Technical Analysis

Chapter 2

Technical analysis

The broad purpose of **technical analysis** is-

(a) to ensure that the project is technically feasible in the sense that all the inputs required to set up the project are available and

(b) to facilitate the most optimal formulation of the project in terms of technology, size, location, and so on.

Technical analysis plays a crucial role in assessing the viability, feasibility, and success of a project from a technical perspective. It provides stakeholders with valuable information and recommendations to make informed decisions and effectively manage project implementation.

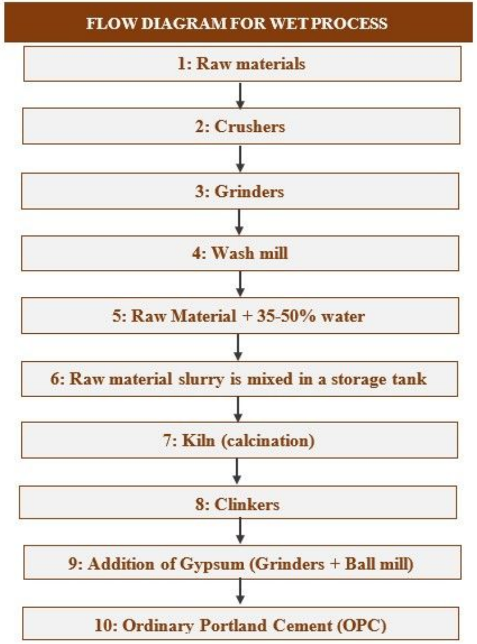
Technical analysis

- Discuss the considerations that have a bearing on the **choice of technology**.
- Describe the various **material inputs and utilities** required for a project.
- Discuss the factors that have a bearing on the **capacity decision**.
- List the important charts and layouts that define the **scope of the project**.
- Show the **inter-linkages among the key facets** of a project.

Choice of technology

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

Cement can be made either by the dry process or the wet process.



Choice of technology

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

Paper can be made of sugarcane waste or by using soda process.

Choice of technology

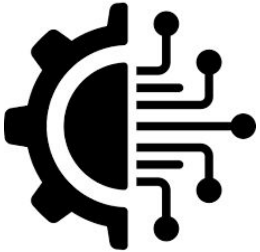
The choice of technology is influenced by a variety of considerations:

- **Plant capacity** (there is a close relationship between plant capacity and production technology. To meet a given capacity requirement, perhaps only a certain production technology may be viable.)
- **Principal inputs** (The choice of technology depends on the principal inputs available for the project. In some cases, the raw materials available influence the technology chosen, e.g., quality of limestones determines whether the wet or dry process should be used for a cement plant.)
- **Investment outlay and production cost** (The effect of alternative technologies on investment outlay and production cost over a period of time should be carefully assessed.)
- **Use by other units** (The technology adopted should be proven by successful use by other units of an industry, preferably in the country under consideration.).
- **Product mix** (The technology chosen must be judged in terms of the total product-mix generated by it, including saleable by-products, products in different colors, sizes and shapes, product lines e.g., a company may have product lines for electronics, apparel, home goods, and beauty products.)
- **Latest developments** (The technology adopted must be based on latest developments in order to ensure inter alia that the likelihood of technological obsolescence in the near future, at least, is minimised.)
- **Ease of absorption** (ease with which a particular technology can be absorbed can influence the choice of technology. A high-level technology may be beyond the absorptive capacity which may lack trained personnel to handle that technology.)

Choice of technology

Appropriate technology refers to those methods of production which are suitable to local economic, social, and cultural conditions. In recent years the debate about appropriate technology has been sparked off mainly by Schumacher and others. The advocates of appropriate technology urge that the technology should be evaluated in terms of the following questions:

- Whether the technology utilises **local raw materials**
- Whether the technology utilises **local manpower**
- Whether the goods and services produced cater to the **basic needs**
- Whether the technology protects **ecological balance**
- Whether the technology is harmonious with **social and cultural conditions**



Technical arrangements

Satisfactory arrangements must be made to obtain the technical know-how needed for the proposed manufacturing process. When collaboration is sought, inter alia, the following aspects of the agreement must be worked out in detail.

