

**Table 8.9 Funds Requirements for our Proposed Schedule**

Rs (in thousand)

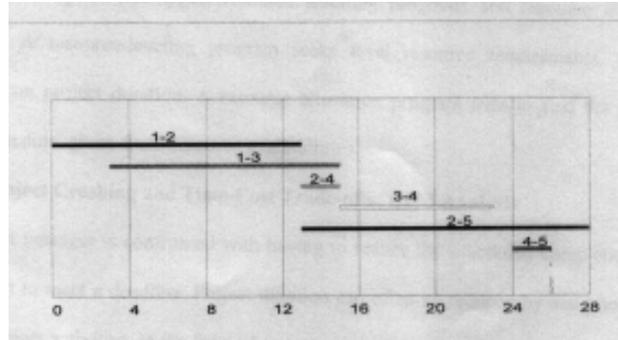
Weeks	Activities	Funds Required	Cumulative Total
1-3	1-2	2*3	6
4-12	1-2,1-3	7*9	69
13	1-2,1-3	7*1	76
14-15	1-3,2-4,2-5	16*2	108
16-23	3-4,2-5	3.5*8	136
24	2-5	1	137
25-26	2-5,4-5	8.5*2	154
27-28	2-5	1*2	156

occurs within the second period of 12 weeks, there is no change in funds requirement on account of activity (3-4).

(c) The earliest starting time for activity (4-5) moves to 23 weeks from 20 weeks and the earliest finishing time for activity (4-5) moves to 25 weeks from 23 weeks. This decreases the fund requirement for the second period of 12 weeks by the Rs 7,500.

The net effect, therefore, is to increase funds requirement funds by Rs 7,500 over and above what it is for the earliest start schedule. Hence the total requirement becomes Rs 68,000+Rs 7,500 = Rs 75,500. However, the funds budgeted for the second period of 12 weeks are only Rs 68,000. So we consider the possibility of shifting some activities to the third period of 12 weeks. We find that by shifting activity (4-5) to the third period of 12 weeks the expenditure in the second period of 12 weeks can be reduced to Rs 68,000, the budget of that period. As a result of this shifting the expenditure for the third period of 12 weeks (first four weeks of it) equals the budgeted funds release for this period. The schedule arrived at finally is shown in Figure 8.12.

**Figure 8.12 Schedule to Match Release of funds**



### ***Problems in Scheduling Real Life Projects***

In the above discussion we have considered simple examples comprising few activities and one constraints, to indicate the broad approach. In real life projects the activities run into hundreds and there may be several constraints. The problem of scheduling in such cases tends to become very complex. For solving such problems the technique of linear programming can be used. However, when a problem has numerous activities, say, more than 100, the technique of linear programming becomes computationally unwieldy and inordinately expensive, even with the aid of fastest computer available. In view of the practical difficulties in using linear programming for solving large scale scheduling problems, heuristic programs have been developed.

A heuristic is a rule of thumb like ‘schedule critical activities first or schedule the activity which has the largest independent float in the end’. A heuristic program consists of a collection of such heuristic. In recent years many heuristic programs have been developed- they are formulated usually as computer programs. These programs may be broadly divided into two types : resource levelling programs and resource allocation programs. A resource - leveling programs seeks to resource requirements, given a constraint on project duration. A resource allocation program tries to find the shortest project schedule, given fixed resource availabilities.

### **8.5.2 Project Crashing and Time-Cost Trade-offs: CPM Analysis**

The project manager is confronted with having to reduce the scheduled completion time of a project to meet a deadline. Project duration can often be reduced by assigning more labor to project activities, in the form of over time, and by assigning more resources, such as material, equipment, etc. However, the additional labor and resources increase the project cost. So, the decision to reduce the project duration must be based on analysis of the trade-off between time and cost.

'*Project crashing*' is a method for shortening the project duration by reducing the time of one or more of the critical project activities to less than its normal activity time. Crashing may become necessary because of many reasons, such as

- to reduce the scheduled completion time to reap the results of the project sooner.
- as project continues over time, the team consumes indirect costs.
- there may be direct financial penalties for not completing a project on time.

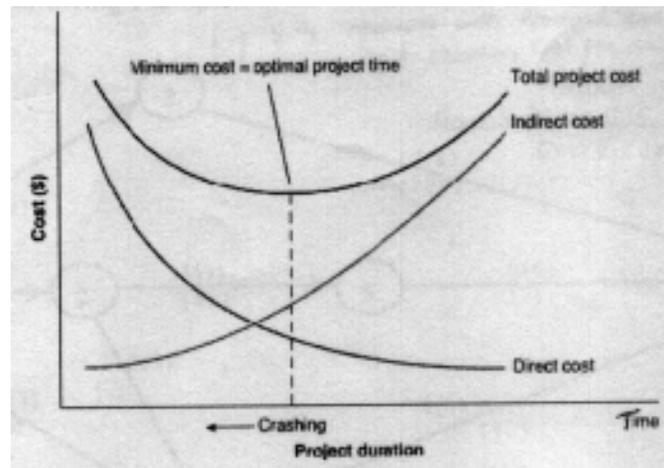
The goal of crashing is to reduce project duration at minimum cost. To reduce project duration while minimizing the cost of crashing, the project team should estimate normal time, normal cost, crash time, crash cost for each activity. And then the team can estimate total crash time, total crash cost, the crash cost per time unit to reduce project duration at minimum cost.

*Assumptions underlying CPM analysis are :*

1. The cost associated with a project can be divided into two components: direct cost and indirect cost. Direct costs are incurred on direct material and direct labor. Indirect costs consist of overhead items like indirect supplies, rent, insurance, managerial services etc.
2. Activities of the project can be expedited by crashing which involves employing more resources.
3. Crashing reduces time but enhances direct cost because of factors like overtime payments, extra payments, and wastage. Project crashing cost and indirect costs have an inverse relationship; crashing costs are highest when the project is shortened, whereas

indirect costs increase as the project duration increase. So, the project time is at the minimum point on the total cost curve as below :

**Figure 8.13 Project Costs**



The Time-Cost trade-off analysis comprises the following steps.

*Step 1* The first step is to identify and crash the critical activity that has the minimum incremental cost of crashing. In the event of multiple critical paths, an activity from each such path is chosen. Of the various combinations available, the one with the least cost is selected. In particular, it may be economical to consider joint critical activities-activities that are common to two or more critical paths.

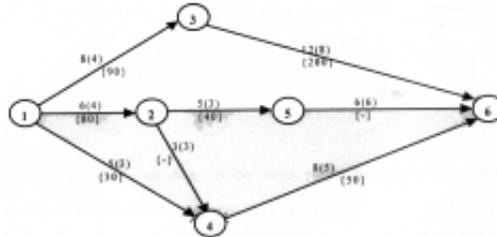
In each case, the crashing is done for one time unit-by a day if the activities times are given in days.

*Step 2* In the second step, the network is revised by adjusting the time and the cost of the crashed activity. The critical path (s) is identified again, and we revert to the step 1. This process is continued till no more crashing of the project is possible.

Now the optimal duration of the project can be determined. It would be the time duration corresponding to which the total cost-direct cost plus indirect cost-is the minimum.

Let us consider the following example.

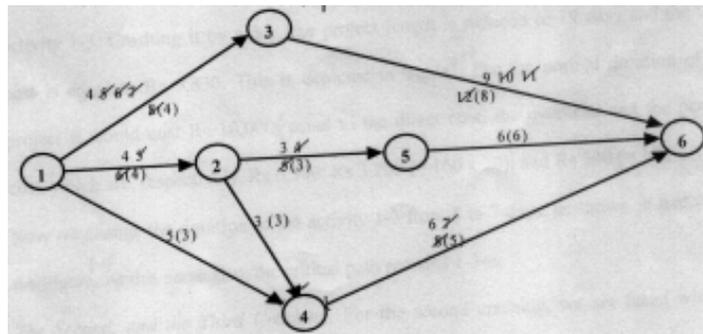
**Figure 8.14 Network with Normal Time, Crash Time and Crashing Cost per day of activities duration.**



**Example :** The network diagram in Figure 8.14 shows for each activity need to completes the project the normal time, the shortest time in which the activity can be completed of a building contract and the cost per day for reducing the time of each activity. The contract includes a penalty clause of Rs 100 per day over 17 days. The overhead cost per day is Rs 160. The cost of completing the eight activities in normal time is Rs 6,500.

- (a) Calculate the normal duration of the project, its cost and the critical path.
- (b) Calculate and plot on a graph the cost/time function for the project and state:
  - (i) the lowest cost and the associated time.
  - (ii) the shortest time and associated cost.

**Figure 8.15 Crashing of Activities**



From the network, we can determine the normal project duration by the length of the critical path using normal activity time. The length of the critical path based of the crash times as shown here gives the minimum duration of the project :

Path	Normal Length	Crash Length
1-3-6	20 (critical)	12
1-4-6	13	8
1-2-4-6	17	12
1-2-5-6	17	13 (critical)

Accordingly, we have the normal and the minimum duration of the project equal to 20 and 13 days respectively.

Now we shall consider the time-cost relationship for this project when it is crashed successively by a period of one day, to know the total cost of the project for durations of 20 days through 13 days.

*The First Crashing* : In this example, the critical activities are 1-3 and 3-6 for which the cost of reduction per day is Rs 90 and Rs 200. Obviously, we would decide to crash the activity 1-3. Crashing it by a day, the project length is reduced to 19 days and the total cost is equal to Rs 9,380. This is depicted in Table 8.10. For the normal duration of the project it would cost Rs 10,000.(equal to the direct cost, the overhead and the penalty cost, which are, respectively, Rs 6,500; Rs 3,200(= 160 x 20); and Rs 300(= 100 x 3)). Now we change the duration of the activity 1-3 from 8 to 7 days, as shown in Figure 8.15. At this stage also, the critical path remains 1-3-6.

*The second and the Third crashing* : For the second crashing, we are faced with the same activities to choose from as in the first crashing, viz. 1-3 and 3-6. The situation is the same in the third crashing. The total project cost equals Rs 9,660 and Rs 9,490 after the second and the third crashing. Notice that the crashing cost at any given stage is equal to the cumulative cost of crashing till that point. After the third crashing, the critical paths, each with a length of 17 days, are : 1-3-6; 1-2-4-6; and 1-2-5-6.

*The Fourth Crashing* : To reduce the project length from 17 days to 16, an activity from each of these paths should be chosen. The various alternatives, along with their cost are as follows :

<b>Alternative</b>	<b>Activities</b>	<b>Total Crashing Cost</b>
1	1-3,1-2	$90+80 = 170$
2	1-3, 4-6, 2-5	$90+50+40 = 180$
3	3-6, 1-2	$200+80 = 280$
4	3-6, 4-6, 2-5	$200+50+40 = 290$

Thus we would crash activities 1-3 and 1-2 at a cost of Rs 170. The total cost of the project at this stage is Rs 9,500, and the critical paths, after adjusting the activity timings, are the same as above.

*The Fifth Crashing* : For reducing the length of the project time to 15 days, we have the following alternatives. Notice that the activity 1-3 cannot be crashe any more.

<b>Alternative</b>	<b>Activities</b>	<b>Total Crashing Cost</b>
1	3-6, 1-2	$200+80 = 280$
2	3-6, 4-6, 2-5	$200+50+40 = 290$

Now we decide to crash activities 3-6 and 1-2 by a day each, at the additional cost of Rs 280. The project cost now equals Rs 9,620, the critical paths still being 1-3-6; 1-2-4-5 and 1-2-5-6.

*The Sixth and the Seventh Crashing* : At each of these crashings, the only choice open is to crash each of the following activities-one activity from every path at a cost of Rs 290: 3-6, 4-6 and 2-5.

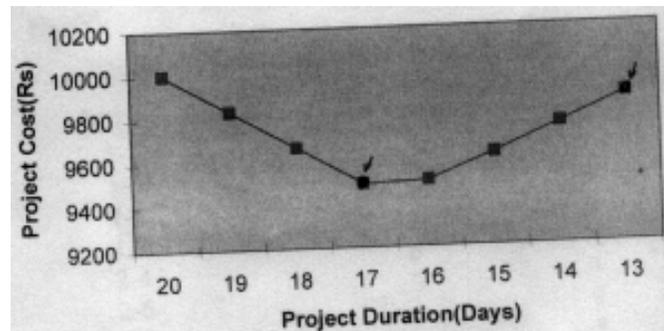
The total cost of the project is Rs 9,750 and Rs 9,880, respectively, after these crashings. From the table 8.10, it is clear that the lowest cost is Rs 9,490 corresponding to the project duration equal to 17 days, whereas the shortest time to complete the project is 13 days at a total cost of Rs 9,880.

**Table: 8.10 Determination of Time-cost Relationship**

Project Duration (days)	Direct Cost (Rs)				Indirect Cost (Rs)		
	Normal	Crashing	Total	Overhead	Penalty	Total	(Rs)
20	6500	-	6500	3200	300	3500	10000
19	6500	90	6590	3040	200	3240	9830
18	6500	180	6680	2880	100	2980	9660
17	6500	270	6770	2720	-	2720	9490
16	6500	440	6940	2560	-	2560	9500
15	6500	720	7220	2400	-	2400	9620
14	6500	1010	7510	2240	-	2240	9750
13	6500	1300	7800	2080	-	2080	9880

The time-cost function is shown graphically in Figure 8.16

**Figure 8.16 Time-Cost Function for the Project**



## 8.6 SUMMARY

Network analysis is a generic name for a number of associated project planning and control procedures that are all based on the concept of network. PERT and CPM are the two widely used techniques of project management that are developed, independently and simultaneously, during 1950s. PERT treats activity time as a random variable whereas CPM requires a single deterministic time value for each activity. After establishment of logic and details of the project network, time estimate must be assigned to each

activity. With this one can determine the minimum completion time for the project. In determining the scheduling timing, the technological restriction, resource requirement for different activities, availability of resources and their allocation must be considered.

## **8.7 KEYWORDS**

**Load Chart:** This chart is used for manufacturing projects during peak or heavy load periods.

**Network:** It is a set of symbols connected with each other with a sequential relationship with each step making the completion of a project or event.

**PERT:** It schedules the sequence of activities to be completed in order to accomplish the project within a short period of time.

**Scheduling:** It refers to the introduction of time schedule for each activity of the project.

## **8.8 SELF ASSESSMENT QUESTIONS**

1. Discuss the role of network techniques in project planning, scheduling and controlling.
2. Bring out the difference between PERT and CPM. In what ways these techniques are similar ?
3. State the rules for network construction. What are dummy activities ?
4. Explain the determination of EOT and LOT of the different events of the project. Also state how are the EST, LST, EFT and LFT of activities obtained?
5. What is critical path ? What is the procedure for determining critical path ?
6. Explain the concept of float. What is the difference between total float, free float and independent ?
7. What are the earliest start schedule and late start schedule ?
8. What are the three time estimates used in the context of PERT ? How are the expected duration of the project and its standard deviation calculated ? Illustrate with the help of an example how would you calculate the probability of completion at a specified time.

