UNIT 16

FACTORS OF INDUSTRIAL LOCATION

Structure

16.1 INTRODUCTION

As a part of secondary economic activities, the issue of location of industry is a major concern of economic geography. A particular industrial plant cannot be located anywhere. An industrial plant is often located at a place on the surface where inputs required for running that industry are available or there is a high demand for that industrial product (i.e., market) near that area. Economic geographers, specializing in industrial geography, are usually concerned with following two fundamental questions: *where is an industrial plant located*, and *why is it located there*. Finding answers to these questions and then trying to develop explanations and generalisations (model, theories and laws), concerning the location of industrial plants by identifying and analyzing many factors of industrial location. Most of the generalisations owe their origin to classical economics.

At the core of such deductive models of industrial location has been an economic man. An economic man is one who is completely rational, profit-maximizing, all-knowing, a social individual, whose decisions drove the models. Generally, in a capitalist economy, an industrialist would locate the industrial plant at a place on the Earth's surface, where the profit is maximum. Maximum profit can accrue in two ways – either the cost of production is least or the demand of industrial product is very high. Such conditions exist in

areas where many factors influencing the location of a particular industry are present (e.g., raw material, market, transportation, labour and capital, etc.). It is important to note that the factors influencing the location of industries depend on the very nature of industry.

You will learn about the factors of industrial location as explained in detail in Section 16.1. Further, you will study about various theories of industrial location in Section 16.2. Next two Sections 16.3 and 16.4 are devoted to the study of two classical theories of industrial location separately. Finally, Section 16.5 throws a brief light on the recent trends entailing the theories of industrial location. It tries to portray the ever-changing contours of geo-political, economic and technological circumstances transcending across the Globe. In reality, such factors often give birth to spatial variations and varied forms of complexities, be it socio-economic, political, infrastructural, and institutional as well as prominently, environmental etc.

Expected Learning Outcomes

After studying this Unit, you should be able to:

- describe factors influencing the location of an industrial plant;
- explain the theory of industrial location of Alfred Weber and its major limitations;
- explain the theory of industrial location of August Losch and its major limitations; and
- discuss the recent trends in theories of industrial location.

16.2 FACTORS OF INDUSTRIAL LOCATION

Industrial plants are not randomly located in geographical space. Instead, they are located where factors influencing industrial location are present. Industries depend on a number of factors, such as raw materials, transportation, power, labour, markets, management, banking and agglomeration economies, etc. However, industries do not uniformly depend on these factors. The importance of these factors varies from industry to industry. For some industries, availability of raw material is most important, for others access to cheap supply of labour. In the following Section, we discuss about factors of industrial location.

(i) **Raw Materials:** Many industrial plants are located closer to raw material for economic reasons. The industrial plant using heavy, bulky or perishable raw materials are located near sites of raw materials. For example, sugar industries are located near sugar cane growing areas. Can you think of another industry, which is dependent on raw material?

(ii) **Labour:** Industrial units depend on labour- both skilled and unskilled. Generally, labour-intensive manufacturing industries need large number of cheap labour force. On the contrary, high-tech industries depend on appropriate skilled workers. For example, informatics technology industries and pharmaceuticals industries need highly skilled labour force, while textile and metal industries need semi-

skilled labour force. Textile and related industries, sugar industries, hospitality industries and household industries require large amount of labour force. On the other hand, information technology and software industries need limited labour force. In recent year, automization and robotization has decreased the dependence of many industries, such as motor-parts and computer manufacturing industries on labour force.

(iii) **Market:** Do you know which are the industries located near the market? For those industries which depend on bulky, perishable, fragile and large-size raw materials, accessibility to market is essential for the sale of commodity.

(iv) **Transport:** A good transport network helps reduce costs and make the movement of materials and products easier.

(v) **Cost of Land:** Availability of cheaper land helps reduce the initial costs.

(vi) **Capital:** Capital refers to the money needed to start an industry.

(vii) **Government Policies:** Industrial development is encouraged in some areas and restricted in others. Governments formulate industrial policies for various social, political and strategic reasons. For instance, Indian government have industrial policy for backward areas.

(viii) **Water:** Some industries such as iron and steel, textile and chemical require large quantities of water for their running at maximum capacity and, therefore, they are established near fresh water bodies.

(ix) **Climate:** Some industries require high humidity. For example, cotton being a natural fibre absorbs a lot of moisture from the atmosphere. The fibre processes well with appropriate level of moisture and therefore, a humid climate is suitable for the growth of cotton textile industry.