- **The nature of support to be provided by the collaborators** during the designing of the project, selection and procurement of equipment, installation and erection of the plant, operation and maintenance of the plant, and training of project personnel.
- **Process and performance guarantees** in terms of plant capacity, product quality, and consumption of raw materials and utilities.
- **The price of technology** in terms of one-time licensing fee and periodic royalty fee.
- **The continuing benefit of research and development** work being done by the collaborator.
- **The period of collaboration agreement**.
- **The assistance to be provided and the restrictions to be imposed** by the collaborator with respect to exports.
- **The level of equity participation and the manner of sharing of management control**, especially if the technical collaboration is backed by financial collaboration.
- **Assignment of the agreement** by either side in case of change of ownership.
- **Termination of the agreement or other remedies** when either party fails to meet its obligation.
- **Approach to be adopted in force majeure** (e.g., war, extreme weather events) situations.

Material inputs and utilities

An important aspect of technical analysis is concerned with defining the materials and utilities required, specifying their properties in some detail, and setting up their supply programme.

Material inputs and utilities may be classified into four broad categories:

- raw materials,
- processed industrial materials and components,
- auxiliary materials and factory supplies, and
- utilities.

Material inputs and utilities: raw materials

Agricultural products

- In studying agricultural products the quality must first be examined.
- an assessment of quantities available, currently and potentially, is required.
- What is the present marketable surplus?
- What is the present area under cultivation?
- What is the likely increase in yield per acre?

Mineral products

- In assessing mineral raw materials, information is required on the quantum of exploitable deposits and the properties of raw materials.
- The study should provide details of the location, size, and depth of deposits and the viability of open cast or underground mining.
- information should be generated on the composition of the ore, level of impurities, need for beneficiation, and physical, chemical and other properties.

Livestock & forests

- Secondary sources of data on livestock and forest products often do not provide a dependable basis for estimation.
- IA specific survey may be required to obtain more reliable data on the quantum of livestock produce and forest products.

Marine products

- Assessing the potential availability of marine products and the cost of collection is somewhat difficult.
- Preliminary marine operations, essential for this purpose, have to be provided for in the feasibility study.

Material inputs and utilities

Processed Industrial Materials and Components

what are their properties? What is the total requirement of the project? What quantity would be available from domestic sources? What quantity can be procured from foreign sources? How dependable are the supplies? What has been the past trend in prices? What is the likely future behaviour of prices?

Auxiliary Materials and Factory Supplies

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.

Utilities

A broad assessment of utilities (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 capacity. Since the successful operation of a project critically depends on adequate availability of utilities, questions to be raised: 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?

Product mix

The choice of product mix is guided by market requirements. In the production of most of the items, variations in size and quality are aimed at satisfying a broad range of customers.

For example, a garment manufacturer may have a wide range in terms of size and quality to cater to different customers. It may be noted that variation in quality can enable a company to expand its market and enjoy higher profitability.

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.

Plant capacity

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

Plant capacity may be defined in two ways: feasible normal capacity (FNC) and nominal maximum capacity (NMC).

The feasible normal capacity refers to the capacity attainable under normal working conditions. This may be established on the basis of the installed capacity, technical conditions of the plant, normal stoppages, downtime for maintenance and tool changes, holidays, and shift patterns.

The nominal maximum capacity is the capacity which is technically attainable and this often corresponds to the installed capacity guaranteed by the supplier of the plant.

Several factors have a bearing on the capacity decision.

- Technological requirement
- Resources of the firm
- Governmental policy
- Market conditions
- Input constraints
- Investment cost