9. With the help of an example, illustrate the problem of activity scheduling in the view of resource constraint.

10. Explain crashing of CPM network with the help of an example.

**Problem**

(a) In the following table three times estimates (in weeks)-optimistic (a), pessimistic (b) and most likely (m)- are given for different activities of a project.

Activity	a	m	b
1-2	4	6	10
1-3	3	7	12
1-4	5	6	9
1-7	2	4	6
2-4	6	10	20
2-6	3	4	7
2-7	5	9	15
3-4	3	7	12
4-5	2	4	5
5-6	1	3	6
3-7	2	5	8
6-7	1	2	6

b. Draw the network.

c. Determine the critical path and critical activities.

d. Calculate the events slack and activities floats.

e. Find the expected duration of the project and the standard deviation of the expected duration.

f. Compute the probability of completing the project in 30 weeks.

## **8.9 SUGGESTED READINGS**

1. Projects: Planning, Analysis, Selection, Implementation and Review *by* Pasanna Chadra. Tata McGraw Hills Publishing Company Ltd., New Delhi.
2. Quantitative Techniques in Management *by* N.D. Vohra. Tata McGraw Hill Publishing Company Ltd., Delhi.
3. Introduction to Management Science *by* William J. Stevenson. IRWIN, Australia.
4. Principals of Operations Research *by* Hervey M. Wagner. PHI Pvt. Ltd., New Delhi.
5. Production and Operations Management *by* K. Ashwathapa and K. Shridhara Bhat. Himalaya Publishing House, Delhi.

## **Lesson 9**

### **PROJECT FINANCING IN INDIA**

#### **STRUCTURE**

- 9.0 Objective
- 9.1 Introduction
- 9.2 Meaning and importance of project finance
- 9.3 Means of finance and sources of project finance in India.
- 9.4 Financial institution structure and financial assistance
- 9.5 Norms of finance and term loan procedure
- 9.6 SEBI guidelines
- 9.7 Sample financing plans.
- 9.8 Summary
- 9.9 Keywords
- 9.10 Self assessment questions
- 9.11 Suggested Readings.

#### **9.0 OBJECTIVE**

After studying this lesson, you should be able to explain

- a) Meaning and importance of project finance
- b) Discuss the various sources of project financing and financial institutions structure in India.
- c) Describe the SEBI guidelines regarding public issues and debentures.

#### **9.1 INTRODUCTION**

Finance is the lubricant of the process of economic growth. When finance mode is available, industrial activities can be initiated which gives rise to new investment opportunities towards industrialization. The Indian financial institutions have been very important constituent of the Indian economy. This importance they have derived from their financial muscle and they have linked it to the industrial development in the country.

For years now the Indian financial institutions have been the life line of credit for the Indian corporate. This has been mainly because of their strong financial muscle and the various concessions they received from the Central Government for their role.

In India, special financial institutions have been developed to provide finance to the upliftment of industrial activities in all regions so as to sustain an equitable industrial growth in the county. Financial assistance is being extended to the industrial enterprises by the financial institutions and development banks on concessional terms of finance as per their bye laws in the state.

## **9.2 MEANING AND IMPORTANCE OF PROJECT FINANCE**

Project finance refers to the financing of long-term infrastructure, industrial projects and public services based upon a non-recourse or limited recourse financial structure where project debt and equity used to finance the project are paid back from the cash flow generated by the project.

Project finance is used by private sector companies as a means of funding major projects off balance sheet. At the heart of the project finance transaction is the concession company, a special purpose Vehicle (SPV) which consists of the consortium shareholders who may be investors or have other interests in the project (such as contractor or operator). The SPV is created as an independent legal entity which enters into contractual agreements with a number of other parties necessary in the project finance deals.

The attractiveness of project finance is the ability to fund projected in the off balance sheet with limited or non-recourse to the equity investors i.e. if a project fails, the project lenders recourse is to ownership of the actual project and they are unable to pursue the equity investors for debt. For this reason lenders focus on the projects cash flow as the main source for repaying project debt.

### **Importance of Project finance**

Project financing is being used throughout the world across a wide range of industries and sectors. This funding technique is growing in popularity as governments

seek to involve the private sector in the funding and operation of public infrastructure.

Private sector investment and management of public sector assets is being openly encouraged by governments and multilateral agencies who recognize that private sector companies are better equipped and more efficient than government in developing and managing major public services.

Project finance is used extensively in the following sectors.

- Oil and gas
- Mining
- Electricity Generation
- Water
- Telecommunications
- Road and highways
- Railways and Metro systems
- Public services

### **9.3 MEANS OF FINANCE AND SOURCES OF PROJECT IN INDIA**

The long-term sources of finance used for meeting the cost of project are referred to as the means of finance. To meet the cost of project, the following sources of finance may be available :

- Equity Capital
- Preference Capital
- Debentures
- Rupees term loans
- Foreign currency term loans
- Euro issues
- Deferred credit
- Bill rediscounting scheme
- Suppliers line of credit
- Seed capital assistance

- Government subsidies
- Sales tax deferment and exemption
- Unsecured loans and deposits
- Lease and hire purchase finance
- Public Deposit
- Bank Credit

### **Equity Capital**

This is the contribution made by the owners of business, the equity shareholders, who enjoy the rewards and bear the risks of ownership. However, their liabilities, limited to their capital contribution. From the point of view of the issuing firm, equity capital offers, two important advantages: (i) It represents permanent capital. Hence there is no liability for repayment. (ii) It does not involve any fixed obligation for payment of dividend. The disadvantages of raising funds by way of equity capital are : (i) The cost of equity capital is high because equity dividend are not tax-deductible expenses. (ii) The cost of issuing equity capital is high.

### **Preference Capital**

A hybrid form of financing, preference capital partakes some characteristics of equity capital and some attributes of debt capital. It is similar, to equity capital because preference dividend, like equity dividend, is not a tax-deductible payment. It resembles debt capital because the rate of preference dividend is fixed. Typically, when preference dividend is skipped it is payable in future because of the cumulative feature associated with it. The near-fixity of preference dividend payment renders preference capital somewhat unattractive in general as a source of finance. It is, however, attractive when the promoters do not want a reduction in their share: share of equity and yet there is need for widening the net worth base (net worth consists of equity and preference capital) to satisfy the requirements of financial institutions. In addition to the conventional preference shares, a company may issue Cumulative Convertible Preference Shares (CCPS). These shares carry a dividend rate of 10 per cent (which; if unpaid, cumulates) and are compulsory convertible into equity shares between three and five years from the date of issue.

### **Debenture Capital**

In the last few years, debenture capital has emerged as an important source for project financing. There are three types of debentures that are commonly used in India: Non-Convertible Debentures (NCDs), Partially Convertible Debentures (PCDs), and Fully Convertible Debentures (FCDs). Akin to promissory, NCDs are used by companies for raising debt that is generally retired over a period of 5 to 10 years. They are secured by a charge on the assets of the issuing company. PCDs are partly convertible into equity shares as per pre-determined terms of conversion. The unconverted portion of PCDs remains like NCDs. FCDs, as the name implies, are converted wholly into equity shares as per pre-determined terms of conversion. Hence FCDs may be regarded as delayed equity instruments.

### **Rupee Term Loans**

Provided by financial institutions and commercial banks, rupee term loans which represent secured borrowings are a very important source for financing new projects as well as expansion, modernisation, and renovation schemes of existing units. These loans are generally repayable over a period of 8-10 years which includes a moratorium period of 1-3 years.

### **Foreign Currency Terms Loans**

Financial institutions provide foreign currency term loans for-meeting the foreign currency expenditures towards import of plant, machinery, equipment and also towards payment of foreign technical know-how fees. Under the general scheme, the periodical liability towards interest and principal remains in the currency/currencies of the loan/s and is translated into rupees at the then prevailing rate of exchange for making payments to the financial institution. Apart from approaching financial institutions (which typically serve as intermediaries between foreign agencies and Indian borrowers), companies can directly obtain foreign currency loans from international lenders. More and more companies appear to be doing so presently.

## **Euro issues**

Beginning with Reliance Industries' Global Depository Receipts issue of approximately \$150 ml in May 1992, a number of companies have been making euro issues. They have employed two types of securities: Global Depository Receipts (GDRs) and Euroconvertible Bonds (ECBs).

Denominated in US dollars, a GDR is a negotiable certificate that represents the publicly traded local currency (Indian Rupee) equity shares of a non-US (Indian) company. (Of course, in theory, a GDR may represent a debt security; in practice it rarely does so.) GDRs are issued by the Depository Bank (such as the Bank of New York) against the local currency shares (such as Rupee shares) which are delivered to the depository's local custodian banks. GDRs trade freely in the overseas markets.

A Euroconvertible Bond (ECB) is an equity-linked debt security. The holder of an ECB has the option to convert it into equity shares at a pre-determined conversion ratio during a specified period. ECBs are regarded as advantageous by the issuing company because (i) they carry a lower rate of interest compared to a straight debt security, (ii) they do not lead to dilution of earnings per share in the near future, and (iii) they carry very few restrictive covenants.

## **Deferred Credit**

Many a time the suppliers of machinery provide deferred credit facility under which payment for the purchase of machinery is made over a period of time. The interest rate on deferred credit and the period of payment vary rather widely. Normally, the supplier of machinery when he offers deferred credit facility insists that the bank guarantee should be furnished by the buyer.

## **Bills Rediscounting Scheme**

Operated by the IDBI, the bills rediscounting scheme is meant to promote the sale of indigenous machinery on deferred payment basis. Under this scheme, the seller realises the sale proceeds by discounting the bills or promissory notes accepted by the buyer with a commercial bank which in turn rediscounts them with the IDBI. This scheme is

meant primarily for balancing equipments and machinery required for expansion, modernisation, and replacement schemes.

### **Suppliers' Line of Credit**

Administered by the ICICI, the Suppliers' Line of Credit is somewhat similar to the IDBI's Bill Rediscounting Scheme. Under this arrangement, ICICI directly pays to the machinery manufacturer against usance bills duly accepted or guaranteed by the bank of the purchaser.

### **Seed Capital Assistance**

Financial institutions, through what may be labelled broadly as the 'Seed Capital Assistance scheme, seek to supplement the resources of the promoters and of medium scale industrial units which are eligible for assistance from All-India financial institutions and/ or state-level financial institutions. Broadly three schemes have been formulated:

(i) *Special Seed Capital Assistance Scheme* The quantum of assistance under this scheme is Rs 0.2 million or 20 per cent of the project cost, whichever is lower. This scheme is administered by the State. Financial Corporations.

(ii) *Seed Capital Assistance Scheme* The assistance order this scheme is applicable to projects costing not more than Rs 20 million. The assistance per project is restricted to Rs 1.5 million. The assistance is provided by IDBI through state level financial institutions. In special cases, the IDBI may provide the assistance directly.

(iii) *Risk Capital Foundation Scheme* Under this scheme, the Risk Capital Foundation, an autonomous foundation set up and funded by the IFCI, offers assistance to promoters of projects costing between Rs 20 million and Rs 150 million. The ceiling on the assistance provided between Rs 1.5 million and Rs 4 million depending on the number of applicant promoters.

### **Government Subsidies**

Previously the central government as well as the state governments provided subsidies to industrial units located in backward areas. The central subsidy has been discontinued

but the state subsidies continue. The state subsidies vary between 5 per cent to 25 per cent of the fixed capital investment in the project, subject to a ceiling varying between Rs 0.5 million and Rs 2.5 million depending on the location.

### **Sales Tax. Deferments and Exemptions**

To attract industries, the states provide incentives, *inter alia*, in the form of sales tax deferments and sales tax exemptions. Under the sales tax deferment scheme, the payment of sales tax on the sale of finished goods may be deferred for a period ranging between five to twelve years. Essentially, it implies that the project gets an interest-free loan, represented by the quantum of sales tax deferred, during the deferent period.

Under the sales tax exemption scheme, some states exempt the payment of sales tax applicable on purchases of raw materials, consumables, packing, and processing materials from within the state which are used for manufacturing purposes. The period of exemption ranges from three to nine years depending upon the state and the specific location of the project within the state.

### **Unsecured Loans and Deposits**

Unsecured loans are typically provided by the promoters to fill the gap between the promoters' contribution required by financial institutions and the equity capital subscribed by the promoters. These loans are subsidiary to the institutional loans. The rate of interest chargeable on these loans is less than the rate of interest on the institutional loans. Finally these loans cannot be taken back without the prior approval of financial institutions.

Deposits from public, referred to as public deposits, represent unsecured borrowing of two to three years' duration. Many existing companies prefer to raise public deposits instead of term loans from financial institutions because restrictive covenants do not accompany public deposits. However, it may not be possible for a new company to raise public deposits. Further, it maybe difficult for it to repay public deposits within three years.

## **Foreign Currency Loans**

Apart from rupee term loans, financial institutions provide foreign currency loans. This assistance is now provided only for the import of capital equipment (as per the liberalised exchange risk management system, foreign currency required for other purposes has to be purchased from authorised dealers at market rates). On foreign currency loans sanctioned under the general scheme, the interest rate charged is typically a floating rate as determined by the lenders, (the foreign agency that has given a line of credit to the financial institution for onward lending) and the risk of exchange rate fluctuation is born by the borrower. On foreign currency loans sanctioned under the Exchange Risk Administration Scheme, the principal repayment obligations of the borrower are rupee tied at the rate of exchange prevailing on the dates of disbursement. On such rupee-tied loan liability, the borrower pays by way of servicing his loan a composite, cost every quarter. The composite cost consists of three elements: (i) the interest portion which is arrived on the basis of the weighted average interest cost of the various components of the currency pool, (ii) the spread of the financial institutions, and (iii) the exchange risk premium. The 'composite cost' is a variable rate determined at six-monthly intervals. It has a floor and a cap. Both the floor and the cap as well as the rate of interest applicable for the period is reviewed and announced from time to time.

## **Leasing and Hire Purchase Finance**

With the emergence of scores of finance companies engaged in the business of leasing and hire purchase finance, it may be possible to get a portion, albeit a small portion, of the assets financed under a lease or a hire purchase arrangement.

Typically, a project is financed partly by financial institutions and partly through the resources raised from the capital market. Hence, in finalising the financing scheme for a project, you should bear in mind the norms and policies of financial institutions and the guidelines of Securities Exchange Board of India and the requirements of the Securities Contracts Regulation Act (SCRA).

