

# Influences Productivity: Location and Layout of Plants

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## **ABSTRACT:**

The positioning and design of manufacturing facilities are key factors in influencing the general effectiveness, output, and success of manufacturing activities. The main factors and methods for choosing the best site and creating a practical plan for industrial facilities are summarized in this chapter. The importance of site choices in manufacturing is highlighted in the chapter's first paragraph. The operational and logistical characteristics of a manufacturing facility are influenced by a variety of variables, including proximity to raw materials, transportation infrastructure, labor availability, market accessibility, and governmental requirements. An appropriately thought-out site can offer cost benefits, supply chain efficiency, and competitive advantages in accessing target consumers. The chapter also touches on the significance of layout design in increasing output and operational effectiveness inside a manufacturing plant. It emphasizes the need to properly take into account variables including workflow, material handling, equipment positioning, and worker ergonomics. An effective layout may accelerate worker productivity, alleviate bottlenecks in the production process, and minimize material transportation.

## **KEYWORDS:**

Design, Facilities, Layout, Manufacturing, Production, Product.

## **I. INTRODUCTION**

Humanity's standard of existence is dependent on effective product manufacturing. Effective manufacturing suggests that a product's manufacturing cost should be as low as feasible to enable a large number of people to afford to purchase it. If there is a high demand for the product in the market, the cost of manufacture per unit also decreases. These factors contributed to the development of the mass production manufacturing philosophy, which is organized in sizable workshops or plants. These factories employ a huge number of workers who have the necessary training, and the factories themselves are situated in handy areas to enable the production of goods as quickly and inexpensively as possible. In terms of output and productivity, the location and design of facilities are important factors. Operational success, cost-effectiveness, and overall productivity are significantly impacted by decisions on where to locate a facility and how to design its structure. The significance of plant location and layout in streamlining production procedures and raising productivity levels will be covered in this introductory essay. The location and design of the production floor have a big impact on how productive and efficient the manufacturing operations are. This chapter provides an overview of the significance of location and layout in plant production and how they impact productivity.

The placement of the plant is a tactical choice that immediately affects several production-related variables. Numerous factors, including accessibility to raw materials, suppliers, and customers, transportation infrastructure, labor availability, and local laws, affect how effectively and inexpensively operations are conducted. A location that is carefully picked can save logistical costs, speed up travel, and streamline the supply chain, increasing output and improving client satisfaction [1], [2]. The layout of a factory is crucial for optimizing manufacturing processes and increasing output, in addition to location. The plan must take into account how people, goods, and equipment move through a facility. It involves carefully placing workstations, storage areas, equipment, and support services to reduce material handling, get rid of production bottlenecks, and increase efficiency. A well-designed layout fosters efficient operations, reduces downtime, and boosts overall productivity by enabling the movement of materials and people. Product production efficiency is essential to maintaining humanity's level of living. For a wide number of people to be able to afford to buy a product, effective manufacturing implies that the manufacturing cost of the product should be as low as is practical. The cost of production per unit also drops if there is a significant demand for the goods on the market.

The mass production manufacturing philosophy, which is structured in huge workshops or plants, was developed as a result of these causes. The factories themselves are located in convenient locations to facilitate the manufacturing of items as rapidly and inexpensively as possible, and they employ a sizable number of individuals who have the requisite training. The location and layout of facilities have an impact on output and productivity. Decisions about a facility's location and structure have a substantial impact on operational performance, cost-effectiveness, and overall productivity. This introductory essay will discuss the role that plant location and layout play in optimizing manufacturing processes and increasing productivity levels. Plant placement refers to the deliberate selection of the most advantageous geographic area for the development of a manufacturing facility. Many factors are taken into account while picking the ideal location, including access to transportation networks, the availability of skilled labor, the proximity to markets, governmental regulations, and the local business climate.