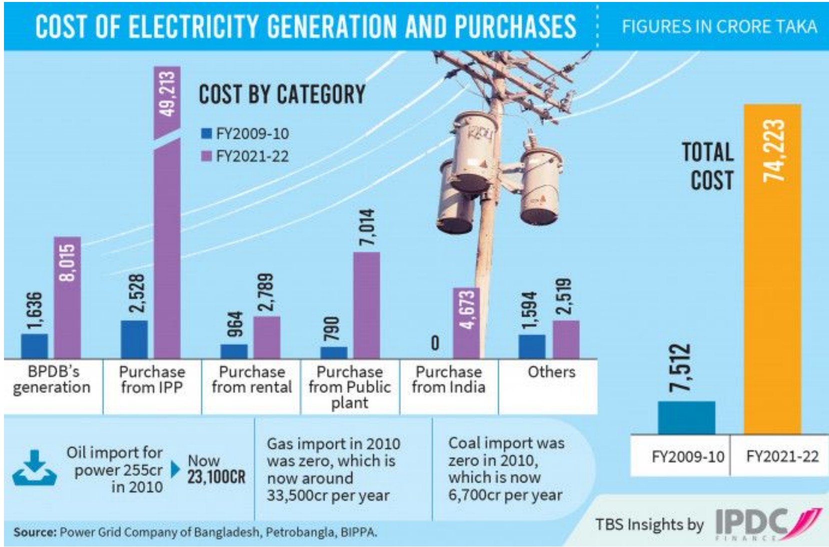
Plant capacity: technological requirement

For many industrial projects, particularly in process type industries, there is a certain minimum economic size determined by the technological factor.

A cement plant should have a capacity of at least 300 tonnes per day in order to use the rotary kiln method.

Plant capacity: input constraints

In a developing countries there may be constraints on the availability of certain inputs. Power supply may be limited; basic raw materials may be somewhat scarce; foreign exchange available for imports may be inadequate.



Plant capacity: investment cost

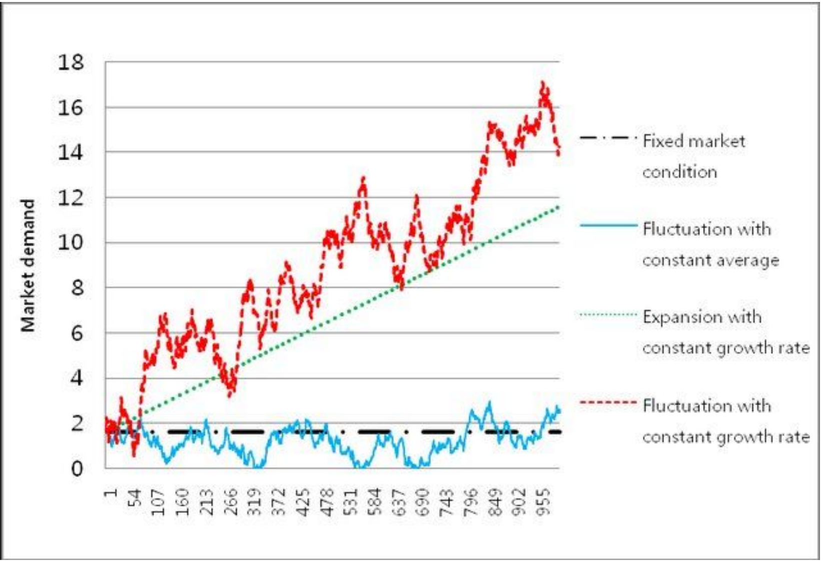
When serious input constraints do not obtain, the relationship between capacity and investment cost is an important consideration. Typically, the investment cost per unit of capacity decreases as the plant capacity increases.

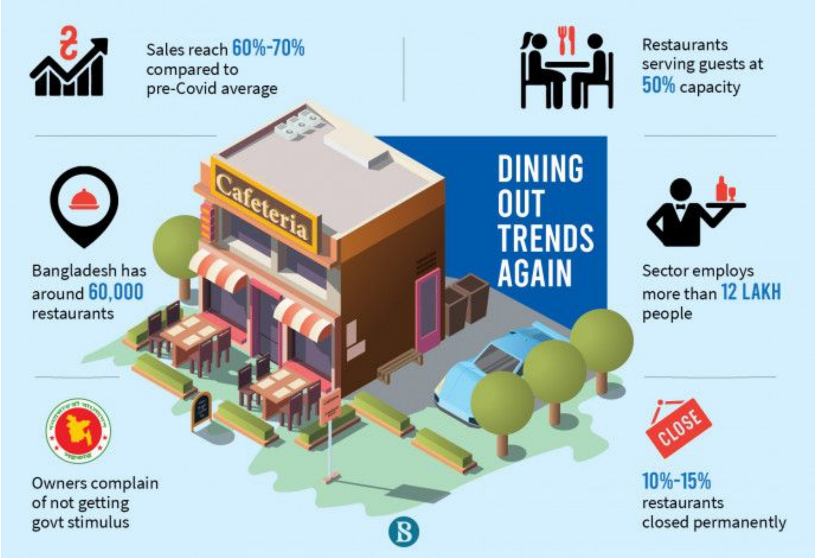
$$C_2 = C_1 \left(\frac{Q_2}{Q_1} \right)^a$$