## **Public Deposit**

Public deposits have been a peculiar feature of industrial finance in India. Companies have been receiving public deposits for a long time in order to meet their medium-term and long-term requirements for finance. This system was very popular in the cotton textile mills of Bombay, Ahmedabad and Sholapur and in the tea gardens of Assam and Bengal. In recent years, the method of raising finance through the public deposits has again become popular for various reasons. Rates of interest offered by the companies are higher than those offered by banks. At the same time the cost of deposits to the company is less than the cost of borrowings from banks.

While accepting public deposits, a company must follow the provisions of the Companies Act and the directions issued by the Reserve Bank of India. According to the Companies (Acceptance of Deposits) Rules, 1975 as amended in 1984 Act, no company can receive secured and unsecured deposits in excess of 10% and 25% respectively of paid up share capital plus free reserves. The Central Government has laid down that no company shall invite a deposit unless an advertisement, including a statement showing the financial position of the company, has been issued in the prescribed form. Under the new rule, deposits can be renewed. The rate of interest payable on deposits must not exceed 15% per annum. In order to repay the deposits maturing in a particular year, the company must deposit 110% of the deposits with a scheduled bank or in specified securities.

## **Bank Credit**

Commercial banks in the country serve as the single largest source of short-term finance to business firms. They provide it in the form of outright loans, cash credit, and lines of credit.

## **9.4 FINANCIAL INSTITUTION STRUCTURE AND FINANCIAL ASSISTANCE**

This part concerned with the various aspects of financial institutions and their functioning in India, is divided into six sections as follows :

- Institutional Structure

- Financial assistance : direct and indirect
- Special schemes
- Term loan procedures
- Project appraisal
- Key financial indicators

### **Institutional Structure**

The structure of financial institutions in India is as follows :

#### **I. All India institutions**

- Industrial Finance Corporation of India
- Industrial Credit and Investment Corporation of India
- Industrial Development Bank of India
- Other all-India institutions

#### **II. State-level institutions**

- State Financial Corporations
- State Industrial Development Corporations

#### **Industrial Finance Corporation of India (IFCI)**

Industrial Finance Corporation of India (IFCI)- The IFCI is the first industrial financing institution to be Set up in India soon after independence. It was set up as a statutory corporation in July, 1948 But was later converted in to a Government Company. The IFCI provides financial assistance to any public limited company and co-operative society registered in India. Such units must be engaged in the manufacture, preservation or processing of goods, or in the shipping, mining or hotel industry, or in the generation and distribution of electricity or any other form of power. Public limited companies in the public sector are also eligible to receive assistance from the IFCI. But proprietary concerns, partnership firms and private companies are not eligible for financial assistance from the corporation. The corporation may grant assistance ranging from Rs.30 lakhs to Rs.2 crores to a single enterprise. Assistance may be given in anyone or more of the above forms for a maximum period of 25 years.

State Financial Corporations (SFC's)- As the Industrial finance Corporation does not provide industrial finance to all types or enterprises, the need was felt for state level financial institutions to finance the needs of non-corporate and other small enterprises. On September 2, 1951, the Parliament passed the State Financial Corporations Act. The Act came in to force with effect from 1<sup>st</sup> August, 1952. It empowers the State Governments to establish financial institutions for their respective States.

### **Industrial Credit and Investment Corporation of India (ICICI)**

In view of the limited risk capital which IFCI and SFC s provide, need was felt for a more enterprising and flexible institution to facilitate industrial development in the private sector in India. A World Bank-cum-American Investment Mission visited India in 1954 and recommended the establishment of special institution the purpose of assisting industries in the private sector. Accordingly, the ICICI was set up on January 5, 1955 as a public limited company under the Companies Act. The Corporation was set up as a privately owned institution but later on the Life Insurance Corporation of India (a statutory corporation) became its major shareholder.

The ICICI has wide powers. It can provide any amount of financial assistance to any public or private company in the private sector. It can now give assistance to projects in the joint sector and co-operative sector. It is authorized to provide foreign currency loans to partnerships and proprietary concerns also. Ordinarily Rs.5 lakhs is the minimum limit and Rs.1 crore is the higher limit for financial assistance to a single concern. Loans are given generally for the purpose of buying capital assets like land, buildings and machinery. In fact, the ICICI specializes in providing loans in foreign currency. The Corporation helps in the promotion of new enterprises as well as in the expansion and modernization of existing concerns so as to build up a sound industrial.

### **Industrial Development Bank of India**

The Industrial Development Bank of India was established in 1964 as a subsidiary of the Reserve Bank of India. It is headquartered in Bombay. It is the apex term-lending

financial institution in India. It has been designated as the principal financial institution of the country for coordinating, in conformity with national priorities, the working of institutions engaged in financing, promoting, and developing industry. IDBI finances the industry directly and also provides principal support to State Finance Corporations and State Industrial Development Corporations and commercial banks in their financing of industries, through refinancing and bill discounting facilities. The resources of IDBI consist of paid-up capital, reserves repayment of loans, market borrowings both within and outside the country, temporary credit from the Reserve Bank of India, and foreign lines of credit from the World Bank, Asian Development Bank and others.

### **Life Insurance Corporation of India**

The Life Insurance Corporation of India (LIC, hereafter) came into being in 1956 after the nationalization and merger of about 250 independent life insurance societies. It is headquartered in Bombay. The primary activity of LIC is to conduct the life insurance business, but it has gradually developed into an important all-India financial institution which provides substantial support to industry.

### **General Insurance Corporation**

The General Insurance Corporation (GIC, hereafter) was founded when the management of general insurance business in India was taken over by the government in 1971 and subsequently nationalised in 1973. It is headquartered in Bombay. GIC provides substantial assistance to industrial projects be way of term loans, subscription to equity capital and debentures, and underwriting of securities.

### **Industrial Reconstruction Bank of India**

The industrial Reconstruction Bank of India, headquartered in Calcutta, was set up when its precursor, the Industrial Reconstruction Corporation of India, was reconstituted in 1984. IRBI is primarily an agency to help the reconstruction and rehabilitation of industrial units which have closed down or which face the risk of closure. IRBI offers assistance in various forms : (i) financial assistance which is not available from normal channels of finance and banking, (ii) technical assistance and

guidance to sick units to revive them, (iii) managerial in the fields of administration, finance, marketing, industrial relations, etc. and (iv) suggestions for reconstruction and rationalization.

### **State Level Institutions**

#### **State Financial Corporations**

The State Financial Corporation, set up under the State Financial Corporation Act, 1951, render assistance to medium and small scale industries in their respective states. Their shareholders are the respective state governments, IDBI, insurance companies, credit cooperatives and private shareholders.

#### **State Industrial and Development Corporations**

The State Industrial Development Corporation, were set up by the state governments during the 1960s to serve as catalytic agents in the industrialization process of their respective states. Presently almost every state has an SIDC which is fully owned by the respective state government.

### **Financial Assistance : Direct and Indirect**

#### **Direct Financial Assistance**

Financial institutions provide direct financial assistance in the following ways :

- Rupee term loans
- Foreign currency term loans
- Subscription to equity shares
- Seed capital

#### **Indirect Financial Assistance**

Besides providing direct financial assistance, financial institutions extend help to industrial units in obtaining finance/credit through the following ways :

- Deferred payment guarantee
- Guarantee for foreign currency loans
- Underwriting

### **Deferred Payment Guarantee**

Financial institutions issue guarantee on behalf of the buyer of industrial machinery to the supplier offering the facility of deferred payments. Should there be a default by the buyer in the payment of deferred installments, financial institutions make the payment and subsequently recover the amount from the assisted unit. A nominal commission is charged for providing such guarantee.

### **Guarantee for Foreign Currency Loans**

Financial institutions provide guarantee for foreign currency loans obtained by industrial concerns from institutions and banks abroad. A nominal commission is charged to the assisted unit for such guarantee.

### **Underwriting**

As part of the overall financial package, financial institutions generally participate in underwriting equity issues of assisted units. This helps the assisted units in raising funds from the capital market.

### **Special Schemes**

Several special schemes have been designed to serve the varied needs of industry. The important ones are :

- Bill rediscounting scheme
- Suppliers line of credit
- Soft loan scheme
- Equipment finance scheme

## **9.5 NORMS OF FINANCE AND TERM LOAN PROCEDURE**

The principal norms and policies of financial institutions are described below:

### **Eligibility**

Till recently, long term loans were provided by financial institutions to concerns in certain industries and denied to concerns in industries placed in the negative list. Now, however, a shift is taking place in their policy, They are inclined to finance almost every kind of industry. Further, till recently financial institutions followed a consortium

approach as per the advice of the Ministry of Finance. Now they are permitted to lend individually as well as participate in consortium lending.

### **Debt-equity Ratio**

Presently, the general debt-equity norm for medium and large scale projects is 1.5:1. This serves as a broad guideline against which variations are permitted on a case to case basis, especially under the following circumstances: (a) high degree of capital intensity, (b) location in a backward area, and (c) background' of the promoter. Other things being equal: (i) a capital intensive project is eligible for a higher debt-equity ratio, (ii) a project in a backward area qualifies for a higher debt-equity ratio, and (iii) a project promoted by a technocrat-promoter is entitled to a higher debt-equity ratio.

How are debt and equity defined for the purpose of calculating the debt-equity ratio? Debt consists of the following: (i) loans and deposits that are repayable after one year (this includes interest bearing unsecured loans from government agencies, promoters, etc.), (ii) non-convertible debentures and convertible debentures (except that part which is compulsorily convertible into equity) until they are converted, irrespective of the maturity period, (iii) deferred payments, and (iv) preference shares due for redemption within three years.

Equity consists of the following: (i) paid-up ordinary share capital, (ii) irredeemable preference shares, cumulative convertible preference shares where the redemption period is due after three years, (iii) premium on share issues, (iv) central/ state cash subsidy, (v) long term interest-free unsecured loans from state governments or government agencies or promoters subordinate to loan from financial institutions, and (vi) free reserves (including surplus in profit and loss account) less any accumulated losses, arrears or unabsorbed depreciation, intangible assets (like goodwill), expenditures not written off (like preliminary expenses), and investments in other undertakings where these are 'prima facie' considered unrealisable.

### **Promoters Contribution**

Financial institutions require promoters to contribute 25 to 30 per cent of the project cost. This is lowered selectively in certain cases like capital-intensive projects,

high priority projects, and technocrat-promoted projects. Contributions made by the following or of the following kinds represent promoters' contribution (i) equity investment by promoters, their friends, relatives and associates (including NRIs), (ii) equity investment by other companies controlled by promoters, (iii) equity participation by shareholders of other promoter companies, (iv) foreign collaborators,' (v) investment from oil exporting developing countries, (vi) state government, in the case of joint sector or assisted sector projects, (vii) seed capital assistance, (viii) unsecured loan from promoters, (ix) venture capital participation, (x) mutual fund participation, (xi) internal accruals in the case of an existing company, (xii) rights issue to existing shareholders, and (xiii) any other contribution approved as promoters' contribution.

### **Term Loan Procedure**

The procedure associated with a term loan involves the following principal steps.

1. Submission of loan application  
The borrower may submit the application to any of the three term lending institutions, viz, IDBI, ICICI, and IFCI. The borrower is required to fill out a common application form.
2. Initial processing of loan application
3. Appraisal of the proposed projects
4. Issue of the letter of sanction
5. Acceptance of the terms and conditions by the borrowing unit
6. Execution of loan agreement
7. Disbursement of loans
8. Creation of security
9. Monitoring

### **Project Appraisal**

Financial institutions appraise a project from the marketing, technical, financial, economic, and managerial angles. The principal issues considered and the criteria employed in such appraisal are discussed below (for detail see in lesson 1)

1. Market Appraisal
2. Technical Appraisal
3. Financial Appraisal
4. Economic Appraisal
5. Managerial Appraisal

### **Key Financial Indicators**

The key financial indicators used by financial institutions while evaluating projects are the internal rate of return, the debt service coverage ratio, and the break-even point. The manner in which these indicators are calculated is discussed below.

#### **Internal Rate of Return**

For calculating the internal rate of return of project, its cash outflows and cash inflows are defined as follows :

#### **Cash Outflows**

Outlay on fixed assets	:	Cost of Project <ul style="list-style-type: none"> <li>• Working capital margin</li> <li>• Interest during construction period</li> </ul>
Outlay on current assets	:	Current asset investment in the beginning As well as additional investment in current assets in future.

#### **Cash Inflows**

Operating inflows	:	Earnings before depreciation, interest, and taxes (EBDIT)
Terminal inflow	:	Residual value of fixed assets + Realisable value of current assets

#### **Debt service Coverage Ratio**

The debt service coverage ratio is defined as :

$$\frac{\text{Profit after tax} + \text{Depreciation} + \text{Other non-cash charges} + \text{Interest on term loan}}{\text{Interest on term loan} + \text{Repayment of term loan}}$$

## **Break-even Point**

The break-even point for a project is calculated with reference to the year when the project is expected to reach its target level of capacity utilisation, which is usually the third of the fourth operating year.

## **9.6 SEBI GUIDELINES**

The Capital Issues Control Act, 1947 (and the exemption orders and rules made there under) was the primary legislation regulating the issue of securities by the corporate sector till recently. This Act was repealed in May 1992 and capital issues were brought under the purview of the Securities Exchange Board of India (SEBI hereafter) which was clothed with statutory powers when the SEBI Act, 1992 was passed.

On June 12, 1992, SEBI released its guidelines applicable to capital issues. A comparison of these guidelines with the guidelines that were followed under the earlier regime (that is under the Capital Issues Control Act, 1947) suggests that the thrust of regulation is no longer on product and price control. In the earlier regime, there were restrictions on the kinds of securities that could be issued, the pricing of these securities, and the interest rates or dividend rates payable on them. Under the new regime there is virtually no restriction on the types of securities (financial instruments) that can be issued, there is substantial freedom in pricing these securities, and there is no ceiling on interest/ dividend rate payable 'on these securities. While the new regime more or less does away with product and price controls, it lays stress on adequate disclosure, seeks to safeguard the interest of investors, and emphasises prudential controls. The key SEBI guidelines are summarised below.

### **New Instruments**

While there is no restriction on the kinds of financial instruments, the issuer of capital shall make adequate disclosures' regarding the terms and conditions, redemption, security, conversion, and any other features of the instrument so that an investor can make a reasonable determination of risks, returns, safety, and liquidity of the instruments. The disclosures shall be vetted by SEBI in this regard.