(x) **Energy Supply:** Regular supply of power is a pre-requisite for the location of industries. Many industries tend to concentrate at the source of power. In particular, aluminium smelting is a power intensive process and aluminium industries are located near sources of power.

(xi) **Natural Routes:** Rivers and sea routes provide easy means of transportation and are necessary for easy movement of materials. Railways are needed for movement of bulky raw materials.

(xii) **Sites:** Big industrial projects require large accessible areas of flat land, on which to build their factories.

(xiii) **Others:** In addition to above factors of industrial location, efficient banking facilities, efficient organisation, industrial agglomeration, industrial inertia and insurance facilities help in the smooth running of industries.

Not all of these factors are simultaneously present at one place and time. Further, the relative significance of these factors also varies from industries to industries and across time and space. For example, due to automization and robotization, the relative importance of labours has declined. Again, due to

growing concern for environment and ecology in the developed countries, many polluting industries have shifted to Asia to reap benefits of cheap labour and liberal environmental laws. Some industries, such as beverage and alcohol, have shifted to developing countries due to growing market there. For these reasons, geographers and economists have tried to find out the changing significance of various factors of industrial location while developing their theories.

SAQ I

Mark the following statements as True or False.

a) Metal industries need highly skilled labour force.
b) Industries which depend on bulky, perishable, fragile and large-size raw materials, are generally located near the market.
c) Many polluting industries have shifted to Asia to reap the benefits of cheap labour and liberal environmental laws.
d) Sugar industries are generally located near the market.

16.3 THEORIES OF INDUSTRIAL LOCATION

The study of industry has been a major concern of geography ever since the development of Commercial and Economic Geography in the second half of the 19th Century. Initially, geographers were concerned with the regional study of particular industrial region (e.g. Rurh, Lake Region and Osaka, etc.). The focus was descriptive study of industrial regions, belts, zones or districts, based on observation and mapping. However, there was a revolutionary change of emphasis in industrial geography at the time of positivist (popularly known as quantitative) revolution in geography during 1950s. There was a conscious effort to make geography more scientific. The methods of science were infused so that geographers could identify and explain the existing pattern and order in the location and distribution of geographical phenomena in geographical space. Theories were developed to explain the location of industrial plants. Similarly, models were developed to predict the future trends of their location. In nutshell, industrial location theory aims to address the question of where an industry is (can be) located and why it is (can be) located there.

The underlying ideas are that the locational decisions are not random. Instead, they are based on economic rationality. Industries tend to locate in areas, where the most favourable conditions exist. For example, some industries tend to locate in areas where raw materials are in abundant supply. Other industries are attracted to areas, where there is high demand for the particular industrial product. Again, some industries are attracted to an area, where there is cheaper labour or there is benefit due to agglomeration. Geographers and economists have developed theoretical frameworks that take into considerations large number of factors involved in industrial location and provide generalised rule that govern the location.

Broadly speaking, four types of industrial locational theories have been developed by geographers and economists.

(i) ***Least Cost Location Theory*** **(Alfred Weber, 1909):** The industrial plants tend to locate at points in space where the cost of production is minimum most.

(ii) ***Locational Interdependence Theory*** **(Harold Hotelling, 1929):** The process of spatial competition leads firms to agglomerate at market centre. The interdependence theory is based on the assumptions that the cost of production is equal at all points and that the objective of situating in a specific place is to control the largest market area.

(iii) ***Least Cost Location Theory, Locational Interdependence Theory, Maximum Demand Theory*** **(M.L. Greenhut, 1964):** Demand influence the location of industry as it is a prime location variable from place to place, that it causes, and at the same time reflects, varying uncertainties and profits and that it influences and is influenced by the location of industry.

(iv) ***Maximum Profit Theory*** **(August Losch, 1939; Smith and Allen Pred, 1971):** Losch's theory of industrial location is based on a free economy, where the optimum placement of the individual enterprise in different sites can be determined from the cost and demand curves. The optimum locational point of an industrial plant lies where the net profit is greatest.

SAQ 2

Match the following.

Locational Theory	Propounder of the Theory
a) Maximum Profit Theory	i) Alfred Weber
b) Locational Interdependence Theory	ii) M. L. Greenhurt
c) Least Cost Locational Theory	iii) Harold Hotelling
d) Maximum Demand Theory (combined)	iv) August Losch

16.4 ALFRED WEBER'S THEORY OF INDUSTRIAL LOCATION

Till now, you must have realised that the question where to locate an industry is central to the study of industrial geography. Alfred Weber (1868-1958), a German economic geographer, proposed his theory of industrial location in 1909. He was basically curious to know why industries tend to shift from place to place and what factors trigger such movements. A location theory basically aims at predicting, where an industrial plant will or should be located. Generally, the location of an industrial plant depends on many factors, viz. geographical, economic, political and cultural factors. We have already discussed these factors in Section 16.2.