where C2 is the derived cost for Q2 units of capacity,
C1 is the known cost for Q1 units of capacity, and
a is a factor reflecting capacity-cost relationship. This is usually between 0.2 and 0.9.

Plant capacity: 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 effected with the growth of market.



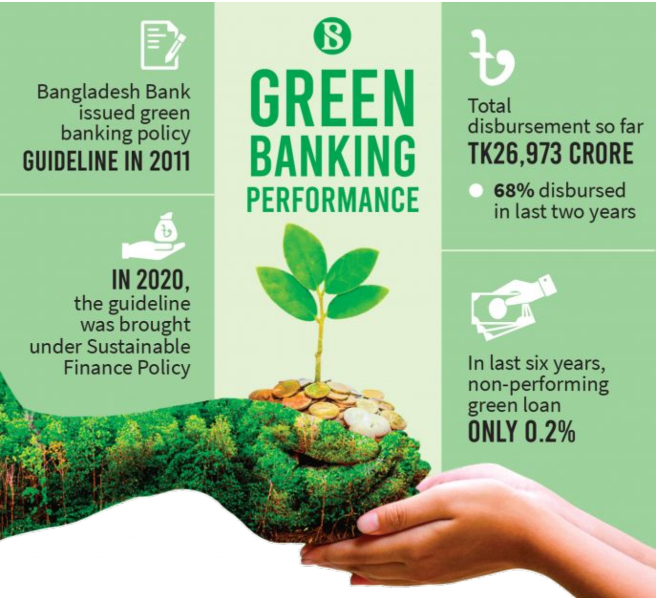


Plant capacity: resources of the farm

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 or managerial capability.

Plant capacity: government policy

The capacity level may be influenced by the policy of the government. Traditionally, the policy of the government was to distribute the additional capacity to be created in a certain industry among several firms, regardless of economies of scale. This policy has been substantially modified in recent years and the concept of 'minimum economic capacity' has been adopted in several industries.



Nazma Chowdhury was the first (in the 1908s) female manager, quality controller, designer, and production line chief in the garment sector of Bangladesh (in Desh Garments).

Location and site

The choice of location and site follows an assessment of demand, size, and input requirements.

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**
- **labour situation**
- **governmental policies, and**
- **other factors.**

Location and site: **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 the final product) is minimised.

This generally implies that: (i) a resource-based project like a cement plant or a steel mill should be located close to 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 centre of consumption.

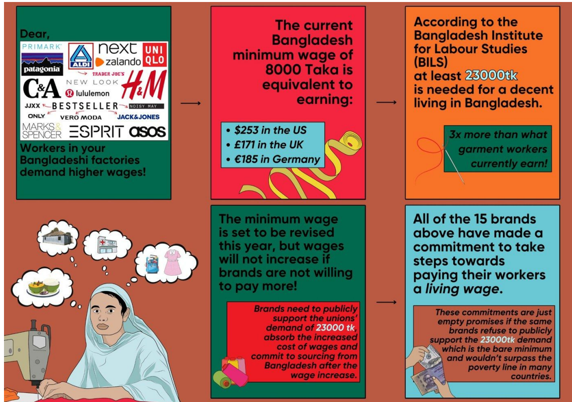
Location and site: **availability of infrastructure**

Availability of power, transportation, water, and communications should be carefully assessed before a location decision is made. In addition to power, transport, and water, the project should have adequate communication facilities like telephone and internet.