## **Pricing of Public Issues of Equity Capital**

The salient features of SEBI guidelines with respect to the pricing of public issues of equity capital are as follows:

- A new company set up by entrepreneurs without a track record will be permitted to issue capital to public only at par.
- A new company set up by existing companies with a five year track record of consistent profitability will be free to price its issue provided the participation of the promoting companies is not less than 50 per cent of the equity of the new company and the issue price is made applicable to all new investors uniformly.
- An existing private/closely held company with a three year track record of consistent profitability shall be permitted to freely price the issue.
- An existing listed company can raise fresh capital by freely pricing further issue.

## **Fully Convertible Debentures (FCDs)/Partially Convertible Debentures (PCDs)/Non-convertible Debentures (NCDs)**

The guidelines relevant to these instruments are as follows:

1. Credit rating is compulsory in the case of FCDs if the conversion is effected after 18 months and in the case of NCDs/PCDS if the maturity period exceeds 18 months.
2. In the case of FCDs/PCDs the terms of conversion (time of conversion and conversion price) shall be predetermined and stated in the prospectus.
3. Any conversion in part or whole of the debenture will be optional at the hands of the debenture holder, if the conversion takes place at or after 18 months from the date of allotment, but before 36 months. FCDs having a conversion period exceeding 36 months must have 'put' and 'call' option (the 'put' option gives the debenture holder the right to sell the debentures back to the company at a specified price whereas the 'call' option gives the company first right to buy back the debentures at a specified price).

4. A Debenture Redemption Reserve (DRR) shall be created by all companies raising debentures, except when the debenture issue has a maturity of 18 months or less, on the following basis: (a) A moratorium up to the date of commercial production can be provided for creation of the DRR in respect of debentures raised for project finance. (b) The DRR may be created either in equal installments for the remaining period or higher amounts if profits permit. (c) In the case of PCDs, the DRR should be created in respect of the non-convertible portion of the debenture issue on the same lines as applicable to NCDs. In respect of convertible issues by new companies, the creation of the DRR should commence from the year the company earns profits for the remaining life of debentures. (d) Companies may distribute dividends out of general reserves in certain years if residual profits after transfer to the DRR are inadequate to distribute reasonable dividends. (e) The DRR will be treated as a part of general reserve for consideration of bonus issue proposals and for price fixation related to post-tax return. (f) In the case of new companies, distribution of dividend shall require approval of the trustees to the issue and the lead institution, if any. (g) The company should create the DRR equivalent to 50 per cent of the amount of debenture issue before the debenture redemption commences. Drawl from the DRR is permissible only after 10 per cent of the debenture liability has been actually redeemed by the company.

#### **Promoters' Contribution and Lock-In Period**

The key provisions in this regard are as follows: (a) Equity capital to be subscribed in any issue to the public by promoters, i.e., those described in the prospectus as promoters, directors, friends, relatives and associates should not be less than 25 per cent of the total issue of equity capital up to Rs 1000 million and 20 per cent of the issue above Rs 1000 million. In the case of FCDs, one third of issue amount should be contributed by promoters, directors, friends, relatives and associates by way of equity before the issue is made. In the case of PCDs, one third of the convertible portion should be brought in as contribution of promoters, directors, friends, relatives and associates before the

issue is made. The minimum subscription by each of the friends/relatives and associates under the promoters' quota should not be less than Rs 0.1 million. (b) The promoters' contribution shall not be diluted for a lock-in period of five years from the date of commencement of the production or date of allotment whichever is later. Promoters must bring in their "full subscription to issues in advance before public issue. (c) All firm allotments, preferential allotments to collaborators, shareholders of promoter companies, whether corporate or individual, shall not be transferable for three years from the date of the commencement of production or date of allotment whichever is later.

## 9.7 SAMPLE FINANCING PLANS

Four sample financing plans follow:

### **XYZ Co. Limited**

The project cost and means of finance for a project of XYZ Co. Limited for the manufacture of 155,000 sq. mts. of granite and slabs that was appraised by SBI Capital Markets Limited in the month of May 1992 are given below:

<b>Project Cost</b>	<b>in Millions</b>
- Land and Site Development	12.1
- Buildings	16.6
- Plant and Machinery	
Imported	142.7
Indigenous	2.5
Foundation	5.0
- Training Expenses	0.2
- Miscellaneous Fixed Assets	26.2
- Preliminary and Capital	7.9
Issue Expenses	
- Preoperative Expenses	13.3
- Provision for Contingencies	21.7
- Margin for Working Capital	11.9
	<b>260.1</b>

## Means of Finance

		<i>Rs in million</i>
- Equity Share Capital		
Promoters	38.7	
UTI	5.0	
EEC	15.0	
Public (Convertible portion of debentures)	40.0	98.7
- Debt		
Non-convertible portion of debentures	40.0	
Foreign Exchange Loan	117.8	157.8
- Capital Subsidy		2.0
- Lease Finance		1.6
		<b>260.1</b>

## 9.8 SUMMARY

The role of project financing is becoming predominant in the funding, construction and operation of infrastructure around the world. World Bank estimates predict that this source of finance is set to expand and that the private sector will have an increasingly crucial role to play in the provision of public services.

Private sector brings with it private sector management skills and innovation which aid the improved delivery of key services such as power, transportation, water telecoms and health care. Governments should set policy and delegate the provision of services to the private sector who are best equipped to provide.

## 9.9 KEYWORDS

**Project Finance:** It refers to financing of long-term projects based upon a non-recourse or limited recourse financial structure.

**Equity Capital:** Equity capital is the contribution made by the owners of business.

**Preference Capital:** It is a hybrid form of financing which partakes some characteristics of equity capital and some attributes of debt capital.

**Leasing:** It is an agreement between two parties whereby one party gives the right to use an asset to another party for a consideration for a definite period of time.

**Break-even Point:** It is that point where total sales are equal to total cost.

### 9.10 SELF ASSESSMENT QUESTIONS

- 1 Define the project finance. Discuss the role of project finance.
- 2 What is the means of finance? Explain the various sources of project finance in India
- 3 Write a detail note on
  - Euro issues
  - Consortium Finance
  - Subordinate debt
  - Debenture
4. Discuss in detail financial institution structure in India
- 5 Explain the SEBI guidelines regarding public issues and debentures

### 9.11 SUGGESTED READINGS

1. Prasana Chandra : Projects Planning, Analysis, Selection, Implementation & Review, Tata McGraw Hill, New Delhi.
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## 10.1 INTRODUCTION

In the post second world war period the public sector enterprises have generally increased in number and importance for various reasons. After the Great depression 1929-33 people lost faith in the market mechanism. It was thought that the invisible hand of the market would have to be replaced at least partly by the visible hand of the government. In other words, there was the need for government participation in the economic affairs of the nation. It was felt that one of the ways in which the government could play an active role in modern economy was by nationalizing those industries and setting up a wide range of public sector units. The developing country like India has accepted today the technique of economic planning as a means of development and has given importance to the public sector. India's first important step in the direction was taken immediately after achieving independence. In the real sense, public enterprises in India are of recent origin. But the scholars have traced the history of public enterprises as far as back as 300 B.C. Kautilya, the founder prime Minister of Maurya Empire in India in his 'Arthashastra' (a book in Sanskrit) spoke of public enterprises. There was a 'Lavanadhyaksha' in charge of manufacture of salt and fixation of its price. Likewise the 'Akaradhyaksha' the 'Rupadarasaka' and the 'Suvarnadhyaksha' seem to have been in charge of mining, coinage and gold all in the control of the state.

In the medieval period India was a cynosure of all eyes in the west. The golden period India was famous for its steel and cloth. The iron pillar near Kutub Minar has baffled many metallurgists. It has a pillar of its huge size and rustless quality could have been cast in those far off days. The fine cloth particularly, 'Dacca Muslim' was favorite wear of western women.

In modern India, we find two sorts of efforts – one by the alien government and the other by Swadeshi Movement headed by Indian National Congress which paved the base for public enterprise. The working committee of congress in August 1937 recommended its provincial government to appoint a committee of experts to draw up schemes of "National Reconstruction and Social planning" The conference of 1938

## **LESSON: 11**

### **PROJECT APPRAISAL: ASSESSING THE TAX BURDEN**

#### **STRUCTURE**

- 11.0 Objective**
- 11.1 Introduction**
- 11.2 Framework for Deriving Taxable Income**
- 11.3 Important Provisions Relevant for Deriving Taxable Income**
- 11.4 Set off, Carry Forward, and Order of Deduction for Computing Income from Business**
- 11.5 Summary**
- 11.6 Keywords**
- 11.7 Self Assessment Questions**
- 11.8 Suggested Readings**

#### **11.0 OBJECTIVE**

The main objective of this lesson is to make the students gain knowledge of the relating provisions that provide the assessment of possible tax burden vis-à-vis project appraisal.

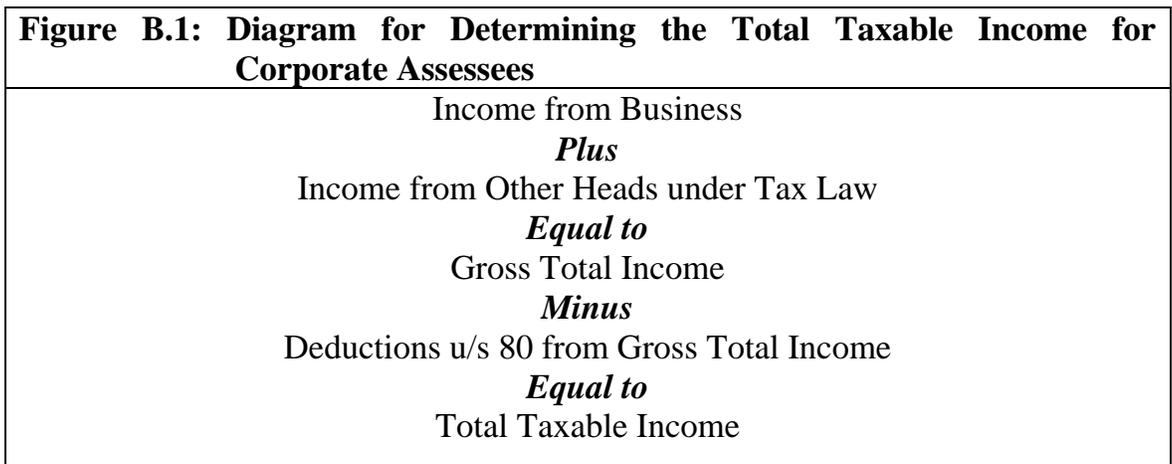
#### **11.1 INTRODUCTION**

For preparing the profitability projection, the expected tax burden for the forecast period, which is usually eight to ten years, has to be figured out. This calls for familiarity with the provisions of the Income Act those are relevant for determining the magnitude and timing of the tax burden for a new project. This lesson seeks to provide help in this respect. It discusses the broad framework for deriving the taxable income, important provisions relevant for computing the taxable income; process for the determination of tax burden and payment of tax, and finally, a comprehensive illustration for the purpose. It should be emphasized here that taxation is a complex and specialized field, which is best, handled by

experts. Our purpose here is to build a basic understanding of the tax framework relevant for financial appraisal of projects and not to provide a detailed exposition of the field.

## 11.2 FRAMEWORK FOR DERIVING TAXABLE INCOME

Income tax is a charge calculated by applying the rates prescribed annually in the Finance Act on the base called the total income. The total income, also known as taxable income, is computed with reference to a period defined as the previous year. *Figure B.1* shows the schematic diagram for determining the total income of a corporate assessee under the Income Tax Act. As a part of rationalization and simplification process, the Income Tax Act is being amended by doing away with many of the incentive schemes, and at the same time reducing the overall corporate income tax rates. By the way, the Government hopes to reduce the complexities involved in the calculation of tax and administration of tax law would become easier.



### 11.2.1 Income from Business

This broadly consists of receipts less deduction associated with activities, which can be attributed to the character of business/profession. The principal sources of receipts are sale proceeds, professional fees, and labour charges.

The deductions can be classified as follows:

- Actual business expenses incurred. The major items included under this head are: (i) rent, rates, taxes, insurance, repairs and maintenance in respect of premises used for business (section 30); (ii) repairs, maintenance and insurance in respect of plant and machinery (section 31); (iii) expenditure on scientific research not being in the nature of capital expenditure related to the business of the assessee (section 35); (iv) expenditure on scientific research by certain notified businesses get weighted deductions; (v) insurance premium paid in respect of insurance of stock or stores of the business; bad debt etc. (section 36); (vi) any other expenditure (not being in the nature of capital expenditure or personal expenses of the assessee) laid out or expended wholly and exclusively for the purposes of the business/profession (section 37).
- Amortization of certain expenses. Certain expenses are incurred at one time and a percentage of such expenses are allowed to be deducted against the income over a number of years by way of amortization. These include: (i) outlays on fixed assets which are depreciated at the rates prescribed under rule 5 of the Income Tax Rules (section 32); (ii) expenditure on patents and copyrights (section 35A); (iii) expenditure for acquiring know-how (section 35 AB); (iv) preliminary expenses (section 35D); (v) expenditure on prospecting of minerals (section 35A); (vi) expenditure incurred by an Indian Company, for amalgamation or demerger of a company (section 35 DD) and (vii) capital expenditure on family planning of employees (section 36).
- Capital expenditures of certain types. Though capital expenditures are not normally allowed as a deduction in computing the business income, the following capital expenditure can be deducted by virtue of certain provisions of the Act: (i) capital expenditures on scientific research related to the business carried on by the assessee [section 35 (1) (iv)]; (ii) capital expenditure incurred in connection with the business consisting of prospecting

for or extraction or production of mineral oils (section 42). (iii) capital expenditure incurred in connection with acquiring any rights to operate telecommunication services (section 35 ABB).

- Certain contribution. Payments made to (a) certain recognized scientific research institutions to be used for scientific research [section 35 (1) (ii)]; (b) certain recognized institutions to be used for research in social science or statistical research [section 35 (1) (iii)]; (c) approved public sector companies and institutions for promoting the social and economic welfare of, or the uplift of, the public (section 35 AC); and (d) certain associations and institutions for carrying out programmes of conservation of natural resources (section 35 CC B) can be deducted for tax purposes.

In respect of contributions made to approved National Laboratories or a University or an Indian Institute of Technology with a specific direction that the amounts be used for scientific research undertaken under an approved programme, an amount equal to 125% of the contribution is allowed as deduction (35 2AA).

- Carried forward losses and allowances. In computing the business income, losses and allowances carried forward from the previous year can be deducted subject to compliance with certain conditions.