However, Weber's industrial location theory considers the following three factors only:

1. Transportation costs
2. Labour costs
3. Agglomeration economies

Assumptions: Alfred Weber starts with certain assumption about the geographical area where his theory will apply. This he does to reduce the complexities of the real world.

- Weber's theory assumes that there is a single, isolated country with homogeneous conditions.
- Some of the raw materials are found everywhere (ubiquitous), while some have fixed locations.
- In production process, both *pure raw materials* (no weight loss in the process of production), as well as *impure raw materials* (with varying amount of weight loss in the process of production) are used.
- The workforce (labour) is found in fixed locations.
- Transportation costs are simply a function of cargo weight and the distance.
- Demand is uniform throughout the region for all products; hence, there is uniform price for all products at all locations.
- Locations of sources of raw materials as well as markets are known.

In view of the above assumptions (particularly the last one), the industrial plant located at the least costs point would get the highest profit.

In order to identify this point in space, Weber first considered the transportation cost. In particular, he pursued for the ***least transport cost location***. It is the most important factor that influences the location of an industry. To measure the least cost location; Weber introduced a simple concept of **Material Index** (M.I.), which is a numerical value obtained by dividing the weight of input (raw materials), by the output (finished products). If the material index is higher than 1, the location tends to be toward the source of raw materials. If it is less than 1, the location tends to be toward the market. Using this concept, Weber, visualised the following scenarios of least cost industrial location. Let us discuss both the scenarios one by one.

Scenario 1: ***One raw material and one market.***

The decision to locate industry is relatively easier when it depends on one main raw material, and there is only one market where the industrial products have to be transported. In this scenario, the selection of a suitable place for location industry depends on the nature of raw material and the proportion of weight loss during the manufacturing. There are three possible scenarios (Table 16.1).

Industrial plant using heavy source of raw material in the process of manufacturing, the plant will be located at or near the source of raw material. Can you name any one industry that belongs to this category? Examples, if the weight of raw material is equivalent to the weight of finished product, the industrial plant will be located anywhere (at source of raw material, market or in between the two). If the weight of raw material is lower than the weight of finished product, the industrial plant will be located at or near the site of market.

Table 16.1: Material Index and Location of Industrial Plants

Industry	Principal raw material	Finished product	Material Index (MI) (Weight of raw material /Weight of finished product)	Type of industry	Place of industrial location
Sugar cane industry	Sugar cane	Raw sugar	7 tons of sugar cane/ 1 ton of raw sugar = 7	Weight loosing industry	Raw material orientation
Beer industry	Wheat	Beer	1 ton of wheat/ 10 tons of beer = 0.1	Weight gaining industry	At market
Cotton textile industry	Yarns	Clothes	10 tons of yarns/ 10 tons of clothes = 1	Neither weight gaining nor weight loosing	Footloose location - at market or source of raw material or at any intermediate location between them

Scenario 2: ***Two raw materials and one market.***

When raw materials are used in the process of production and there is only one market where the finished product can be sold, the area under consideration for location will be a triangular (locational triangle) area. Here, the possible location of the industrial plant within the triangular-shaped space could be:

- at the market,
- at the source of raw material 1,
- at the source of raw material 2, or
- at any intermediate place between the above three.

It is important to note that in the triangular space, Weber initially considered the role of transport cost only. Further, the location of an industrial plant in the triangular space is also influenced by the very nature of the raw material used in the manufacturing (whether pure or impure). Thus, the material index of each raw material and the distance among raw materials (SR1 and SR2) and market (M) decide the least cost location of the industrial plant.

- *If one raw material is ubiquitous (either pure or impure), (SR1), and the other raw material (SR2), is localised or impure, the industrial plant (x), will be located at the localised raw material (i.e., SR2), as shown in Fig. 16.1.*
- *If both the raw materials (SR1 and SR2) are pure, the least cost location of an industrial plant (x) will be near or at market (M), as shown in Fig. 16.2.*

- *If both the raw materials are localised and impure (with weight loss ratio of 50 percent), and the raw materials and the market are at an equidistance in a triangular-shaped space (100 kilometre from each other), the locational decision becomes little complex (Fig. 16.1).*