Location and site: **labor situation**

In labour-intensive projects, the labour situation in a particular location becomes important. The key factors to be considered in evaluating the labour situation are:

- Availability of labour, skilled, semi-skilled and unskilled
- Prevailing labour rates
- Labour productivity
- State of industrial relations judged in terms of the frequency and severity of strikes and lockouts
- Degree of unionisation



Location and site: **government policies**

Government 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 subsidies, concessional finance, reliefs from indirect taxes, income tax benefits, lower promoter contribution, and so on.

Bangladesh's largest solar power plant in Mymensingh is fully installed with the Huawei Smart photovoltaic (PV) solution, through which it has been now connected to the national grid recently.
The 73 MW PV power plant would help meet the government's target of generating 10 percent of the country's total electricity using renewable energy by 2021.

Location and site: **other factors**

- Climatic conditions
- General living conditions
- Proximity to ancillary units
- Ease in coping with pollution

Machineries and equipment

The requirement of machineries and equipments 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, machineries and equipments required should be such that the various stages are matched well.**

To determine the kinds of machinery and equipment required 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 machineries and equipments required for each function**.

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

Possible constraints:

(i) there may be a limited availability of power to set up an electricity-intensive plant;
(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 equipments; and
(iv) the import policy of the government may preclude the import of certain machineries and equipments.

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 (e.g., waste treatment, emission control, transportation, etc.)

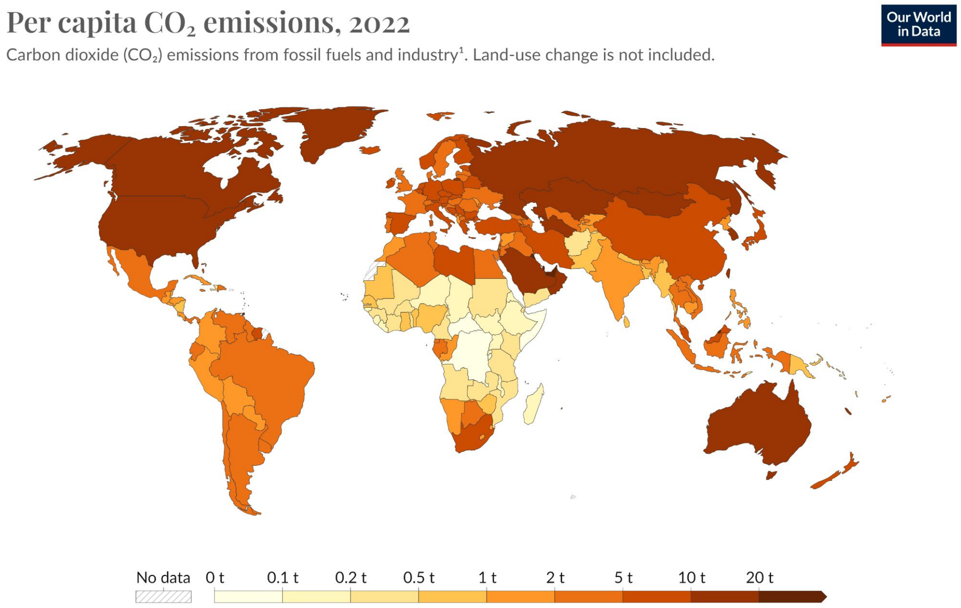
Environmental aspects

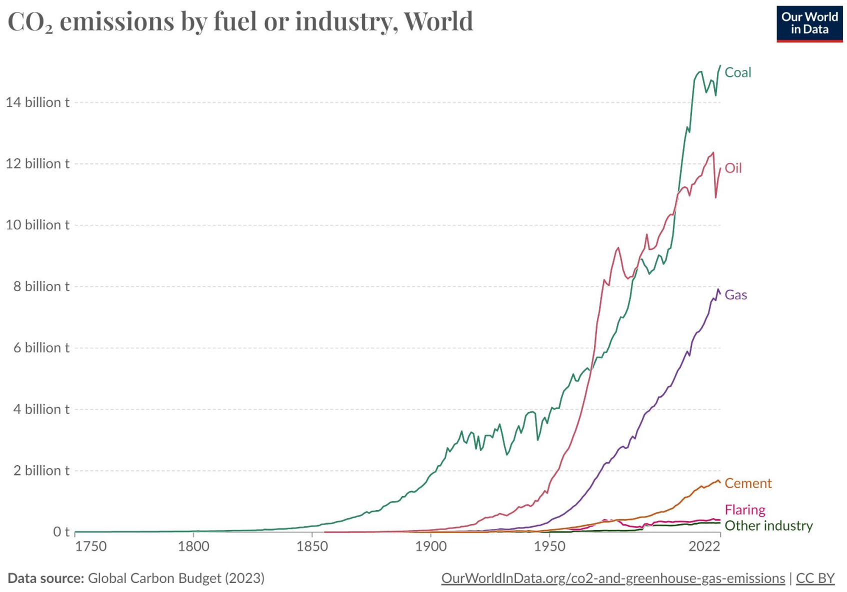
A project may cause environmental pollution in various ways: it may throw gaseous emissions; it may produce liquid and solid discharges; it may cause noise, heat, and vibrations.