### **11.2.2 Income from other Heads Under Tax Law**

The various other heads, the nature of income, and the deductions allowed under these heads by the Act are shown below;

<u>Head</u>	<u>Nature of Income</u>	<u>Deduction Allowed</u>
Income from house Property	Income arising from building and land appurtenant thereto owned by the assessee	Deductions are specified under Sections 23 and 24 of the Act
Capital gains	Full value of consideration on transfer of capital assets	(a) Indexed cost of acquisition (b) Indexed cost of improvements (c) Expenses on transfer (d) Certain exemptions
Income from other Sources	Interest and other incomes, which cannot be taken under any other head	Expenses incurred to earn the income and depreciation where applicable

### 11.2.3 Gross Total Income

This represents the summation of income from business and income from other heads under the Act as described above. This aggregation process involves setting off negative figures in the manner as prescribed in the Act. Such set off is done at two levels as follows:

- (a) Setting off negative figures under any source against positive figures under any other source within the same head of income; and
- (b) Setting off negative figures under any head of income against positive figures under any other head of income.

**Exemptions/Deductions from Gross Total Income** Certain incomes enjoy special exemptions under Chapter III, and do not form part of the total income.

The important exemptions are

1. Exemption of such profits or gains from the export of articles or things or computer software established in a Free Trade Zone etc. (Section 10A)

2. Exemptions of such profits or gains from the export of articles or things or computer software from 100% export oriented unit (Section 10B).

#### **11.2.4 Deduction from Gross Total Income**

Chapter VI A of the Act deals with various deductions that are allowed from the gross total income. The deductions under this chapter are allowed irrespective of the source of income and are akin to incentives. They are different from other deductions discussed earlier, which are related to a specific head of income. If the gross total income is negative than no deduction under chapter VI A is allowable. These deductions cannot make a gross total negative.

The important deductions under chapter VI A are as follows:

1. Deduction in respect of profits and gains from projects or execution of work outside India (Section 80 HHB).
2. Deduction in respect of profits and gains from housing projects in certain areas and which are aided by World Bank (Section 80 HHBA).
3. Deduction in respect of export of goods or merchandise outside India subject to certain conditions. (Section 80 HHC)
4. Deduction in respect of earnings in convertible foreign exchange from the business of hotel and tour operators (Section 80 HHD)
5. Deduction in respect of profits from export of computer software etc. (Section 80 HHE)
6. Deduction in respect of profits from export or transfer of film software, television software etc. (Section 80 HHF)
7. Deduction in respect of profits and gain from new industrial undertaking providing infrastructure facility after a certain date (Section 80IA)
8. Deduction in respect of profits and gain of business from new industrial undertaking other than infrastructure facility as mentioned above (Section 80JJ)

9. Deduction in respect of profits and gain from business of collecting and processing bio-degradable waste (Section 80JJ)
  10. Deduction in respect of employment of new workmen (Section 80JJAA)
  11. Deduction in respect of royalties etc received from certain foreign enterprises (Section 80O)
- (Deduction under Section 80HHB, 80HHBA, 80HHC, 80HHD, 80HHE, 80HHF, 88 are being phased out in a gradual manner such that no deduction will be available for the assessment years commencing on 1.4.2005 and subsequent years).

#### **11.2.5 Total Taxable Income**

This represents the difference between the gross total income and the deductions from the gross total income and is the base on which the tax rate is applied to arrive at the tax liability.

### **11.3 IMPORTANT PROVISIONS RELEVANT FOR DERIVING TAXABLE INCOME**

In applying the framework for deriving the taxable income, discussed in the preceding section, certain provisions and considerations relating to the following must be borne in mind:

- Expenses incurred during construction period
- Depreciation
- Deduction in respect of expenditure on scientific research
- Deduction in respect of certain capital expenditure
- Deduction in respect of profits derived from export business
- Deduction in respect of profits and gains from projects outside India
- Deduction in respect of profits from the export of computer software and other related technical services

- Exemptions in respect of profits and gains of newly set up industrial undertakings in free trade zone
- Deduction in respect of profits and gains from newly set up industrial undertakings engaged in infrastructure development
- Deduction in respect of profits and gains from certain industrial undertakings other than infrastructure development undertakings
- Disallowances of expenditures
- Set off, carry forward, and order of deduction for computing income from business

**Expenses Incurred During Construction Period :** The first question that needs to be answered is what is construction period or what is the date from which the computation of profits and gains of the business should be reckoned for the purpose of income tax. Section 3 of the Act dealing with the definition of previous year (the period with reference to which total income is computed) provides a clue in the matter. According to this Section, the previous year in respect of any business commences from the date on which it is 'set up'. In the case of a factory, the date of 'set up' will be the date on which the unit is 'ready' to commence production after trial run, etc, though the actual commercial production may not start due to various reasons such as non-availability of raw material, power supply etc. This date of 'set up' is the cut off date and all the expenditures incurred after this date is to be treated as revenue expenditure deductible in computing the income from business. It may not matter at this stage whether the unit is effecting sales or not for computing income under the head 'Profits and Gains of Business or Profession' for the purposes of income tax. Once the date of 'set up' of business is determined, the treatment of various expenses incurred up to the date of the setting up of the unit (other than direct expenses relating to construction) may be discussed.

During the construction stage of a project, new company incurs various expenses. These expenses can be broadly classified as: (a) direct expenses relating to construction and (b) expenses other than direct expenses.

The expenses, which are directly related to construction, are considered as part of plant, machinery, building etc. The treatment of other expenses needs some consideration. These expenses (other than direct) may be classified as follows: (i) preliminary expenses, (ii) indirect expenditure relating to construction, (iii) indirect expenditure not relating to construction, (iv) expenditure relating to technical know-how, (v) expenditure relating to a new project of an existing company, and (vi) income earned during the construction period.

**Preliminary Expenses :** Preliminary expenses consists of following: (a) expenditure in connection with preparation of feasibility report, preparation of project report, engineering services, market survey or any other survey necessary for the business of the assessee; (b) legal charges for drafting any agreement between the assessee and any other person for any purpose relating to the setting up or conduct of the business of the assessee; (c) legal charges for drafting the memorandum and articles of association, fees for registration of the company under the provisions of the Companies Act, cost of issue for public subscription of shares and debentures of the company; (d) such other items of expenditure (not being expenditure eligible for any allowance or deduction under any other provision of this Act) as may be prescribed.

According to Section 35D of the Act, 20 percent of the preliminary expenses can be claimed as deduction for each of the five successive previous years beginning with the previous year in which the business commences or the extension of the industrial undertaking is completed. The maximum amount of preliminary expenses that can be amortized is five percent of the cost of the project or capital employed (as defined in Section 35D) whichever is more.

**Indirect Expenditure Relating to Construction:** These consist of expenses like financial charges, remuneration of various personnel engaged in construction activity, traveling and other expenses incurred for the purpose of implementing the project, depreciation on various assets used for the purpose of construction and trial production expenses. These expenses are allowed to be capitalized, i.e., added to the value of various assets set up by allocating them over the items of plant, machinery, buildings, etc., on some reasonable basis. The unit is permitted to claim depreciation on the enhanced value of these assets arrived at after such allocation and this value is referred to as the 'actual cost' of the assets. Such actual cost is reduced by that portion, if any, as has been met directly or indirectly by any other person or authority [Section 43 (1)].

**Indirect Expenditure not Relating to Construction:** There are several expenses incurred during the construction period, which are not in any way related to construction. Examples: expenses on the marketing department, expenses incurred due to the corporate status of the unit. Such expenses are not allowed to be capitalized nor are they allowed to be deducted from the income of the subsequent years. From the point of view of financial accounting, these expenses are treated as deferred revenue expenses and are written off over a period of time. From the income tax point of view, however, the company does not derive the benefit of charging these expenses against revenue. Hence, it is preferable that such expenses are incurred, as far as possible, after the date of setting up of the unit.

**Expenditure on Technical Know-how:** Capital Expenditure incurred on technical know-how, incurred after 1<sup>st</sup> April, 1998 can be capitalized as direct expenditure related to construction or can be by itself treated as an intangible asset, on which depreciation can be claimed under section 32. Revenue

expenditure on technical know how can be claimed as expenses under section 37 (1).

**Expenditure Relating to a New Project of an Existing Company:** When an existing company with ongoing business activities sets up a new project, expenses that are directly relatable to the construction of the project is capitalized. Other indirect expenses incurred during the construction period are allowed to be claimed as a deduction from the incomes earned from other existing activities of the company. However, this does not preclude the company from capitalizing all indirect expenses relating to construction without claiming it as a deduction from other incomes as previously mentioned.

**Income Earned during Construction Period:** Income earned during construction period, which is attributable to construction activity, can be reduced from the construction cost of the asset itself. Examples of such income are sale of products produced during trial run, sale of packing material used for machinery, hire charges received for plant and machinery which was given to the sub contractor, sale of packing material used of machinery etc. Other types of incomes like interest received and share transfer fees received are normally treated as income for the purpose of Income Tax Act.

**Depreciation According:** According to Section 31 (1) of the Income Tax Act, depreciation at prescribed rates on the actual cost (as determined in the manner stated in the preceding heading) in respect of (i) buildings, plant and machinery and furniture and fittings being tangible assets and (ii) know-how, patents, copyrights, trademarks, licences, franchises or other business other business or commercial rights being intangible assets used for business/professional purposes is a tax deductible expenses. For claiming the depreciation allowance, the assets should be owned and used for the purpose of business by the assessee.

When a capital asset is imported, by incurring a liability in foreign exchange and the rupee equivalent of such liability is outstanding at the end of each year or at

the time of repayment increases/decreases due to fluctuation in rates of exchange then such increases/decreases are adjusted against the actual cost (Section 43 A). The actual cost so adjusted at the end of each year is treated as if it was the actual cost from the date of acquisition of the asset. This necessitates adjustment toward depreciation in each year in respect of earlier years.

Depreciation is charged on blocks of assets, which represent a group of assets, within the broad class of assets, of buildings, plant, machinery, and furniture, for which a common rate of depreciation is applicable. Depreciation will be calculated by applying the prescribed rate (which varies between 5% and 100%) on the written down value (WDV) of the entire block. When an asset is sold the amount realized from the sale of such asset (after deducting expense on sales) will simply be deducted from the WDV of that block. If the amount realized is greater than the WDV of the block, the difference will be treated as short term capital gain. In a case where all the assets in the block are disposed off and there is still a balance in the account of the block, such amount will be treated as short-term capital loss.

To illustrate the above provisions, let us consider an example. A block of assets consisting of 10 items acquired during 2000 to 2005 has a written down value of Rs.3 million as on 1<sup>st</sup> April 2005. During 2004-2005, the assessee sells an asset for Rs.2 million (on which an expense of Rs.0.1 million is incurred on sale) and acquires an asset for Rs.0.5 million.

The net block of assets for depreciation purposes at the end of 2004-2005 will be:

Opening WDV	Rs.2 million
Value of addition during the year	<u>Rs.0.5million</u>
	Rs.2.5million
Less	
Sale proceeds (after deducting selling expense)	Rs. 1.9
For the asset sold	
Net block for purposes of depreciation	Rs.0.6 million

In the above example, if the sale proceeds (after deducting selling expense) had been Rs.5 million, the difference between this amount and Rs.2.5 million should be treated as short-term capital gain and the net block for purposes of depreciation will be zero. Suppose, all the assets in the block (including the assets acquired during the year) are sold for Rs.2.2 million (after deducting selling expense), the balance of Rs.0.3 million remaining in the block amount will be treated as short-term capital loss.

It may be noted that when any asset is acquired and put to use during the previous year for a period less than 180 days then depreciation will be allowed only to the extent of 50 percent of the prescribed rate for that asset in respect of the year of acquisition.

**Deduction in Respect of Expenditure on Scientific Research:** Under Section 35, the following expenses relating to scientific research incurred during the previous year are allowed as deduction in computing the income from business: All expenses, both revenue and capital (other than cost of land) incurred on scientific research relating to the business of the assessee. Such expenditures incurred within three years before the commencement of business shall also be deemed to be incurred in the year of commencement of business and accordingly deductible in that year.

Contributions to approved scientific research associations/institutions, University / College, and to be used for scientific research are eligible for deduction of 125% of the contribution made [section 35 (1)(ii)].

In respect of contributions made to approved National Laboratories or University or Indian Institute of Technology, with a specific direction that the amounts be used for scientific research undertaken under an approved programme, an amount equal to 125% of the contribution is allowed as a deduction. [section 35 (2AA)].

Contributions to approved institutions to be used for research in social science or statistical research whether related to business or not are eligible for a deduction of 125% of the contribution [section 35 (1)(iii)].

Section 35 (2 AB) allows a weighted deduction of one and one half times, on revenue and capital expenditure (other than land and building) incurred on approved in house research and development, of companies engaged in manufacturing and production of drugs and pharmaceuticals, telecommunication equipment, chemicals, bio-technology, computers and others notified from time to time. This deduction is available up to March 31, 2005. [section 35(2AB)].

Expenditure in the nature of capital expenditure incurred for acquiring any right to operate telecommunication services, either before the commencement of business or thereafter. Deduction can be claimed under section 35 ABB, starting from the year in which the payment is made (or the business had commenced), in equal instalments and ending in the year in which the licence comes to an end.

**Deduction in Respect of Profits Derived from Export Business:** Section 80 HHC allows deduction of a certain percentage out of the profits derived from export business of a resident business entity or an Indian company. Various conditions governing the grant of this deduction are as follows.

1. The assessee should be engaged in the business of export out of India of any goods and merchandise. Exports of mineral oils and minerals and ores (other than processed minerals and ores specified in the twelfth schedule to the Income Tax Act) do not qualify for this deduction.
2. The sale proceeds from exports of such goods are receivable by the assessee in convertible foreign exchange within a period of six months or such extended time given by the Appropriate Authority from the end of the previous year in which the export took place.

3. The profits derived from export business (hereinafter referred to as exempted profits) is determined under 3 cases, viz. where the exported goods are manufactured or processed by the assessee, where the exported goods are trading goods and where the exported goods consist of both types.

**Case 1:** Export of manufactured goods

Eligible profit = Profit of the business x  $\frac{\text{Export turnover of Manufactured goods}}{\text{Total turnover of the business}}$

**Case 2:** Export of trading goods

Eligible profit = Export turnover of trading goods – Direct and indirect costs attributable to export of such goods.

**Case 3:** Export of both manufactured and trading goods

(a) For manufactured goods:

Eligible profit = Adjusted profit of the business x  $\frac{\text{Adjusted export turnover}}{\text{Adjusted total turnover}}$

(b) For trading goods:

Eligible profit = Export turnover of trading goods – Direct and indirect costs attributable to export of such goods.

The percentage rate of deduction of the eligible profits shall be an amount equal to: 70, 50 and 30 percent for the financial year beginning from April 1, 2001, 2002. And 2003 respectively.