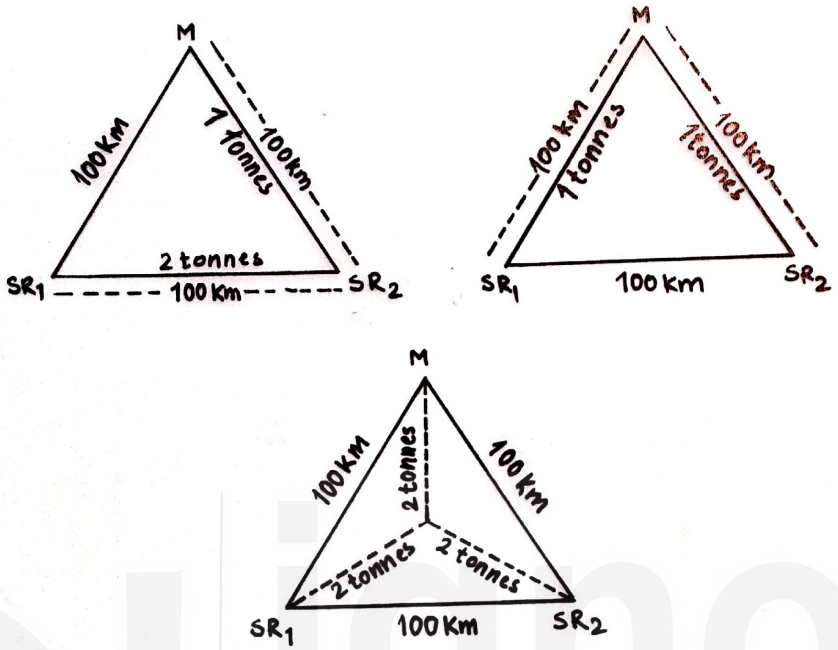

Fig. 16.1: Example of a Weight Loosing Industry (both raw materials are localised and have equal weight loss ratio).

The raw material required for each source is two tonnes, the rate of transport cost is Rs.5 per tonnes per kilometre, the total transport cost at four possible place of locations within the locational triangle will be as under.

I. If the industry is located at SR1, the total transport cost incurred will be:

Assembly cost (cost of transporting raw material from SR2 to SR1) = (2 Tonnes × 100 kilometre × Rs. 5.00) = Rs. 1000.00

Marketing cost (cost of transporting finished product from SR1 to M) = (2 tonnes × 100 kilometre × Rs. 5.00) = Rs. 1000.00

Total transportation cost (Assembly cost + Marketing cost) = 2000.00

II. If the industry is located at SR2, the total transport cost incurred will be:

Assembly cost (cost of transporting raw material from SR1 to SR2) = (2 Tonnes × 100 kilometre × Rs. 5.00) = Rs. 1000.00

Marketing cost (cost of transporting finished product from SR2 to M) = (1 tonnes × 100 kilometre × Rs. 5.00) = Rs. 500.00

Total transportation cost (Assembly cost + Marketing cost) = 1500.00

III. If the industry is located at M, the total transport cost incurred will be:

Assembly cost (cost of transporting raw material from SR1 to M) = (2 Tonnes × 100 kilometre × Rs. 5.00) = Rs. 1000.00

Assembly cost (cost of transporting raw material from SR2 to M) = (2 Tonnes × 100 kilometre × Rs. 5.00) = Rs. 1000.00

Marketing cost (cost of transporting finished product from M to M) = (2 Tonnes × 00 kilometre × Rs. 5.00) = Rs. 00.00

Total transportation cost (Assembly cost + Marketing cost) = 2000.00

IV. If the industry is located at X, which is an intermediate point between SR1, SR2 and M, the total transport cost incurred will be:

Assembly cost (cost of transporting raw material from SR1 to X) = (2 Tonnes × 50 kilometre × Rs. 5.00) = Rs. 500.00

Assembly cost (cost of transporting raw material from SR1 to X) = (2 Tonnes × 50 kilometre × Rs. 5.00) = Rs. 500.00

Marketing cost (cost of transporting finished product from X to M) = (2 Tonnes × 87 kilometre × Rs. 5.00) = Rs. 1870.00

Total transportation cost (Assembly cost + Marketing cost) = Rs, 1435.00

Since, among all the four places (i.e., SR1, SR2, M, and X), the least cost location is at point X. Hence, the industrial plant will be located at this point. If the same amount of raw material is required and the rate of their weight loss is unequal, then the place of least transport cost location will shift towards the source of raw material with higher weight loss ratio.

Here, it is important to understand the two concepts introduced by Weber. First is **isotim**, which is a line joining places having equal assembly or marketing costs (Fig. 16.2). An extended concept related to this is **isodapane**, which is the line joining point of equal total transportation costs (Fig. 16.3).

