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# 4 Technical Analysis

## 4.1 INTRODUCTION

Technical analysis provides a broad view of the technical feasibility of a particular project idea in order to establish that the same is rational, well founded, appropriately engineered and follows accepted standards. This study should be taken up early and during the planning stage itself of a project. Different alternatives involve different issues that are to be considered in the study. These issues generally vary from project to project.

## 4.2 OBJECTIVES OF THE STUDY

At the preliminary stage, there are usually a number of alternative technical solutions from which the most appropriate one in terms of viability, operating features and costs needs to be selected. This is the primary objective of technical analysis. Furthermore, for capital-intensive technologies, there are often capacity limits, and the one with most favorable operational characteristics should be selected.

The other objective of this study is to ensure that the entire system of organization and technology operates in unison to achieve the purpose of the project. Therefore, technical analysis should also attempt to identify and correct weaknesses that could adversely affect the project.

Last, but not the least, the objectives and priorities of the sponsor(s) must be considered along with technical aspects as these would form the basic frame of reference for ultimate decisions. Thus, in a private sector, profit would be the primary motive force (except in certain special instances), while in public sector units and public utilities, social benefit is more important than profit making. In either case, the project analyst has to focus on the objectives of the organization while carrying out his activities.

## 4.3 MATERIAL INPUTS

It is necessary to identify, quantify and evaluate inputs like:

- Raw materials;
- Processed industrial materials and components;
- Other supplies.

### 4.3.1 RAW MATERIALS

Raw materials generally include the following items that need to be studied properly.

#### **4.3.1.1 Farm Products**

These are agricultural products. Points to be studied are current availability and future potential of the product, current area of land available and future prospect of increase of land area, yield per acre, etc.

#### **4.3.1.2 Mineral Ores**

The aspects to be investigated are the physical, chemical and other properties of the ore available and whether the ore has (or likely to have in the future) a demand. The study should also provide an idea about the location, size and depth of deposits as well as viability of underground or opencast mining.

#### **4.3.1.3 Other Products**

Data on other products such as animal/livestock, forest products and marine products are not generally readily available. As such, specific survey may be warranted to get appropriate data on these products.

### **4.3.2 PROCESSED/SEMI-PROCESSED COMPONENTS**

Processed and semi-processed components, subassemblies, etc. are also important inputs for any industrial venture. It must be ensured that these inputs are of right quality and of competitive price throughout the duration of the project life cycle. In case these are not easily available, it may be necessary to explore new sources of supply or develop sustainable sources of supply for long-term advantage. If necessary, the possibility of import may have to be considered.

### **4.3.3 OTHER SUPPLIES**

Apart from the items mentioned above, other items like chemicals, additives, packaging materials, oil and grease are required in any industrial project. These also need to be considered in the technical feasibility study.

## **4.4 TECHNOLOGY/MANUFACTURING PROCESS**

It is common experience that a particular product or service may be acquired by using two or more alternative technologies. For example, electricity-generating units may be thermal plants, hydroelectric power plants, nuclear power plants, solar energy plants, wind energy plants, etc., using different sources of energy. Also, the plants could be fully automatic, or semi-automatic. These aspects come within the preview of technology or manufacturing process.

The technology to be chosen for a project should be most up-to-date incorporating the latest developments in order to avoid or at least minimize the chance of becoming technologically out-of-date in the near future. It should also be flexible to adjust with or absorb newer technologies which may be available in the future.

Choosing of the technology from among a number of alternatives for carrying out a production program should be made after careful study of a variety of factors. These factors are briefly discussed in the following paragraphs.

#### **4.4.1 PRINCIPAL INPUTS**

The quality of available materials and other required resources should satisfy the required specifications. The cost of these materials and resources would be one of the major deciding factors.

#### **4.4.2 PRODUCT MIX AND QUALITY**

These must be of acceptable standard.

#### **4.4.3 PLANT CAPACITY**

This should be compatible with the production technology.

#### **4.4.4 SCARCE RESOURCE**

In case scarce resources are required as inputs for the technology, directives for regulatory authorities may preclude the use of such resources for the manufacturing process, thereby excluding these technologies from probable choice.

#### **4.4.5 LABOR VERSUS CAPITAL COST**

The cost of labor as compared with the cost of capital consumed per unit output is a factor to be considered for technology choice. Labor-intensive technologies normally have advantage of production flexibility, while capital-intensive ones have a better quality control system.

#### **4.4.6 RELIABILITY**

A reliable technology has the advantage of minimal downtime for repair, thereby minimizing the cost of production.