Each of these elements has an impact on how profitable, efficient, and competitive the plant's operations are. The arrangement and organization of a plant's multiple offices, work areas, technological components, and facilities are described as its plant layout. Reduced bottlenecks, increased operational effectiveness, and improved employee and supply flow are the main objectives of the layout design. The morale of the workforce, productivity, safety, and cost-cutting initiatives are all directly impacted by an effective industrial layout. It is insufficient to only locate the plant in an appropriate location. A plant has numerous pieces of machinery and other industrial buildings. If such equipment and facilities are not given with planning and foresight, there would be a lot of criss-cross movement of semi-processed material. The performance won't go as planned, and the cost will go up [3], [4]. The complete factory or production facility is referred to as the plant. It is necessary to divide a large plant into many departments or shops. Here, a simple example of a food processing plantlet's say, a company that makes pickles will be used. The factory will have a receiving area where bulk deliveries of raw materials such as mangoes, lemons, and other citrus fruits will be received, weighed, and stored before being brought to the cleaning section or storage. This room may be used to sort, dry, and wash the arriving material. After being cleaned and dried, the fruit can next be peeled, sliced, squeezed, etc. in the machine department/shop. There will, of course, be further divisions and merchants. To ensure that production happens as quickly and affordably as feasible, numerous departments, tools, and machinery are organized methodically and practically in a plant layout. It involves setting up systems for power and water supply, connecting roads, managing plant materials internally, etc.

## II. DISCUSSION

### Plant Placement

The strategic choice of the ideal geographic location for the construction of a manufacturing facility is referred to as plant placement. When choosing the perfect location, several variables are taken into consideration, including access to transportation networks, the availability of trained labor, the closeness to markets, governmental laws, and the local business climate. Each of these variables affects how productive, economical, and competitive the plant's operations are. A location should be chosen that is close to the source of raw materials to cut down on transportation expenses, simplify logistics, and maintain a consistent supply chain. For sectors that depend largely on large or perishable raw materials, this is particularly important [5]–[7]. Access to well-developed transportation networks, including ports, airports, railroads, and highways, is essential for effective inbound and outbound logistics. The plant's capacity to collect inputs and distribute finished items in a timely way is improved by its strategic position, which offers simple connectivity to important markets and suppliers.

**Labour Supply and Skills:** Choosing where to locate a facility depends heavily on the supply of skilled labor. A location with access to specialized labor pools or a qualified workforce makes it possible for the plant to run smoothly and change with the demands of production. In addition, labor expenses and workforce stability must be balanced with cost-effectiveness and productivity.

**Market Proximity:** Placing a facility close to a market's potential customers can cut down on transportation expenses, delivery wait times, and inventory needs. Being close to clients makes it easier to respond quickly to market demands, improves customer service, and makes it possible to use just-in-time or customized production techniques.

**Government Regulations and the Business Environment:** A location's regulatory environment, tax advantages, business-friendly laws, and political stability affect how easy it is to conduct business there and how much it costs overall. Operational effectiveness and productivity can be increased by picking a location with friendly legislation and a welcoming company environment.

## Layout of Plants

Plant layout describes how numerous offices, workspaces, pieces of technology, and facilities are arranged and organized within a plant. The goal of the layout design is to reduce bottlenecks, improve operational efficiency, and optimize the flow of supplies, information, and employees. An efficient industrial layout directly affects worker morale, productivity, safety, and cost-cutting initiatives. Choosing a suitable place for the plant is insufficient. A plant has a lot of equipment and other industrial facilities. There would be a lot of criss-cross movement of semi-processed material if such machinery and facilities are not provided with planning and foresight. The performance won't go smoothly; the price will rise.

The word plant refers to the entire factory or production facility. A big plant needs to be broken up into different departments or shops. Here, a straightforward illustration of a food processing plantlets says a pickle manufacturing business will be used. The factory will contain a reception area where raw materials such as mangoes, lemons, and other citrus fruits will be received in bulk, weighed, and kept before being delivered to the cleaning area or store. The arriving material might be sorted, dried, and washed in this area. The fruit can then be peeled, sliced, squeezed, etc. at the machine department/shop after being cleaned and dried. Of course, there will be other departments and stores. Plant layout describes a methodical and practical organization of various departments, equipment, and machinery that is provided to ensure that production occurs as cost- and time-effectively as possible. It entails things like linking roadways, internal plant material management, setups for power and water supply, etc [8], [9].