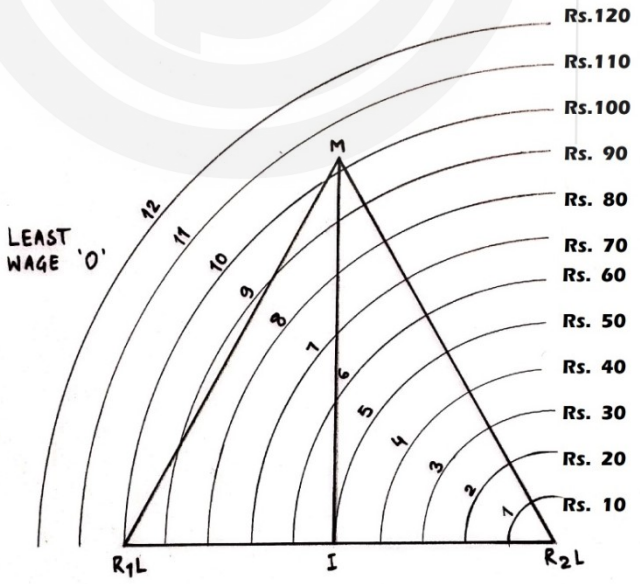

Fig. 16.2: Lines of Equal Transport Cost.
(Source: Adapted from Hussain, M., 2007)

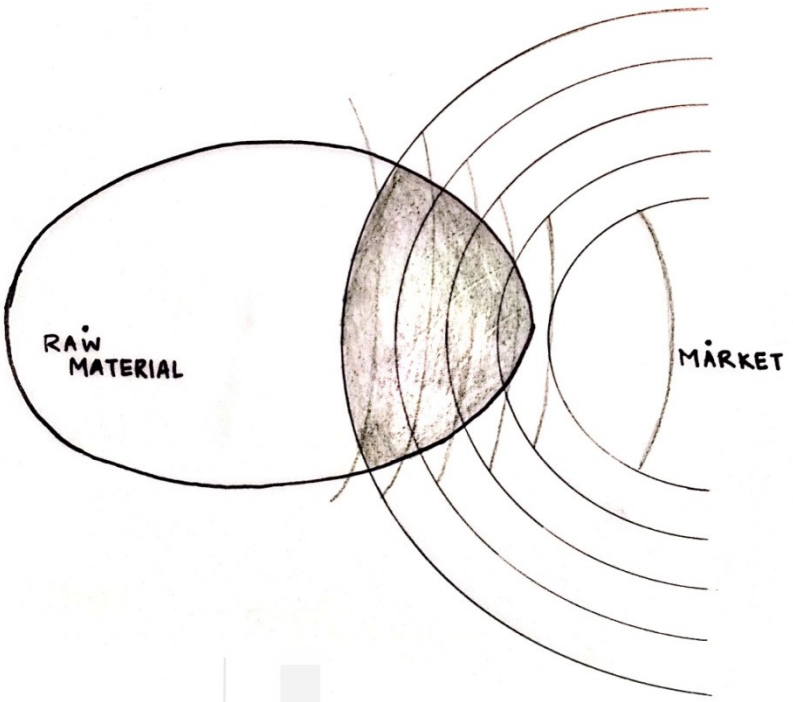

Fig. 16.3: Isodapane showing the Total Transportation Cost.
(Source: Adapted from Hussain, M., 2007)

Role of Labour

According to Weber, industrial plants are located at a point in geographical space, where the transport costs (assembly cost + marketing cost) is cheapest. However, Weber also examined the effects of labour costs on location. According to him, an industrial plant may be located away from the point of least transport costs to the point of least labour costs, if savings made in the labour costs were higher than any additional costs incurred due to such a move.

In Fig. 16.4, X is the least transport cost point. A series of concentric lines, which are lines of equal transport cost lines, called isodapanes, have been drawn around this point. These are lines of equal transport costs from X. There is cheap labour at point L1, L2, and L3, which would reduce costs by Rs.15 per unit of production. It is evident from the Fig. 16.6, that any location within the Rs.15 transport isodapane would save more on labour than would be spent on additional transport cost. Therefore, L2 would be more profitable for the industrial plant than point X. On the other hand, location of the industrial plant at L3 would mean that the increased transport cost would be more than any saving in labour costs. The isodapane line beyond which savings made in labour costs cannot compensate the increased transport costs is known as *critical isodapane*.