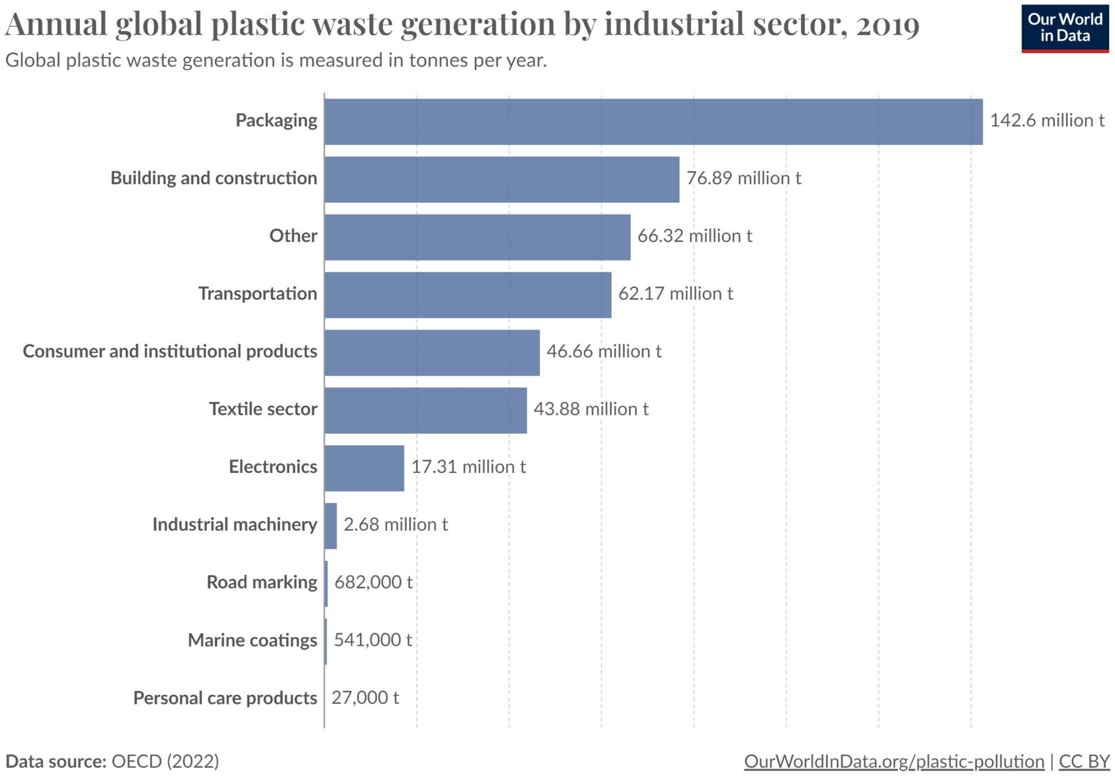
What are the types of effluents and emissions generated?
What needs to be done for proper disposal of effluents and treatment of emissions?
Will the project be able to secure all environmental clearances and comply with all statutory requirements?