## Advantages of A Good Layout

1. There is minimal, ordered, and streamlined material movement. It aids in decreasing inventory.
2. The product moves smoothly and precisely through all of the manufacturing steps.
3. The use of space is accomplished effectively. Creating an additional room is an expensive endeavor.
4. The layout increases employee morale and offers intrinsic worker safety.
5. It offers efficient oversight.

## Types of Layouts

There are three different layouts.

1. Process or functional layout.
2. line or product layout.
3. Group or combination layout.

All related machines or procedures are placed together in a process or functional layout. For instance, all shapers, both large and little, will be situated on one side of a machine shop, all milling machines on the opposite side, and all lathes individually in another corner, etc. When a product or line is laid out, the equipment is offered in the order that it will be used to process the product. If milling is the first operation, a milling machine will be installed first; similarly, if shaping is the second operation, a shaper will be positioned next to the milling machine. In this system, the raw material is inserted at one end of the line and the finished product, which has undergone several processes in a predetermined order, is produced at the other end of the line. Fewer machines will be needed with a process-type arrangement. Work can be done on another machine while one is being repaired. The line layout does not offer this option.

The operation of the entire line will be compromised if one machine in the line breaks down. Although the nature of the process makes supervision simple, there is always a greater amount of material being processed. More time cycles are needed in the process layout to finish the product. Additional benefits and drawbacks for each type of layout could be listed. Combination layouts were developed as a combination of the aforementioned two types of layouts to enhance the benefits of line and process layouts and minimize their drawbacks. The majority of modern industries use a combination or group structure. When manufacturing a particularly large product, such as an ocean-going ship or a Boeing airplane, it is occasionally impractical to move the product from one location to another, as would be necessary if a functional, line, or combination arrangement were used. As a result, all processes in such circumstances are performed at the same fixed site where the product remains. Such a working arrangement is known as a fixed location layout.

## Types of Production

The production can be divided into several categories depending on the quantity produced and the type of product:

1. Production in lots or pieces.
2. Medium-scale or batch production.
3. Production in bulk or mass.

This classification is crucial because plant managers implement various manufacturing tactics for effective output depending on the quantity of production.

**Piece or Job Lot Production:** In this case, repeat orders are unlikely because the parts are produced in tiny quantities. As a result, the plant doesn't spend money on unique machinery. Only general-purpose machines are utilized to manage the task, and standard tools are employed whenever possible. Due to their daily exposure to a variety of tasks, employees must possess greater skills. Typical examples include replacement parts for worn-out parts and parts needed for machinery maintenance. These are one-time needs.

**Batch Production:** In this case, orders are placed in tiny batches that are then repeated later. Only general-purpose machinery and equipment are employed, but jigs and fixtures are more frequently used to speed up production and guarantee the precision of the parts. Examples of this form of production include the manufacture of machine tools, pumps, compressors, and book printing.

**Mass Production:** In this case, a lot of products must be produced every month. The amount might be 100,000 or more each year. The manufacturing of sewing machines, scooters, cycles, vehicles, electric switches, electric fans, etc. is a typical example. Here, the manufacturers rely on sophisticated machinery to speed up production and use specific tools, among other things. Since most operations are repetitive, management typically opts for a line- or product-type arrangement for the plant and uses a semi-skilled or even unskilled workforce to complete the work. Even robots are employed in factories to carry out repetitive tasks.

### **Production and Productivity**

The terms production and productivity have various meanings. Production is the total amount produced, whereas productivity is the effective use of the resources used to produce that total amount. There are various forms of resources, including material, people, machine hours, energy used, and space employed, etc. Higher productivity results from lower resource use per unit of production. Take two motorcycle manufacturers as an example, whose products are similar in terms of design, horsepower, etc. The latter producer's material productivity is higher if one manufacturer uses 1.5 tonnes of steel per motorcycle and the other uses 1.4 tonnes. Even while a factory with higher productivity will use fewer resources and its product is likely to be cheaper, productivity shouldn't be mistaken for the cost of manufacturing. Another illustration will help clarify the distinction between productivity and production. In comparison to another steel producer that uses 6.8 tonnes of coke for every tonne of steel produced, the first steel maker's productivity is higher if it utilizes 6 tonnes of coke per tonne of steel produced. When discussing productivity, it makes no difference that the first steel producer produces just 1.5 mt of steel annually whereas the second steel maker produces 4.5 mt. A crucial idea is productivity, whether it be in manufacturing operations or any other activity. The high levels of productivity attained by Japanese manufacturing companies are credited with the country's recent success. Production alone won't help a country become great; productivity alone will make the products competitive.