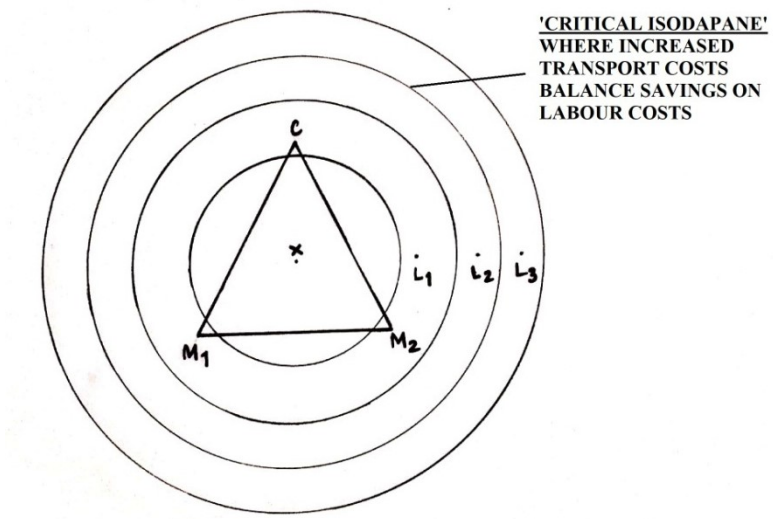

Fig. 16.4: The Effect of Labour and Transport Costs on Location.
(Source: Adapted from Knowles, R., and Wareing, J., 1976)

Role of Agglomeration

After examining the effects of transport and labour costs, Weber examined the role of agglomeration. In Fig. 16.5, A, B, C, D, and E are points of least cost locations, but the industrial plant could cut their cost by Rs.15 per unit of production, if at least three of them operate in the same location. However, they must not incur increased transport costs of over Rs.15 per unit of production. In Fig. 16.5, the critical isodapane of Rs.15 has been drawn around each industrial plant. It is clear that plants located at C, D, and E could reduce their total costs of production by shifting.

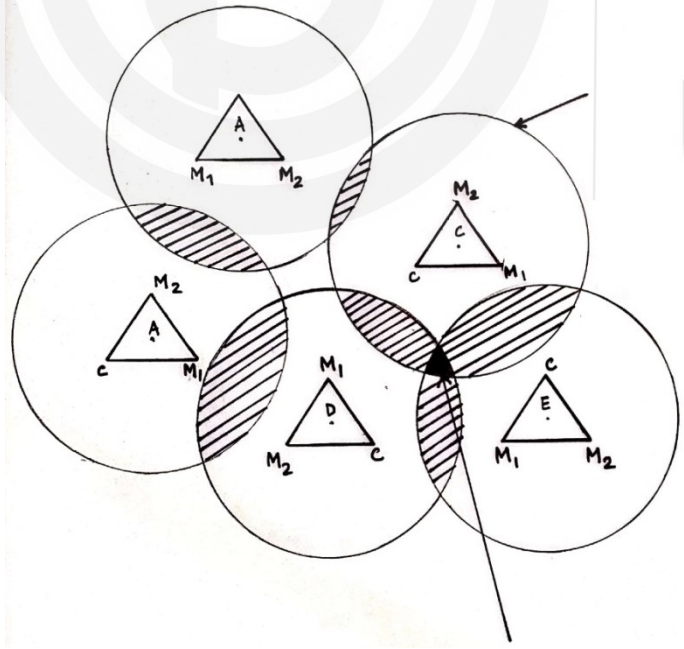

Fig. 16.5: The Effect of Agglomeration on Location.
(Source: Adapted from Knowles, R., and Wareing, J., 1976)

Critical Appreciation

Weber's theory of industrial location is widely considered as a pioneering attempt to explain the location of industry. He attempted to find out the least

cost location by considering the role of transport costs (assembly as well as marketing costs). Subsequently, he modified the theory by considering labour costs and agglomeration economy. He was of the view that the industry may shift away from the point of least transport cost location to higher transport costs locations, if additional costs incurred is less than the savings made by availability of cheap labour or agglomeration economy

Weber's theory faced many criticisms. In particular, his assumptions regarding transport costs, labour, and effects of agglomeration have been questioned. Some of the major criticisms are as follows:

(i) Weber emphasized on the supply side of the industry and totally ignored the demand side of the industry.

(ii) He overemphasized the role of transport in the location of industry.

(iii) Transport costs are not uniform but vary from product to product. For example, transport costs of finished products are generally costlier than those raw materials. Moreover, transport cost is not uniform in space. There is telescopic reduction in transport costs (i.e., it decreases with increasing distance).