Environmental aspects





Environmental aspects



Environmental aspects

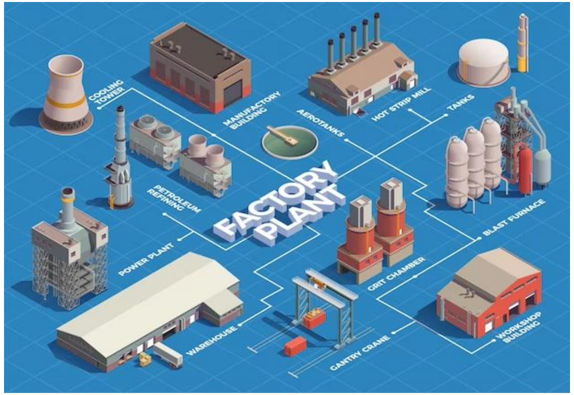
Tata Steel, a steel production company based in India

(6.4 million tonnes of CO_2 in 2019)

Environmental aspects

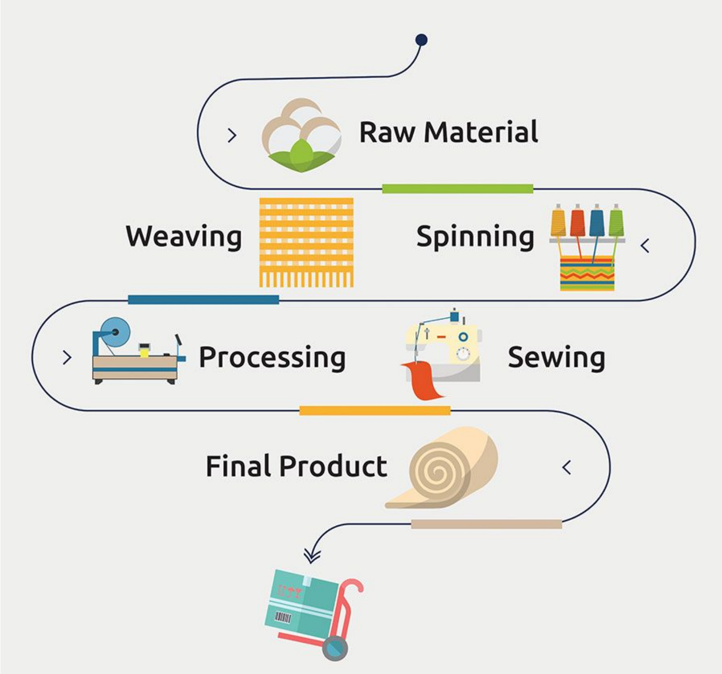
Project charts and layouts

General Functional Layout shows general relationship between equipments, buildings, and civil works.



Plant Layout is concerned with the physical layout of the Factory, often dictated by the production process adopted.

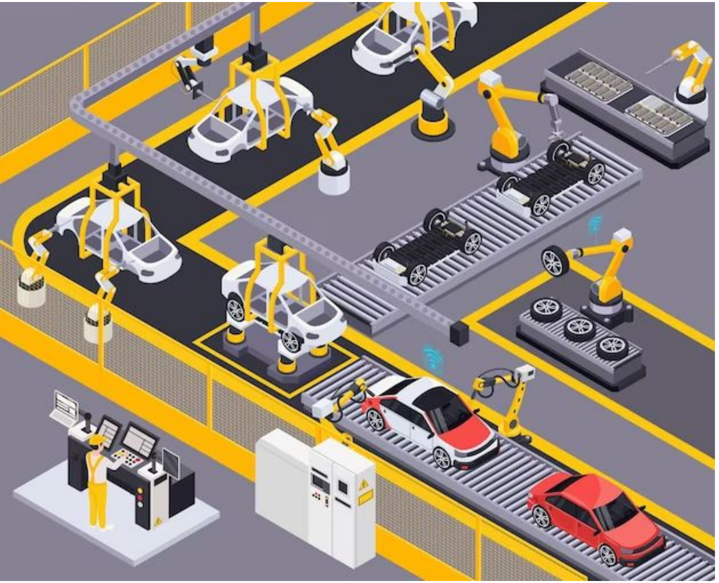
Material Flow Diagram shows the flow of materials, utilities, intermediate products, final products, by-products, and emissions.



Project charts and layouts

Production line diagram

show how the production would progress along with the main equipments.