### **Applications**

The use of plant location and layout to increase production and productivity spans a wide range of businesses and sectors. Here are a few crucial examples:

#### **Manufacturing Facilities**

Optimizing production processes and reaching higher levels of efficiency need careful consideration of the layout and location of manufacturing facilities. Strategic plant placement guarantees close access to sources of raw materials, transportation systems, and target markets, lowering supply chain costs and enhancing operational effectiveness. A well-designed plant layout promotes efficient material flow, eliminates bottlenecks, and creates productive workstations, which leads to increased productivity and shorter lead times for manufacturing.

#### **warehouse and Distribution Centers**

Proper inventory management and on-time order fulfillment depend on the positioning and design of warehouse and distribution centers. These facilities are strategically positioned near busy thoroughfares and client concentrations, which speeds up product delivery and lowers transportation expenses. The facility's efficient

layout design enables easy material handling, maximized storage space, and quick order-picking procedures, all of which increase productivity.

### **Retail Businesses**

The consumer traffic, sales, and operational effectiveness of retail businesses are substantially influenced by their location and design. The likelihood of drawing more consumers and increasing revenue is increased by selecting a great site with high visibility, accessibility, and closeness to target clients. The best store layout encourages consumer flow, offers a pleasurable shopping experience, and allows for effective product display and replenishment all of which help to boost productivity and boost client pleasure.

### **Service Centres**

Strategic positioning and effective layout design are advantageous for service centers, including call centers, repair centers, and customer support centers. It is easier to provide prompt service and support by placing these centers in areas with a large concentration of consumers or a skilled labor pool. Improved productivity and customer satisfaction are the results of effective layout design, which guarantees optimized workstations, streamlined communication flow, and optimal resource utilization.

### **Office Spaces**

Productivity and teamwork are influenced by the location and design of offices, even in non-manufacturing sectors. Employee happiness is increased when a central site is selected, or a location with easy access to transportation. successful office layouts encourage successful teamwork, collaboration, and communication, which helps employees perform more efficiently and effectively.

### **Healthcare Institutions**

Choosing the right location and layout is important for healthcare institutions like hospitals and clinics. The strategic placement of healthcare facilities ensures that patients, medical personnel, and support services are easily accessible. Overall productivity, patient satisfaction, and healthcare results are all improved by an effective architecture that maximizes patient flow, reduces wait times, and offers simple access to medical supplies and equipment.

### **Agriculture and Farming**

Plant layout and location issues are important in these industries. Crop output and productivity are influenced by where farming activities are located, including factors like soil quality, climate, and accessibility to water supplies. Agricultural facilities with effective layouts, like barns, storage spaces, and processing plants, may run more smoothly, make better use of their equipment, and handle their products with less difficulty. there are numerous and varied applications of plant structure and location in terms of output and productivity. Organizations may streamline their operations, cut costs, increase customer satisfaction, and boost overall productivity by carefully choosing plant locations and creating effective layouts. In today's dynamic corporate climate, these factors are crucial for achieving competitiveness, profitability, and sustainable growth.

## **III. CONCLUSION**

The location and design of factories are crucial factors in determining the output and productivity of industrial activities. For efficiency optimization, cost reduction, and overall performance maximization, educated judgments about these issues are crucial. When choosing the best site for a factory, several different aspects must be carefully taken into account, including infrastructure, labor availability, market accessibility, and closeness to raw supplies. A wise site decision may lead to lower transportation costs, better supply chain management, and higher levels of client satisfaction. Furthermore, it can open up access to skilled personnel, encourage business settings, and even reduce costs through advantageous tax policies. The arrangement of the factory is equally significant. A well-designed layout takes into account the movement of people, equipment, and materials to reduce bottlenecks, speed up production, and increase efficiency. Depending on the unique production requirements and the kind of items being made, several layout techniques, such as product layout, process layout, cellular layout, or a mix of these, may be employed.

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