(iv) Weber did not take into account the costs of space and high rent of buildings in areas of industrial agglomeration.

(v) The assumption of perfect competition is only an ideal condition. Perfect competition is difficult to sustain over time.

(vi) Weber did not consider historical factors in the location of industry.

Despite these limitations, the least cost theory of location has enjoyed great popularity because of its pioneer nature. Walter Isard (1948) tested the theory in his influential paper on 'some locational factors in the iron and steel industry, since the early nineteenth century' in the United States of America.

SAQ 3

What is Material Index? How does it influence industrial location?

16.5 AUGUST LOSCH'S THEORY OF INDUSTRIAL LOCATION

August Losch (1906-1945), was a German economist. He is widely known for his work in the field of urban economics and regional science. In geography, he is particularly known for his theory of industrial location. Losch critiqued Weber's theory of industrial location. He proposed his theory of Industrial location in 1944 with a major emphasis on both cost of production and demand. His theory is based on the principle of 'Profit Maximization'.

Assumptions

Like Weber, Losch starts with certain assumption about the geographical area, where his theory will apply. His assumptions are as follows:

1. The region under consideration is an extensive homogenous plain where raw materials are evenly distributed. Similarly, people inhabiting the region have a general homogeneity in taste, knowledge, and technical skill.
2. The transport cost is uniform and directly proportional to distance in all the directions.
3. He assumed that demand for a product decreased with an increase in price. If this price increase were caused by an increase in transport costs, then demand would decrease with distance from production centre.
4. Economic discriminations among the people are non-existing and the economic and career building opportunities are open and uniform to all individuals.
5. The population distribution is very even and the region is self-sufficient in agricultural production.

In case of the excess production of agriculture, the status quo of economy will be distorted. To achieve homogeneity of economy within the region, the theory required some more conditions. These are as follows:

1. The entire area should be equally served by the factories. No area should be exempted from the supply; therefore, no new firm would dare to venture in the area.
2. There must be conformity in the range and quantum of profit. In case of abnormal profit, new firms may try to establish their own plant.
3. The location must satisfy both producer and consumer. The profit of the firm and satisfaction of the consumer must be optimum through the location.
4. There must be provisions for consumers to get the products from other adjacent areas.
5. The number of consumers, producers and areas should be well defined and not very extensive. Only a limited number of producers within a small area will be able to overcome the complexities and satisfy completely the handful of consumers.

To get the desired result from the location and sustained growth of the industry, these above-mentioned conditions are pre-requisites.

According to Losch, an industrialist would locate the industrial plant at a point, where the profit is maximum. Rather than focusing on specific factors of production, such as point of least transport cost or labour cost, he emphasized more on the total production cost. Further, Losch says that to get maximum profit, the volume of total consumption of a product is the key factor. Higher the consumption rate, greater will be the profit. In this case, he placed considerable emphasis on the price reduction of the product. Any decrease in the price of the product would automatically encourage the volume of demand/consumption (Fig. 16.6).

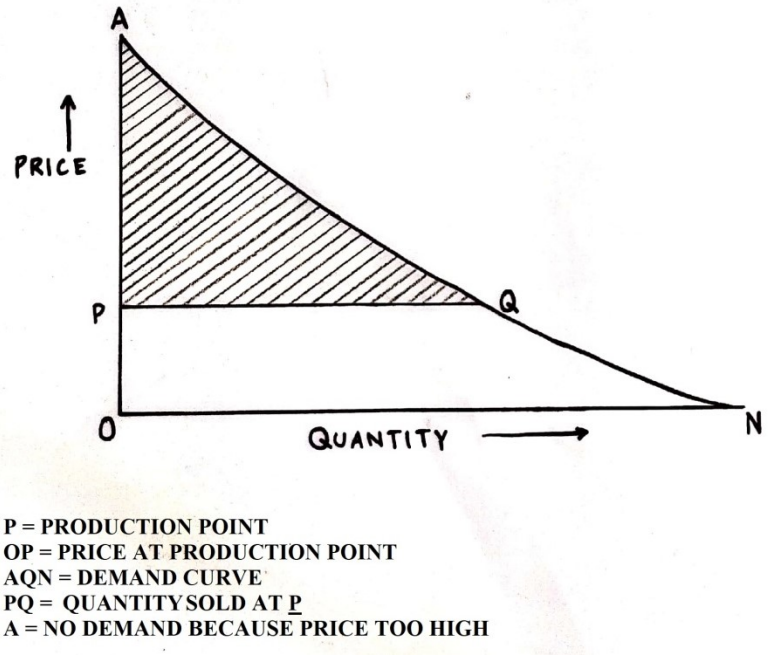

Fig. 16.6: Relation between Price and Demand of a Product.