#### **4.4.7 COST OF TECHNOLOGY**

Technology, whether developed internally or acquired from outside source, costs money. Effect of such investment and production cost over a time period should be examined carefully.

#### **4.4.8 ABSORPTION OF TECHNOLOGY**

In case the existing project staffs are not conversant with the technology, expatriate staff may have to be recruited. However, this alternative is costly and may also be considered while considering this option.

#### **4.4.9 ENVIRONMENTAL IMPACT**

Impact of the technology on the environment is a major determinant of technology choice. Measures necessary to mitigate the impact to acceptable level of existing

regulations and also the possibility of future regulations need to be considered in detail.

#### **4.4.10 SUSTAINABILITY UNDER LOCAL CLIMATE CONDITIONS**

This aspect is important. For example, steel becomes brittle at low temperatures. Therefore for areas where temperature may be very low during winter, technologies using steel should be avoided.

#### **4.4.11 SERVICES**

For advanced technologies, intensive and comparatively complex services are required. Care should be taken to ensure that interruptions to such services are avoided.

#### **4.4.12 LOCAL REGULATIONS**

Often local authorities offer incentives for projects that are likely to upgrade the technological level of the area. Dialogue with such authorities should be initiated on a priority basis.

### **4.5 PRODUCT MIX**

The choice of product mix is essentially guided by market requirements for satisfying diverse series of customers, with different tastes, needs and bearability of price range. Flexibility in respect of product mix enables the producer to stay and grow in the changing market conditions. For example, a biscuit- or snack-manufacturing organization may market two types of packages: a small package for low-cost one-time users and a larger package with price reduction offer for family use. Quality aspect must enjoy paramount interest while considering this aspect to ensure higher profitability. Careful analysis of further investment required for this purpose is another aspect to be considered prior to taking final decision.

### **4.6 PLANT CAPACITY**

Plant capacity or production capacity normally refers to the volume or number of units that can be produced by a manufacturing plant during a particular time frame. This capacity is attainable under normal working conditions and depends on the following factors.

#### **4.6.1 TECHNOLOGICAL CONSIDERATIONS**

A certain type of plant of a minimum economic size will be required to achieve a particular production capacity (such as so many units per day). In case the available plant cannot meet the requirement, an alternative technological solution will have to be resorted to.

#### **4.6.2 INPUT CONSTRAINTS**

In many countries, particularly in developing countries, constraints such as limited power supply, scarce raw materials and foreign exchange restrictions are quite frequent. Some constraints may be seasonal. These need to be borne in mind while considering capacity of a plant.

#### **4.6.3 ENVIRONMENTAL CONSIDERATIONS**

Temperature, atmospheric pressure and humidity can have adverse effect on the running of machineries and equipment. At high elevation, average atmospheric pressure is reduced; this can affect the performance of turbines and combustion processes. Also, steel tends to get brittle at very low temperature; this may affect the machines. Performance of heat-related processes such as condensers and evaporators is dependent on ambient temperatures.

#### **4.6.4 RELATIONSHIP BETWEEN MANAGEMENT AND WORKERS**

This is an important factor that contributes to the efficiency of the plant capacity. Cordial relationship between the management and workers brings out the best from both the parties in question and contributes to the achievement of the feasible normal capacity.

#### **4.6.5 MAINTENANCE**

The amount of downtime due to maintenance of a plant for trouble-free operation is another factor for achieving the feasible normal capacity.

#### **4.6.6 MARKET CONDITIONS**

Anticipated market for goods or services has an important influence on the decision of the capacity of the plant. If the market is likely to increase, a plant of higher capacity would be preferable. However, if the growth is uncertain, it is advisable to commence the project with a lower capacity and additions to the capacity can be worked out in case the demand tends to increase.

#### **4.6.7 RESOURCES OF THE ORGANIZATION**

A plant cannot opt for a scale of operation beyond its operational or monetary capacity. Thus, resources of the organization, in both operational and financial areas, will influence the capacity of the plant.

#### **4.6.8 GOVERNMENT POLICY**

Regulatory policy of the government influences the plant capacity of a unit. This policy may vary from country to country and also time to time. Feasible normal capacity is subject to such state policies.

## **4.7 CHOICE OF LOCATION**

Location signifies a broad geographical area such as urban/rural area, industrial zone and coastal area where a project is being considered to be set up. Various aspects are to be taken into consideration for selecting a particular location.