No deduction is allowed from the assessment year beginning 1.4.2005.

**Note:** For purposes of making the above computations various expressions used there under have the meanings as stated below:

- (a) 'Total Turnover' does not include freight, insurance and export incentives;
- (b) 'Export Turnover' means the sale proceeds received or brought into India in convertible foreign exchange within six months of the previous year or such extended time limit but does not include freight and insurance (beyond customs limit)

- (c) 'Profits of the Business' means the amount computed under the head 'Profits and Gains of Business or Profession' and reduced by (i) 90% of the export incentives, brokerage, commission, interest, rent or receipt of similar nature included in such profit and (ii) the profits of any branch office, warehouse or any other establishment of the assessee situated outside India;
  - (d) 'Direct Costs' means costs directly attributable to the exported trading goods including the purchase price of such goods;
  - (e) 'Indirect Costs' means costs, not being direct costs, allocated in the ratio of the export turnover of trading goods to the total turnover;
  - (f) 'Adjusted Total Turnover' means the total turnover of the business as reduced by the export turnover of trading goods;
  - (g) 'Adjusted Export Turnover' means the export turnover as reduced by the export turnover of trading goods.
  - (h) 'Adjusted Profits of the Business' means the profits of the business as reduced by the profits derived from the business of export of trading goods.
4. An assessee selling the eligible goods to an Export/Trading house holding a valid certificate issued by the Chief Controller of Imports and Exports is entitled to the deduction as stated above on the basis of a certificate of export turnover issued by such Export Trading House and a Chartered Accountant. On issue of such certificate, the amount of deduction available to the Export Trading House will be reduced by the amount calculated as follows:
5. A certificate from a Chartered Accountant certifying that the deduction has been correctly claimed is to be furnished along with the return of income.

**Deduction in Respect of Profits and Gains Projects Outside India (Sec. 80 HHB):** This deduction is applicable to Indian companies or to persons resident in India, engaged in executing foreign projects like construction of buildings, dams,

roads, the assembly or installation of plant or machinery etc., for which compensation is payable in convertible foreign exchange [Section 80 HHB].

The conditions governing the deduction are as follows:

- Separate books of accounts are to be maintained for such projects
- The accounts must be audited and a report prepared in the prescribed format
- The assessee is required to credit the Foreign Projects Reserve Account the specified percentage of profits. The amount credited to the 'Reserve Account' is required to be utilized by the assessee before the expiry of a period of five years following the previous year in which the amount was credited which must be used for the purpose of the business and not for distribution as dividends.
- The specified percentage of profits is also required to be remitted to India in convertible foreign exchange
- The amount that can be claimed is specified percentage of the profits and gains of such business.

The specified percent is 30% for the assessment year commencing from 1.4.2002 and there after this deduction is reduced by 10% each year. No deduction is allowed from the assessment year beginning 1.4.2005.

**Profits from the Export of Computer Software and Other Related Technical Service [Section 80 HHE]:** The deduction is allowed for an Indian Company or a person other than company resident in India, and is a Software developer, and has export out of India of computer software or its transmission from India to a place outside India by any means or has providing technical services outside India in connection with the development or production of computer software.

For the purpose, profit derived from the business specified above is determined as follows:

$$\text{Eligible Profits} = \frac{\text{Export turnover}}{\text{Total turnover}} \times \text{Profit of the business}$$

The deduction allowable is 60% of eligible profits for the assessment year 2002-2003, reduced to 40% and so on in the subsequent assessment years, and is being phased out in a gradual manner such that no deduction will be available for the assessment years commencing on 1.4.2005 and subsequent years.

The terms export turnover, total turnover and profit of business have been defined specifically in the section.

In order to claim the deduction, the assessee is required to furnish an audit report in the prescribed form along with the return of income.

**Exemptions in Respect of Profits and Gains of Newly Set Up Industrial Undertakings in Free Trade Zones [Section 10A]:**

Newly established industrial undertakings in free trade zones, electronic hardware technology parks, software technology parks, or special economic zones, can claim exemption of 100% of their profits and gains derived from such exports for a period of ten years beginning with assessment year relevant to the previous year in which the industrial undertaking begins to manufacture or produce articles or things.

Sale proceeds must be brought into India in convertible foreign exchange within the specified period. The exemption will not go beyond assessment year 2009-2010. The amount of profit that is eligible for deduction is calculated in the ratio of the export turnover to total turnover of the business. This section applies to Kandla Free Trade Zone, Santacruz Electronics Export Processing Zone or any other free trade zone as prescribed by the central government by notification in the Official Gazette or the technology parks set up under a scheme notified by the central government, for the purposes of this section.

**Newly Established Hundred Per Cent Export Oriented Undertakings**

**[Section 10B]:** This provision extends the same type of benefit as allowed for the industrial undertakings set up in a free trade zone or technology park, to newly established undertakings recognized as 100% Export Oriented Undertaking. For

the purposes of this section, “hundred per cent export oriented undertakings” means an undertaking, which has been approved as a hundred per cent export oriented undertaking by the Central Government. All the other provisions are similar to the above Section 10 A.

**Deduction in Respect of Profits and Gains from Newly Set Up Industrial Undertakings Engaged in Infrastructure Development:** Section 80 IA, allows a certain deduction in respect of profits and gains of an industrial undertaking, being an Indian company or a consortium, carrying on the business of developing, or maintaining and operating, or developing, maintaining and operating.

- (a) Infrastructure facility like roads, bridges, airports, inland waterways, ports, highway projects water supply projects, irrigation sanitation and sewerage treatment system
- (b) Telecommunication service
- (c) Industrial parks
- (d) Generation, distribution and transmission of power

The allowable deductions are as follows:

Infrastructure Facility started after 1.4.95

- The deduction will be hundred percent (from assessment year 2002-03) of profits and gains derived from such business for ten consecutive years beginning from the initial assessment year and falling within the fifteenth (twenty in some cases) assessment year from the year in which the enterprise begins operating and maintaining the infrastructure facility.

#### **Telecommunication Services**

- Telecommunication services are services that include basic or cellular services including radio paging, domestic satellite services, network of trucking and broadband network and Internet services.
- These services should have started or starts providing telecommunication service after a 1<sup>st</sup> April 1995 but before 31.2.2003;

- The deduction will be hundred percent for the first five years and thirty percent thereafter (next five years) for ten consecutive years starting from the initial assessment year and falling within fifteen years from which the enterprise begins operations.

#### **Industrial Park:**

- An undertaking which develops and operates industrial parks or (or special economic zones from the assessment year 2002-2003) on or after 1 April 1997 but before 31.3.2006.
- The amount of deduction is 100 percent of profits from the assessment year 2002-2003 for ten consecutive years starting from the initial assessment year and falling within fifteen years from which the enterprise begins operations.

#### **Generation and Distribution of Power**

- An undertaking, which is set up in any part of India for, generation or generation and distribution of power or transmission or distribution by laying network of new lines, begins on the 1<sup>st</sup> April, 1999 but before 31.3.06.
- Splitting up or reconstruction of a business does not form the industrial undertaking already in existence. However, if the business is re-established or revived by the assessee which was discontinued due to damage of building machinery etc. on account of floods, earthquake typhoon etc. or riots and civil disturbances or by fire or explosion or act of war etc. the business will be treated as a new industrial undertaking.
- Amount of deduction will be 100 percent from the assessment year 2002-2003. For ten consecutive years starting from the initial assessment year and falling within fifteen years from which the enterprise begins operations.
- The amount of profits eligible for deduction will be limited to the activities undertaken by the undertaking for example: If the undertaking is engaged in generation of power, then profits generation of power is eligible.

Additional conditions that need to be fulfilled by the business are:

- (i) For calculating the amount of deduction, such industrial undertaking or eligible business is treated as if it was the only source of income.
- (ii) Goods and services transferred by the eligible business or those transferred to the eligible business by any other business carried on by the assessee has to be at the market value. In addition, the assessing officer has the right to recomputed the profits and gains as he may deem fit.

**Deduction in Respect of Profits and Gains from Certain Industrial Undertakings Other than Infrastructure Development Undertakings:** Section 80 IB allows a certain deduction in respect of the profits and gains derived from any newly set up industrial undertaking, other than infrastructure development undertaking referred to as eligible business which must have commenced operation before 31.3.2002.

The allowable deductions are as follows:

- In the case of industrial undertakings located in an industrially backward state for district as specified or set up in any part of India for the generation, or generation and distribution, of power which begins to manufacture or produce articles or things or to operate its cold storage plant or plants or to generate power at any time during the period from 1<sup>st</sup> April, 1994 to 31<sup>st</sup> March, 2002, the deduction will be 100% for the first five years and 30% for the next 5 years. An undertaking refining mineral oil gets 100% deduction for initial seven assessment years.
- Other small scale Industrial undertakings manufacturing or things or operating its cold storage plants, for initial assessment year and nine succeeding assessment years the deduction allowed is @ 30% of profits and gains derived from such industries.

For purposes of computing the amount of deduction, such industrial undertakings are treated as if it was the only source of income.

For computing the profits of the eligible business as previously mentioned, past losses and Unabsorbed allowances relating to such business is deducted even though such past losses, etc., have already been absorbed by other incomes in the past.

For both Sections 80IA and 80 IB the following conditions apply;

- The splitting up, or reconstruction, of a business already in existence, does not form it.
- The transfer does not form it to a new business of a machinery or plant previously used for any purpose.
- In the case of an industrial undertaking other than a small scale industry or an industry set up in a backward state, it manufactures or produces any articles or things other than articles or things specified on the list in the Eleventh Schedule;
- It employs ten or more workers in a manufacturing process carried on with the aid of power or employ twenty, or more workers in a manufacturing process carried on without the aid of power.

**Disallowances :**The Income Tax Act provides that though certain expenses are incurred by the assessee during the previous year, they will not be allowed as a deduction (partly or fully) in computing the income under the head ‘Profits and Gains of Business or Profession’ under certain circumstances. The more important of these items are mentioned below:

1. Advertisement expenditure in the material published by any political party is disallowed in full [Section 37 (2B)].
2. Any expenditure incurred by the assessee who is prohibited by law will not be allowed as deduction. (Section 37).

3. Expenditure because supply of goods, services, or facilities by certain specified related persons/organizations, which is in the opinion of the assessing officer, is excessive or unreasonable can be disallowed [Section 40A (2)].
4. Expenditure in respect of which payment is made in a sum exceeding Rs.20,000/-, at a time, otherwise than by crossed cheque or bank draft (except in certain exempted cases) is disallowed in full [Section 40A (3)].
5. Contributions to unapproved gratuity or other funds of employees are disallowed in full [Section 40 A (7 and 9)].
6. Expenditures of the following kinds are allowed if they are not paid for within the previous year or within a stipulated time after the previous year: (a) expenses on account of tax, duty, or fees, (b) contributions to any provident/superannuating / gratuity/other welfare fund of employees, (c) payment of bonus or commission to employees, and (d) interest on any loan or borrowing from public financial institution (e) Interest on term loan from scheduled banks (f) provision made for amount payable as in lieu of any leave (leave encashment) (as defined in Section 4A of the Companies Act, 1956) (Section 43B).

#### **11.4 SET OFF, CARRY FORWARD, AND ORDER OF DEDUCTION FOR COMPUTING INCOME FROM BUSINESS**

Various deductions and allowances are considered in computing the income from business as discussed in the previous section. If the result after providing for such deductions and allowances is a negative figure in any year, this is allowed to be set off against income from other heads and the remaining unabsorbed amount, if any, can be carried forward to the next year and set off against the income of that year and so on. The provisions relating to set off negative income and

aggregation and the order of deduction for computing income from business are as follows:

- The first step in the aggregation process is the determination of income under each head by setting off losses against incomes under different sources. The rules for such set off are as follows:
  - (a) Losses from any source under a given 'head of income' can be set off only against income from any other source under the same 'head of income' with exceptions noted in (b) below,
  - (b) Losses from speculation business (which falls under the head of income 'profits and gains of business or profession') can be set off only against profits from speculation business. Likewise, losses from owning and maintaining racehorses can be set off against profits from similar activity.
  
- Setting off losses does aggregation of income from all heads of income from one head of income against income from other head/s. The rules regarding set off and carry forward are as follows:
  - (a) Subject to (i) above losses under any head of income other than the head capital gains can be set off against the income under any other head of income. Losses under the head house property to the extent it relates to the interest on loan taken for construction, purchase or repair of such property can be set off against income from any other head. In the subsequent year, the carried forward loss should be set off against income from house property and the balance loss can be carried forward for a period of eight subsequent years from the year in which the loss was first computed.
  - (b) Losses that remain under the head capital gains can be carried forward and set off against income under the head capital gains of subsequent years

and so on. Such carry forward can be done for a period of eight subsequent years from the year in which the loss was computed.

(c) Unabsorbed business loss (other than speculation business loss) of any year can be carried forward and set off against income under the head of business of subsequent years. Such carry forward can be done for eight subsequent years from the year in which the loss was computed.

(d) Unabsorbed loss from speculation business can be carried forward and set off against income from speculation business. Such carry forward can be done for eight subsequent years.

- Unabsorbed depreciation can be carried forward and set off against the income from any other head of subsequent years without any limitation as to the number of years.
- Capital expenditure on scientific research, which is not absorbed by available current profits, is treated in the same way as unabsorbed depreciation.

**Order of Deduction for Computing Income from Business** For the purposes of carry forward and set off, the unabsorbed benefits from an earlier year are divided into various categories and are considered for set off, along with certain current allowances, in the order given below in computing the income from business of the current year:

- Current scientific research capital expenditure
- Current depreciation
- Carried forward business loss
- Unabsorbed depreciation and Unabsorbed capital expenditure on scientific research

A loss cannot be carried forward unless the return of Income Tax is filed within the time allowed under Section 139 (1) of the Act.

## 11.5 SUMMARY

Once the taxable income of the company (assessing the project appraisal) is derived, the next step is the determination of the tax burden and its payment. For this purpose, we need to know; (i) tax rates for companies, (ii) calculation of Minimum Alternate Tax, (iii) provisions for payment of advance tax, and (iv) provisions for payment of tax along with the filing return.

For tax purposes, companies are classified as domestic companies and foreign companies and are taxed at 35% and 48% respectively. Though the rates of income tax are prescribed annually in the Finance Act, the Income Tax Act it self stipulates the rates of income tax in respect of certain types of incomes and these generally relate to foreign companies in respect of incomes of the nature of royalties, technical know-how fees, interest and dividends. In respect of long-term capital gains, the Act prescribes rates of tax both for domestic as well as foreign companies.