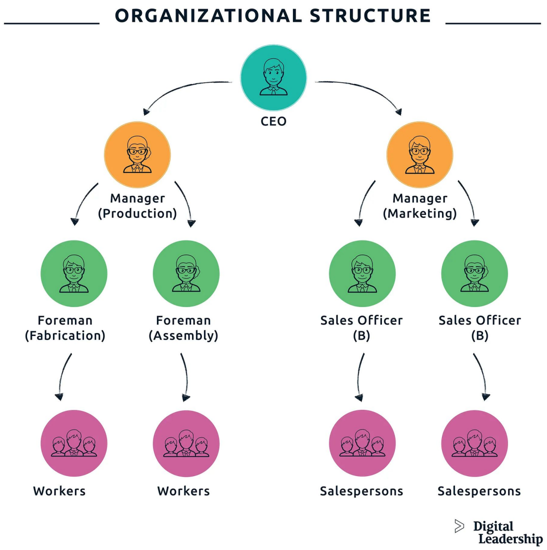
Transport layout

shows the distances and means of transport outside the production line.

Project charts and layouts

Utility layout shows the principal consumption points of utilities (power, water, gas, compressed air, etc.) and their required quantities and qualities.

Organizational layout Shows the organisational set-up of the project along with information on personnel required for various departments and their inter-relationship.



Project charts and layouts

The important considerations in preparing the plant layout are:

- Consistency with production technology
- Smooth flow of goods from one stage to another
- Proper utilisation of space
- Scope for expansion
- Minimisation of production cost
- Safety of personnel

Schedule of project implementation

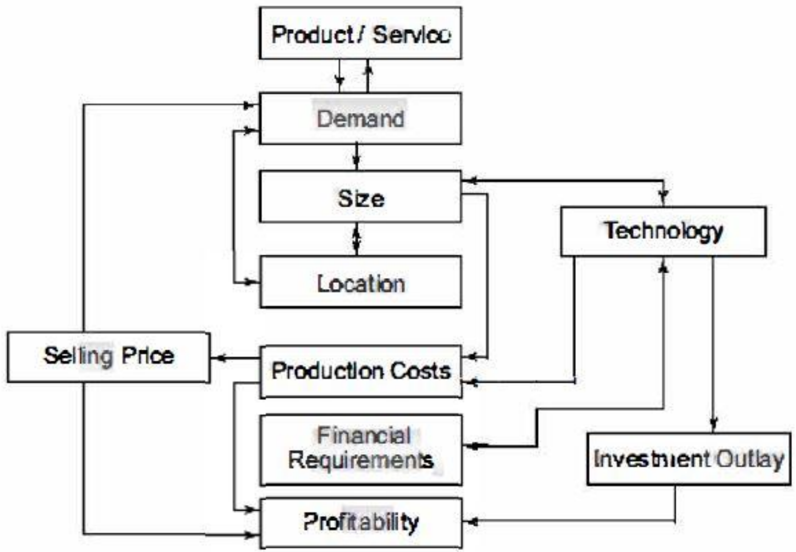
- List of all possible activities from project planning to commencement of production.
- The sequence in which various activities have to be performed.
- The time required for performing various activities.
- The resources normally required for performing various activities.
- The implications of putting more resources or less resources than are normally required.

Work Schedule reflects the plan of work concerning installation as well as initial operations. 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 the availability of finances.
- **To develop a plan of operations** covering the initial period (the running in period).

Key project interlinkages

While evaluating various alternatives, the inter-linkages among key factors of the project like product (or service), demand, plant capacity, production technology, location, investment outlay, financial resources, production costs, selling price, and profitability must be borne in mind.



Exemplar questions

1. Suppose a paper factory has to choose between sugarcane waste and the soda process. Which factors should the factory consider while making the choice and how does the factory make an appropriate choice?

2. Jerry wants to open a restaurant in city. What technical analysis does he need to conduct for planning the restaurant capacity?

3. A fertilizer factory project proposal is submitted to the city municipality. The proposal includes a thorough technical analysis, yet it misses out on the environmental aspects. As an authority, what editions and additions do you suggest to include?

4. Distinguish between material flow diagram and production line diagram by drawing them.