### **4.7.1 PROXIMITY TO RAW MATERIALS**

It is important that location of any project should be close to the source area of the raw materials. Apart from other practical advantages, this would substantially reduce the costs for transporting the raw materials from their source area to the plant. As for example, a hydroelectric power station needs a perennial source of water for its sustenance. Also, a steel plant needs supply of iron ores at a reasonable distance away from the plant site. A cement plant, likewise, needs supply of limestone from nearby source. In all such cases, location of the plant near the source of raw materials would be a great advantage.

### **4.7.2 PROXIMITY TO MARKET**

As in the case of raw materials, it would be an advantage to locate the plant close to the product markets as well.

### **4.7.3 AVAILABILITY OF INFRASTRUCTURAL FACILITIES**

Before the location of a plant is decided, it is necessary to make sure that certain infrastructural facilities such as transport, power, water and modern communication system are available near the proposed location.

#### **4.7.3.1 Transport**

Nature and condition of existing roads, railway facilities (like station and yard), road and rail bridges, air transportation facilities, inland water and sea linkages, including port facilities, need to be assessed before the location is finalized.

#### **4.7.3.2 Power**

Availability of uninterrupted power supply with minimum voltage fluctuation and favorable tariff are the important aspects of infrastructure availability. Also important is the level of investment required for connecting the plant with the network of power-supplying agency.

#### **4.7.3.3 Water**

Water requirement for a plant varies according to the plant capacity and technology adopted. This can be satisfied either by drawing from external sources like public utilities or internally from surface/subsurface sources, depending on the quality, dependability and costs.

### **4.7.4 GOVERNMENT POLICIES**

Government policies often dictate the choice of locations, both for public sector and for private sector projects. Thus, due to some broader policies for the dispersion of

particular industries, due to, say, congestion, the government may direct such industries to be located away from urban areas. Similarly, the government may offer incentives for establishing industries in backward areas, by way of subsidies, concessional financing, tax reliefs and similar benefits.

#### **4.7.5 AVAILABILITY OF SUPPORTING INDUSTRIES**

One important consideration for choice of location is availability of supporting industries. It is a common practice for a plant to get some production operations done from outside sources by subcontracting. For this purpose, it is essential to study whether suitable industries are operating in the surrounding areas to supplement the resources of the plant.

#### **4.7.6 ENVIRONMENTAL POLLUTION**

A project may emit unwelcome gases, and produce detrimental solid and liquid wastes; it may cause noise, heat and vibration. These all cause environmental pollution. This aspect should be considered, and costs for reducing such environmental pollution to acceptable levels or if necessary shifting the project to alternative locations may be considered in the study.

#### **4.7.7 HUMAN RESOURCES**

The other aspect that gives edge to a particular location is the availability of skilled workforce at competitive rates. Thus, labor-intensive projects like textile and jute mills thrive in areas where cheap labor is available. Similarly, industrial units normally grow where skilled, semi-skilled and unskilled labors are concentrated. Depending on the level of technology used for a particular unit (automatic, semi-automatic, etc.), the technical appraisal is done accordingly. The other factor that needs to be considered is the prevailing state of industrial relationship between the management and the labor in terms of frequency and intensity of strikes, lockouts, etc.

#### **4.7.8 CLIMATE**

Areas with history of heavy rainfall, flooding, heavy snows and severe cold or heat, wind, etc. have adverse effects in the selection of any project. For such areas, additional funds for dehumidification, heating, air conditioning, etc. would probably be needed. Special attention must be given if an area comes within heavy earthquake zone.

Pleasant climatic conditions with natural and scenic beauty may attract tourists, and thus, such a location may boost the growth of health resorts and tourist complexes.

#### **4.7.9 LIVING CONDITIONS**

In addition to the forgoing considerations, a project should have adequate communication facilities like internet connection. Suitable arrangements for disposal

of solid waste, liquid effluent, etc. are also to be investigated. Social amenities like cinema halls, multiplexes, theatre halls, eateries, parks and playgrounds also form part of infrastructure development. Other considerations also include cost of living, availability of accommodation for workmen, proximity to market, healthcare facilities and availability of educational institutions. A rational analysis of such requirements and their implications in terms of time, money and resources is imperative at the appraisal stage itself, to avoid surprises at a later date.

## **4.8 SITE SELECTION**

While location signifies a broad geographical area, site refers to a particular area of land where a project can be set up. Generally, once the location is selected, a few alternative sites are considered and scrutinized in respect of size and shape of the area etc., as well as cost of land and civil work for the development of site.

### **4.8.1 CONSIDERATIONS FOR SITE SELECTION**

Selection of a particular site from several alternatives calls for a systematic analysis. The analysis should be carried in the following sequence.