Such incomes are taxed at rates mentioned in the Act and the remaining total income is taxed at the rates stated above.

The total tax liability computed as above is increased by an amount of surcharge (at present 2 percent) on the tax computed.

In the case of an assessee, being a company, if the income tax is payable on the total income as computed under the Act, is less than 7.5% of its book profit, the tax payable for the relevant previous year shall be deemed to be 7.5% of such book profit. That is every company will now be paying at least 7.5% of the book profits as tax. [Section 115JB (1), inserted with effect from 1.4.2001].

In addition, a report in the prescribed format, from the accountant certifying that the book profit has been computed in accordance with the provisions of this section must be field along with the return of income.

The annual accounts prepared are in accordance with Parts II and III of Schedule VI of the Companies Act using the accounting policies, accounting standards and

methods of depreciation and which are presented before the annual general meeting of the company.

Book profits means the net profit shown in the profit and loss account and should be increased by:

- The amount of provision for income tax
- The amount carried to any reserve
- The amount set aside for unascertained liabilities
- The provisions for losses of subsidiary companies
- The amounts paid or proposed as dividends

Similarly, the following should be deducted from the profit and loss account

- The amount withdrawn from any reserves or provision credited to profit and loss account
- The amount of loss brought forward or unabsorbed depreciation whichever is less as per books of accounts
- The net amount of income as reduced by expenses included in the profit and loss account, which is exempt from tax under Sections 10, 10A or 10B, shall be excluded.
- The amounts of profit which are eligible for deduction under Section 80 HHC, or 80 HHE or 80 HHF and is also excluded for the purposes of calculation if MAT. No tax credits are available under the MAT as calculated under Section 115JJB.

Advance tax is payable on the current income of the company in four installments during the financial year as follows:

On or before                      Advance tax that should have been paid by the due date  
(As a percentage of the estimated total tax liability)

15 <sup>th</sup> June	15
15 <sup>th</sup> September	45
15 <sup>th</sup> December	75
15 <sup>th</sup> March (succeeding)	100

For practical purposes, these provisions mean that income tax is payable along with the earnings. Thanks to this 'pay as you earn' principle, there is hardly any lag between earnings and tax payment.

At the time of filing return, the assessee is required to compute the tax liability based on the income stated in the return of income. If there is a shortfall between this tax liability and the sum of the advance tax paid and the tax deducted at source on incomes due to the company, then such shortfall is required to be paid before the return is filed. Such tax is referred to as self-assessment tax. Along with such shortfall in tax the assessee is also required to pay interest on (a) the shortfall in the advance tax payable in any installment and (b) the self assessment tax, if the return is filed beyond the due date. The due date for filing of return for companies is 31<sup>st</sup> October of the relevant assessment year.

## **11.6 KEYWORDS**

**Gross Total Income:** It represents the summation of income from business and income from other heads.

**Total Taxable Income:** It represents the difference between the gross total income and the deductions from the gross total income and is the base on which the tax rate is applicable to arrive at the tax liability.

**Direct Costs:** It means costs directly attributable to the exported trading goods including the purchase price of such goods.

**Book Profits:** Book profits means the net profit shown in the Profit and Loss Account.

## **11.7 SELF ASSESSMENT QUESTIONS**

1. "A company assessing the tax burden of new project under consideration needs to carry out detailed examination of relevant tax provisions." Explain the statement with example.

2. Discuss the provisions relating to the depreciation and set off and carry forward of losses under income tax act. What is the relevance of such provisions in case of a new project?
3. Reliance India Ltd is engaged in infrastructure projects in the area of construction of National Highways. You as an expert are requested to advice to the company as what steps the company should take in order to avoid any undesirable action from the tax department.
4. What is written down value (WDV)? How far it is useful in calculating the depreciation on capital assets. Bring out the detailed account with some suitable examples.

### **11.8 SUGGESTED READINGS**

1. Chandra, Prasanna: Projects-planning, analysis, financing, implementation and review.
2. Desai, Vasant: Project Management
3. Mahrotra, H. C : Income Tax Law and Practice.
4. Singhania, V K : Income Tax Law and Practice.

## **LESSON: 12**

### **ENVIRONMENTAL APPRAISAL OF PROJECTS**

#### **STRUCTURE**

- 12.0 Objective**
- 12.1 Introduction**
- 12.2 Types and Environmental Dimensions of a Project**
- 12.3 Stresses on Environment**
- 12.4 Environmental Impact Assessment Methodologies**
- 12.5 Summary**
- 12.6 Keywords**
- 12.7 Self Assessment Questions**
- 12.8 Suggested Readings**

#### **12.0 OBJECTIVE**

After reading this lesson, you should be able to

- a) Discuss the environmental dimensions of a project.
- b) Explain the different stresses on environment.
- c) Make the Environmental Impact Assessment.

#### **12.1 INTRODUCTION**

The effects of actions that are not accounted for in the normal market transactions need to be considered explicitly in the decision making process on projects. These effects are to be identified, assessed, and evaluated against the economic advantages arising out of a given action. In this context, the environmental impact appraisals are considered the first step in the process because they give an opportunity to man to consider the effects of his actions on the environment.

Economic development is the result of the interaction between natural resources and technology supported by and designed for people. People are the centre for development. Therefore, it is rightly said that all human activity, be it economic, social or anything else is essentially directed at satisfying “needs” and “wants” of man through “altering” and “using” environmental resources.

## **12.2 TYPES AND ENVIRONMENTAL DIMENSIONS OF A PROJECT**

Broadly, there are two types of projects. The first one refers to those projects that produce physical goods like cement, steel, paper, chemicals etc. These projects, in fact, convert the natural resources into saleable and exchangeable products. In fact, these projects inflict a large number of physical changes and disruptions on environment and, hence, disturb the environmental and ecological balance. Environmentalists are mostly concerned with such type of projects. The second type refers to those that produce/render various kinds of services such as health, education, transport, energy, defense, law etc. Such projects also cover actions like land reforms, agricultural extension, services, sales promotion campaigns, etc. Projects of these types are non-physical in nature and they do not directly cause any physical changes in the environment. However, they bring about significant changes of far-reaching consequences on values, attitudes, lifestyles, social relations, and so on. The net effect of such projects is the creation of new wants and needs in society. They ultimately promote consumerism in the society and thereby increase the number of manufacturing projects. Thus, both are interrelated.

Each project has two dimensions: (a) the intended objectives – they are also called stated goals/benefits; and (b) the unintended consequences. They are also called externalities or social costs which are unplanned, unwanted, and unanticipated. Environmental management or planning is the study of the

unintended consequences of a project. Its purpose is to identify, examine, assess, and evaluate the likely and probable impacts of a proposed project on environment and, thereby, to work out the remedial action plans to minimize the incidence of adverse impacts. It is not anti-development nor is it against the projects. Its goal is development without damage or least damage.

### **12.3 STRESSES ON ENVIRONMENT**

Environmentalists have identified four types of different stresses or pressures that are being continuously inflicted on environment. They are:

- i) **Atrophic Stress** Refers to the release of various kinds of wastes into the river and other water bodies and their consequent drying.
- ii) **Exploitative Stress** Refers to the exploitation of natural resources endowment for production and consumption purposes through agriculture, industry, extraction, fishing etc. It is important to note that the rate of exploitation has a relevance to the nature's capacity to reproduce.
- iii) **Disruptive Stress** Refers to the physical alterations in nature resulting from such activities like forest clearance, highways, railways, factory buildings and so on. These physical changes disturb the environmental and ecological balance.
- iv) **Chemical and Industrial Stress** results mainly from the developments in "science and technology" and their applied fields like industry, warfare and agriculture. This comprises mainly the pollutants and effluents of all types, radiation etc.

Strategies to face these threats to natural environment through pollution, destruction and over-use can be: (a) preventive or (b) regulatory. It is in this

context that the environmental appraisal of projects is gaining significance with a hope of achieving sustainable development in harmony with environment.

### **12.3.1 Meaning and Scope of Environment**

The word “environment” is defined to include everything external to man/organism. It covers the region, surroundings, or circumstances in which anything exists. It is broadly divided into two components. The first one is the biotic or inorganic milieu, comprising the physical elements like land, water, atmosphere, climate, sound, odours, and tastes. They are the inanimate elements of the habitat systems. The other one is the biotic or the organic milieu consisting of animals, plants, bacteria, viruses, all other living organisms, and the social factors including aesthetics. They are the animate elements.

There is another definition particularly relevant in the context of projects. Here, the term “environment” is defined as:

*The surrounding zone (the specific zone to be affected by the project), all natural resources (physical and biological), and the human resources (people, economic development and quality of life values).*

This definition is comparatively more specific, focused, and clear-cut than the earlier one, which was too general and unfocussed. This is more suited to operationalise, quantify, and measure the environmental impacts of a given action. The contentious issue in this definition is the surrounding zone or the project vicinity. However, a distinction has to be made between the “legal boundary” which is the area legally occupied by a project, and the “environmental boundary” which stretches much beyond the legal boundary. In fact, this is the area around the project that is likely to be affected environmentally by the project operations. The extent of environmental boundary for a project depends, among other things, on the diffusion factors like wind speeds and directions, elevations, etc. It varies from project to project and location to location for the same project.

There is yet another definition of environment as below:

The external, natural, physical and residential conditions which affect man directly and indirectly and which are, in turn, influenced by economic decisions and technological developments.

This definition implies a complex interactive model between man, environment, and science and technology, the outcome of which will be economic development. As a matter of fact, projects facilitate such an interaction.

Environmental management, a term encompassing environmental planning, protection, monitoring, assessment, research, education, conservation, and sustainable use of resources, is now accepted as a major guiding factor in all the economic decision making processes on development or otherwise. Subsequently, a wide network of legislation came into being. Now, environmental clearance for all the major projects on the basis of their Environmental Impact Statement (EIS) has become legally mandatory.

### **12.3.2 Environmental resources/values (ER/VS)**

Since the word ‘environment’ is an all-inclusive concept encompassing everything external to us, it is difficult to operationalise and applies to particular situations like the projects. For the purposes of operationalisation and practical application, the environmentalists have developed a concept called ‘Environmental Resources/Values’ (ER/Vs). It is defined as an aspect of environment which is of benefit to man. The environmentalists have identified and classified various components of environment (that is, ER/Vs) into four levels as below:

- (a) Level – 1: Physical Resources, covering land, water and air,
- (b) Level – 2: Ecological Resources, consisting of aquatic, terrestrial and endangered (rare) species (other than man).
- (c) Level – 3: Human Use Values, covering transport, agriculture, water supply, recreation, mining, industry, flood control, etc.

(d) Level – 4: Quality of Life Values, covering socio-economic, cultural and aesthetic aspects.

Thus, the whole environment is decomposed into several operationally feasible components for elements. These elements can further be subdivided into several related items. Alternatively, some other environmentalists identify and classify the various elements of environment broadly under eight types, which are called Environmental Attributes (EA). They are: (a) air, (b) water, (c) land, (d) ecology, (e) sound, (f) human aspects, (g) economics, and (h) resources. Each one can further be subdivided into different related elements.

In the context of environmental appraisal of projects, one can follow either of the classifications, viz., Environmental Resources/values (ER/Vs) or the Environmental Attributes (EA). As a matter of fact, they can be evaluated and assessed individually with respect to the impacts they receive or the changes they undergo due to the proposed project. Since there will be a variety of types of impacts of varying degrees from a project, the decomposition of environment unit into various quantifiable elements will enable the analyst to give focus and direction to his impact assessment analysis.

An environmental effect is considered as the effect of natural or fabricated actions, which alter environment (as measured by physical, chemical, and biological parameters). Our concern is, however, on man made actions. The nature and extent of environmental impacts including magnitude, severity, urgency, risk etc., of a project in the ultimate analysis depends upon:

- (a) Nature, size and type of the project: such as manufacturing, services, agriculture, mining, logging, power, hardour, chemicals, sugar, etc.
- (b) Technology.
- (c) Location/eco-region: such as urban or rural areas, coastal, river valley, forest/hill areas or any of the eco-systems as described earlier.

### **12.3.3 Environmental impact assessment (EIA) and environmental impact statement (EIS)**

Environmental Impact Assessment (EIA) and the Environmental Impact Statement (EIS) are said to be the instruments through which the environmental management tries to accomplish its objective. The basic premise behind the EIS/EIA is that no one has any right to use the precious environmental resources resulting in greater loss than gain to society. From this, it follows that the aim of EIS is to seek ways by which the project can proceed without any irreparable losses to environment and minimum losses if any, so that the net effect will be a desirable gain.

Environmental Impact Assessment (EIA) is defined as: “An activity designed to identify, predict, interpret, and communicate information about the impact of an action on man’s health and well-being (including the well-being of ecosystems on which man’s survival depends). In turn, the action is defined to include any engineering project, legislative proposal, policy programme, or operational procedure with environmental implications.” An EIA, therefore, is a study of the probable changes in the various socio-economic and biophysical attributes of the environment, which may result from a proposed action.

On the other hand, Environmental Impact Statement (EIS) is defined as:

*A report, based on studies, disclosing the likely or certain environmental consequences of a proposed action, thus alerting the decision maker, the public and the government to environmental risks involved; the findings enable better informed decisions to be made, perhaps to reject or defer the proposed action or permit it subject to compliance with specific conditions.*

The EIS is a document prepared by an expert agency on the environmental impacts of a proposed action/project that significantly affects the quality of

environment. The EIS is used mainly as a tool for decision-making. At times, the EIA and EIS are used interchangeably as synonyms. However, both are different activities with many commonalities and with a common purpose. The basic difference between the two is that the EIA is carried out by the expert agency while the EIS as a tool is given to the decision-makers in different formats. As a matter of fact, the EIS is the outcome of EIA. It is better to consider the environmental consequences during the project planning and design stage itself so to avoid higher costs of future remedial actions by prudent planning and early preventive measures.

**Objectives of EIS:** To identify and describe (in as quantified a manner as possible) the environmental resources/values (ER/Vs) or the environmental attributes (EA) which will be affected by the proposed project, under existing or “with or without project” conditions.

- (a) To describe, measure, and assess the environmental effects that the proposed project will have on the ER/Vs (again, in as quantified a manner as possible), including positive effects, which enhance ER/Vs, as well as the negative effects, which impair them. Direct or indirect and short term or long term effects are to be considered. This would also include the description of the specific ways by which the project plan or design will minimize the adverse effects and maximize positive effects.
- (b) To describe the alternatives to the proposed project which could accomplish the same results but with a different set of environmental effects. Energy generation by thermal, hydel, and nuclear modes would explain the case in point. Further, alternative locations are also considered.

