SCHOOL OF STUDIES IN COMMERCE

VIKRAM UNIVERSITY, UJJAIN (M.P.)

CLASS : M.COM. 4TH SEM. (C.B.C.S. PATTERN)

SUBJECT : PROJECT PLANNING AND MANAGEMENT

TOPIC : TECHNICAL ANALYSIS

TEACHER'S NAME : DR. KAYNAT TAWAR

TOPICS

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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 analysis of the project has to be undertaken.

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:

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.

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.

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 byproducts.

(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. 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.

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:

$$C1 = C2 \left(\frac{Q1}{Q2}\right)^{\alpha}$$

Where,
C1 = derived cost for Q1 units of capacity
C2 = known cost for Q2 units of capacity
α = 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.

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 reqired. 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.

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.

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, cafetaria, 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.).

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.

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.

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.

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