#### **4.8.1.1 Size and Shape of the Site**

It must be ensured that layout of buildings, structures, plants and equipment storage areas, parking facilities, etc. are satisfactorily accommodated within the size and shape of the available site.

#### **4.8.1.2 Environmental Sensitivity**

A site may be situated in an environmentally sensitive area such as wetland or in a natural habitat for endangered species where industrial development is prohibited. Such a site has to be rejected from reckoning forthwith.

#### **4.8.1.3 Future Expansion**

There should be scope for additional space for future development, viz., plant extensions, and other add-on facilities.

#### **4.8.1.4 Soil Condition**

Soil condition, particularly bearing capacity for foundations of new structures, should be examined before finally selecting a site.

#### **4.8.1.5 Layout Plan**

A detailed layout plan should be drawn showing arrangements of all the buildings, structures and positions of plants and equipment with important dimensions and levels. This should be considered as a record for a particular alternative site.

### **4.8.2 ESTIMATED INVESTMENT COST**

On the basis of the layout for each particular alternative site, estimates for investment cost are to be computed on the basis of the following heads.

#### 4.8.2.1 Cost of Land

Cost of land may vary from site to site, even within the same broad location. Sites close to urban areas normally cost more than those in the rural areas. At the same time, cost of land in specified areas specially developed by the government for industrial purposes may be available at concessional rates.

#### 4.8.2.2 Civil Works and Other Expenses

Costs involved in construction/relocation of existing structures relate primarily to:

- Excavation, concrete works, masonry, roofing, steel/aluminum sheet works, etc.;
- Special civil engineering activities like soil investigation, soil consolidation, pile foundations, drainage, ramps, chimneys, silos and foundations for heavy equipment;
- Specialist items like carpentry, joinery, steel works, plastering, glazing, tiling, flooring, asphaltting and painting;
- Technical installations like heating, ventilation, air conditioning and plumbing;
- Utility supplies and distributions, e.g., water, electricity, communications, steam and gas;
- Traffic installations like yards, roadways, parking areas, railway tracks and sheds for bicycles;
- *Landscaping*: trees, plants, grass, etc.;
- Others like security installations.

### 4.9 SELECTION OF MACHINERY AND EQUIPMENT

One of the major engineering responsibilities in a project is the selection of machinery and equipment. These should be selected primarily to meet the requirement of the production and should be commensurate with the surrounding operating conditions.

#### 4.9.1 TECHNOLOGY

It is common practice that in case a technology is acquired through a turnkey agreement, the machinery and equipment are selected by the technology provider. In other cases, the project designers select these to suit the technology. If in-house technical expertise is insufficient, consultants from external source (inside or outside the country) may have to be employed for providing the required technology.

#### 4.9.2 PLANT TYPE AND CAPACITY

Requirement of machinery and equipment is influenced by the type and capacity of any particular plant. Consequently, machinery and equipment required for a process-oriented industry will differ from those required for a manufacturing industry.

The machinery and equipment required for a project may be categorized as follows:

- Process equipment;
- Mechanical equipment;
- Electrical equipment;
- Instruments;
- Control system;
- Spare parts, tools, etc. for running the plant and maintenance purpose.

### 4.9.3 OTHER ISSUES

While finalizing the selection of plant and machinery, various issues need to be considered, which include the following:

- Quality assurance plan (QAP);
- Proven and up-to-date technology;
- Reputation of suppliers;
- Delivery/payment schedule;
- Performance guarantee;
- Equipment life;
- After-sales service;
- Availability of sufficient power to run electricity-intensive plants;
- Transportation of heavy equipment;
- Initial difficulties in running technology-intensive equipment, e.g., computer numerically controlled (CNC) machinery;
- Import policy of the government in case the machines are to be imported from abroad.

## 4.10 CONSTRUCTION ACTIVITIES

Development of the site and construction work are associated with any industrial enterprise. The nature of the industry, size and location of equipment and machineries, the manufacturing process, etc. govern the layout and sizes of the structures and buildings. First, the site needs to be leveled and unnecessary structures/buildings removed. Relocation of existing structures like cables, pipelines, power lines, water lines, roads, railway sidings, communication network (like telephones and internet) is to be done. Construction of new work includes factory buildings, laboratories, control rooms, administrative buildings, stores, warehouses, healthcare centers and staff quarters.

Apart from the foregoing activities, construction works also include treatment of factory waste materials, effluents, supply and distribution of utilities like water, electric power, gas, roadways parking areas, railway tracks, garages and lighting facilities.

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