**Guidelines on the Scope and Contents of EIS/EIA:** The following are the commonly accepted points to be covered in an EIA study/report:

- (a) A description of the project proposed action; a statement of its purpose and a description of all relevant technical details to give a complete understanding of the proposed action, including the kinds of materials, manpower/resources etc., involved.
- (b) The relationship of the proposed action to the land-use plans, policies and controls in the affected area or the project-vicinity. It is necessary to gain a complete understanding to the affected environment. What is the nature of biophysical and socio-economic characteristics that may be changed by the action?
- (c) The probable impacts of the proposed project on environment are a very important aspect to be considered in detail. It is necessary to project the project action into the future and to determine the possible impacts on the environmental attributes. The changes are to be quantities wherever possible.
- (d) Alternatives to the proposed action, including those not within the existing authority/agency.
- (e) Any probable adverse environmental effects that cannot be avoided and stating how each avoidable impact will be mitigated.
- (f) The relationship between local short term uses of man's environment and the maintenance of an enhancement of long-term productivity.
- (g) Any irreversible and irretrievable commitments of resources (including natural, cultural, labour, and materials).
- (h) An indication of what other interests and considerations of governmental policy or programme are thought to offset the adverse effects identified.

As seen by its purpose, scope and contents, the EIA is a very complex exercise due to the fact that many and varied types of projects are proposed for an equally

numerous and varied kinds of environmental settings. Each combination of projects and the complex environmental settings results in a unique cause-condition-effect relationships with regard to their impacts. Therefore, each combination must be studied individually in order to accomplish a comprehensive analysis.

**Methodology for Conducting an EIS Study:** So far, there is no consensus on any particular procedure. This is because of the difficulties in quantifying the effects which are often intangible, complex, and imperceptible in nature. It is difficult to develop meaningful parameters to represent the effects and their quantification. The major problems in this regard are:

- (i) The diffused nature of impacts both over time and space; and the lags in impacts after the cause worked.
- (ii) An environmental effect is the joint product of several pollutants.
- (iii) Inadequacy of techniques to estimate the impacts and their costs.
- (iv) Since the impacts are imperceptible, people are not aware of the impacts.

Due to the complex problems involved in identification and quantification of effects, all attempts to develop quantitative approach to EIA (including the checklists, matrices, networks, flowchart relationships, and map overlays) have been essentially subjective with the quantification depending mostly on the background and bias of the investigator or observer.

At present, the generally accepted approach for making the EIS is an item-by-item review of effects on the individual environmental resources/values (ER/Vs), including both the identification of ER/Vs, and description and quantification of the effect to the extent possible. Then, it is possible to group these effects in a systematic manner. The following are the major practical steps in this approach.

- (a) Make a rapid or quick scanning or appraisal of the basic environmental resources viz., land, water and air, at the macro level, say at the district level in which the project is to be located. This scanning is meant to evaluate the

extent of fragility and exploitation of the endowed resource-base, including the human resources. Then relate the project to the regional environmental in broad terms.

- (b) Demarcate the project vicinity or the surrounding zone of the project. Maps can also be used.
- (c) Identify, assess, and describe all the environmental attributes as given in a tabular form earlier; or the environmental resources/values (ER/Vs under four levels) as given earlier, endowed in the project vicinity. This would give a total description of the environment before the start of the project.
- (d) Rank or prioritise the identified ER/Vs by their fragility, importance, relevance and quality. This would help to concentrate on the very significant items rather than spreading the efforts too thinly over a large number of items of lesser significance.
- (e) Carry out the item-by-item review of effects of the proposed project on the already identified individual ER/Vs embedded in the project vicinity.
- (f) Arrange or group the effects in a systematic manner, preferably in a format.
- (g) Prepare the remedial plans for mitigating the adverse effects. They can be: (i) Corrective; (ii) Compensatory; or (iii) Enhancing.

By following the above practical steps sequentially in that order, one can make an environmental appraisal of any type of project. Through EIS/EIA, the environmental protection planning is made compatible with the developmental perspectives.

**Some Major Issues in the Preparation of EIS/EIA:** The following are the major issues reported to be encountered commonly while conducting and preparing the EIS/EIA. Some of the issues cannot be resolved. In the absence of better alternatives, the analyst has to accept the issues as they are.

- **Determining the Environmental Impacts** This is the central theme in any EIS/EIA. It is a very complex process. At the outset, a distinction has to be made between the environmental impact and the changes in environmental attributes. Our interest is on the “impacts” and not on the ‘changes’, which normally take place even without the project. The determination of environmental impacts involves: (a) identification of impacts on environmental attributes or the ER/Vs, (b) measurement of impacts on attributes, and (c) aggregation of impacts on attributes to reflect the total impact on environment.
- **With and Without the Project** the environmental impacts are measurement of attributes with and without the project or activity at a given point in time. However, the changes in the attributes take place over time without the activity. Therefore, the impact must be measured in terms of “net” change in the attribute at a given point in time.
- **Identifying the Impacts** the number of attributes to be evaluated is practically infinite because any characteristic of the environment is considered an attribute. Therefore, they have to be reduced to manageable numbers. Thus, duplicative, redundant, difficult to measure, and obscure attributes may be eliminated in favour of those that are more tractable. This implies that some attributes, which are difficult to measure or conceptualize, may remain to be examined. In this case, bias and subjectivity are likely to be crept in.

- **Characteristics of the Base Conditions Prior to the Activity:** The nature of the impact is determined by the conditions of the environment existing before the project. The assessment of the characteristics of the base is a critical factor.
- **Geographic Characteristics:** The same activity produces different impacts on a particular attribute; say water quality, over different geographical areas. The spatial distribution of different activities introduces one of the difficult elements in comparing one activity and its impact with another. This issue becomes particularly critical while making choices between projects.
- **Role of Attributes** Though the impacts are considered the effects on the definite discrete attributes of the environment, the actual impacts are not correspondingly well categorised. Nature does not necessarily respect man's discrete categories. Rather, the actual impacts may be the effects of varying severity on a variety of interrelated attributes. The issue is one of identifying and assessing the cause-condition-effect in order to work out the remedial measures.
- **Measurement of Impact** Ideally, all impacts must be translatable into common units. However, this not possible because of the difficulty in defining affects in common units (e.g., on income and on water quality). In addition, the quantification of some impacts may be beyond the state of the art.
- **Aggregation Problem** After measuring the project impacts on various individual attributes or ER/Vs, one encounters the problem of how to aggregate all impacts (quantitative and qualitative) thus assessed to arrive at a single composite measure to represent the 'total activity impact'. This would involve expressing the various impact measures in common units, which is very difficult. Some use a weighting

procedure to accomplish this, which is again subjective. There is another associated problem of summing up and comparing with the impact of an alternative activity.

- **Secondary Impacts** Secondary or indirect impacts on environment should also be considered particularly in relation to the infrastructure investments that stimulate or induce secondary effects in the form of associated investments and changed patterns of social and economic activity. Such induced growth brings significant changes in the natural conditions. Similarly, there can also be significant secondary impacts in the biophysical environment.
- **Cumulative Impacts** Here, cumulation refers to the similar activities spread over in all environmental setting like hotels, beach resorts, surface or underground mines, industrial estates, etc. A single individual activity may produce a negligible effect on environment. However, services of similar activities may produce significant cumulative effects on certain aspects of environment. This raises the question of how to deal with these significant cumulative effects. Therefore, it is suggested to prepare an environmental impact assessment (EIA) on broad programmes rather than on a series of component actions (e.g., industrial estates, mining sector, tourism industry, etc.). On the other hand, alternatively, one can prepare and EIA for a particular geographical area where a series of similar activities are located (e.g., mining areas, coastal line for beach resorts, etc.).
- **Reporting Findings** The results should be displayed in such a way that it makes easy and clear to comprehend the total impacts of an activity from a brief review. It is suggested to display the impacts on a summary sheet in a matrix form.

The knowledge about the issues as explained above, however complex they are, will be useful in understanding the processes and complexities involved in preparing an EIS/EIA. Such awareness will help improve the understanding of EIS, leading to more objectives, informed and unbiased decision-making on activities/projects.

**Choice of a Methodology:** Many impact assessment methodologies have been developed in the western industrialized countries as a response to the various legislative control and regulatory measures as also to suit divergent environmental situations and purposes.

The choice will decide the depth of analysis to be carried out in a particular impact assessment. The choice of a methodology depends on; (a) needs of the user, (b) type of project; its size and technology, and (c) location; type of ecosystem.

Depending on these factors, one may be more useful than the other methodology. Therefore, the analyst must decide which one will best fit for a given task and situation. The following are the important considerations for making a choice on the methodology for preparing an EIS/EIA.

- **Use:** Is the EIS for a decision or for information? If it is for a decision, it required greater emphasis on identification of key issues, quantification and comparison of alternatives. If it is for information, it requires a more comprehensive analysis and concentration on interpretation of the significance of a broad list of possible impacts.
- **Alternatives:** Are alternatives fundamentally or incrementally different?
- **Resources:** How much time, skills, money, and data are available? More in-depth and quantitative analysis requires more of everything.

- Familiarity: Is the analyst familiar with both the types of project proposed and the physical site?
- Issue Significance: How big is the issue? The bigger the issue, the greater the need to be explicit, to quantify, and to identify key issues.
- Administrative Constraints: Are choices limited by governmental procedures and format requirements? Some policy guidelines may rule out some tools by specifying the range of impacts to be addressed.

#### **12.4 ENVIRONMENTAL IMPACT ASSESSMENT METHODOLOGIES**

The impact identification and assessment can be made through several ways. Each one represents a methodology. Besides the one already explained, there are six other different methodologies in the literature based on the way the impacts are identified and assessed. A critical overview of the methodologies is given in Figure-1.

1. Ad Hoc: These methodologies provide a minimum guidance for impact assessment. They merely suggest broad areas of possible impacts (e.g., impacts on lakes, forests, etc.) rather than defining specific parameters to be investigated. This is given exogenously to the analyst.
2. Overlays: These methodologies depend upon a set of maps on the environmental characteristics (physical, social, ecological, and aesthetic) of the proposed project's vicinity. These maps are overlaid to produce a composite characterization of the regional environment. Noting the impacted environmental attributes within the project boundaries then identifies impacts.
3. Checklists: The methodologies present a specific list of environmental attributes to be investigated for possible. They need not necessarily attempt to establish the cause-effect links to project activities. They may or may not include guidelines about how attribute data are to be measured and interpreted.

4. **Matrices:** These methodologies incorporate a list of project activities with a checklist of potentially impacted environmental attributes. Then, the two lists are related in a matrix form, which identifies the cause-effect relationships between specific activities and impacts. The matrix methodologies may either specify which actions affect, which attributes, or may simply list the range of project activities and environmental attributes in an open matrix to be completed by the analyst.
5. **Network:** These methodologies work from a list of project activities to establish cause-condition-effect relationships. It is generally felt that a series of impacts may be triggered by a project action. They define a set of possible networks and allow the user to identify impacts by selecting and tracing out the appropriate project actions.
6. **Combination Computer-aided:** These methodologies use a combination of matrices, networks, analytical models, and a computer-aided systematic approach. Since this is a combination of difficult methodologies, it is a multiple-objective approach to; (a) identify activities associated with the governmental policies and programmes; (b) identify potential environmental impacts at different levels; (c) provide guidance for abatement and mitigation techniques; (d) provide analytical models to establish cause-effect relationships and to quantitatively determine potential environmental impacts, and (e) provide a methodology and a procedure to utilize this comprehensive information in decision-making.

## **12.5 SUMMARY**

An environmental impact assessment (EIA) must effectively deal with four key problems; (a) impact identification; (b) impact measurement; (c) impact interpretation, and (d) impact communication to users. These criteria can be used for analyzing a methodology and determining its weaknesses and strengths. It also helps in choosing methods, which are most appropriate for a particular situation.

The above six methodologies display variety in conceptual framework, data formats and data requirements as well as work force, monetary and time resource requirements. An EIA team can use more than one method.

**Figure-1 An Overview of EIA Methodologies**

Methodology	Areas of usefulness	Drawbacks
(a) Ad Hoc	<p>Simple and no training/skills needed. In-depth and focused analysis on few;</p> <p>When no expertise and resources available, this is the best. Given preliminary understanding Project's effects on environment given without any weighting and cause-effect relations.</p>	<p>Restricts to broad areas only. Not all relevant impacts covered. Selective and biased. Lacks consistency due to different criteria to evaluate different groups of factors.</p>
(b) Checklists	<p>Strong in impact identification.</p> <p>Effective in evoking public attention.</p> <p>Simple and easy to understand; comprehensive. Most useful at the stage of initial Environmental examination (IEE).</p>	<p>Scaling and weighting subjective. Leaves interpretation to Decision makers. Measurement deficient.</p>
(c) Matrices	<p>Provides cause-effect relations between project activities and impacts on various attributes. Graphical display of impacts given better understanding. Strong in impact identification and their interaction is possible.</p>	<p>Information is lost due to quantification.</p> <p>Scaling and weighting become subjective.</p>
(d) Networks	<p>Capable of identifying both direct and indirect effects and their interaction. Capable of incorporating mitigation and management measures at the planning stage of a project.</p>	<p>Less useful in considering socio-economic environment. Display becomes large and unwieldy when large Industrial complexes or regional plans are considered.</p>
(e) Overlays	<p>Useful in site and route selection.</p> <p>Effective presentation and display.</p> <p>Useful in transport projects and road route alternative land use planning.</p>	<p>Quantification and measurement weak. Not all impacts covered. Higher order impacts cannot Be identified. Social environment not considered. Subjective Self-limiting in scope.</p>

## 12.6 KEYWORDS

**Atrophic Stress:** It refers to the release of various kinds of waste in the river and other water bodies and their consequent drying.

**Environment:** Environment is defined to include everything external to man/organism.

**Environmental Resources/Values:** It is defined as an aspect of environment which is of benefit to man.

**Environmental Impact Assessment:** It is a study of the probable changes in the various socio-economic and bio-physical attributes of the environment, which may result from a proposed action.

**Cumulation:** It refers to the similar activities spread over in all environmental setting like surface or underground mines, hotels, beach resorts etc.

## 12.7 SELF ASSESSMENT QUESTIONS

1. Discuss and illustrate the issues involved in the assessment of environmental feasibility of a project.
2. Write short notes on the followings:
  - a.) Environmental Methodologies.
  - b.) Environmental Standards.
  - c.) Environmental Considerations in a Projects.

## 12.8 SUGGESTED READINGS

1. Chandra, Prasanna: Projects-planning, analysis, financing, implementation and review.
2. Desai, Vasant: Project Management
3. Bedi, Suresh : Business Environment.
4. Ashwathapa, A K : Business Environment