In this simple model, it is evident that when price of the commodity drops from A to P, the consumption increases from A to Q. The theory of August Losch consider demand as a most important variable. The fundamental objective behind the theory is to find out the most profitable location for industrial establishment.

To determine the location of maximum profit, Losch (1954) states:

The complexity stems from the fact that, there is more than one geographical point where the total demand of a surrounding district is at a maximum… We are thus reduced to determine separately for every one of a number of virtual factory locations the total attainable demand, and for similar reasons the best volume of production as a function of factory price (market and cost analysis). The greatest profit attainable at each of these points can be determined from the cost and demand curves, and from this place of greatest money profits, the optimum location can be found.

As mentioned above, the major objective of the location theory is to attain equilibrium in the producing area and the product and the ability of the producer. If a single entrepreneur enters in the production process, within a vast area, the cost on the distribution of products will be very high. On the other hand, when several small producers are engaged in the production process in separate regions, the distribution cost will come down and due to increasing competition; efficiency of the product and cost of production will be lesser, resulting in substantial increase in profit. Further, due to increasing competition, the area served by individual manufacturing units will be condensed. In the smaller area, several manufacturing units will be situated near each other, without leaving any area un-served. The competition between manufacturing units over market will lead to competition over demand space. Ultimately, a hexagonal pattern would emerge without any overlap and gaps in the economic space.

To establish his theoretical model, Losch proposed the following three distinct phase of development of economic landscape.

1. Initially, if sufficient and symmetrical demand of a product prevails in the market, a demand cone may explain the market conditions. Fig. 16.7 illustrates that the effective demand of the particular product will be exactly same to the volume of the cone. In the above figure, P is a producer, and demand curve is lying on QA. P or price line is controlled jointly by transport cost and distance. The price increased from P to A. Along the Y axis or PQ, demand of quantity is measured between PA and QA.

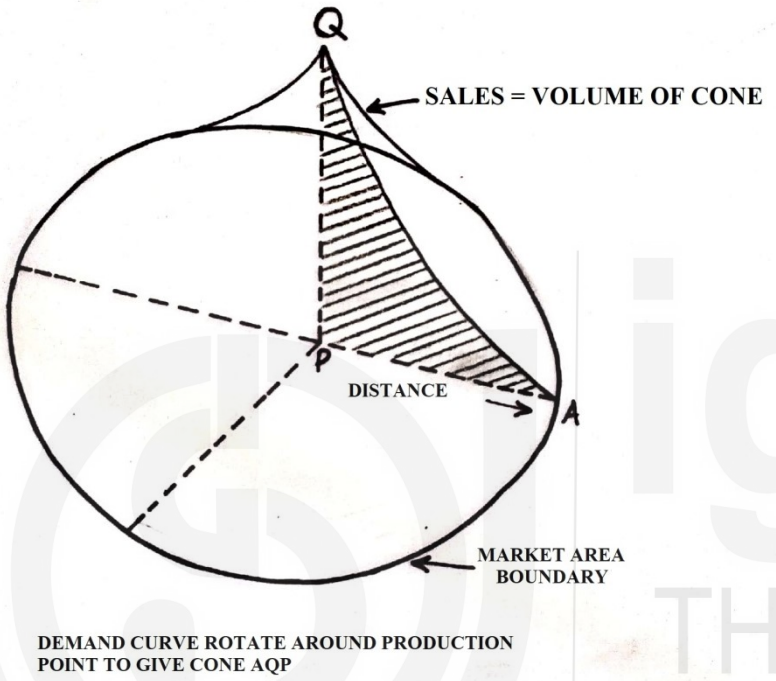

Fig. 16.7: Demand Cone and Market Area.
(Source: Adapted from Losch, A., 1954)

2. The intrusion of one market area to other will distort the circular market areas and the market areas of different manufacturing units will further reduce. This situation will lead to the initiation of the third phase. Fig. 16.10 shows the development of hexagonal market area in the third stage. The dotted lines represent market boundaries of respective production centres. The crossed area is the production centre.

3. The final phase of industrial location witnesses the narrowing of the intermediate space between two market areas. The areas falling vacant between the different market areas become the target of new enterprises. As new firms set up within the vacuum, the hinterlands of earlier industries get reduced. The reduction of the market area results in rapid disruption of the early circular pattern. Gradually, the market area of the industries attains a hexagonal shape (Fig. 16.8).

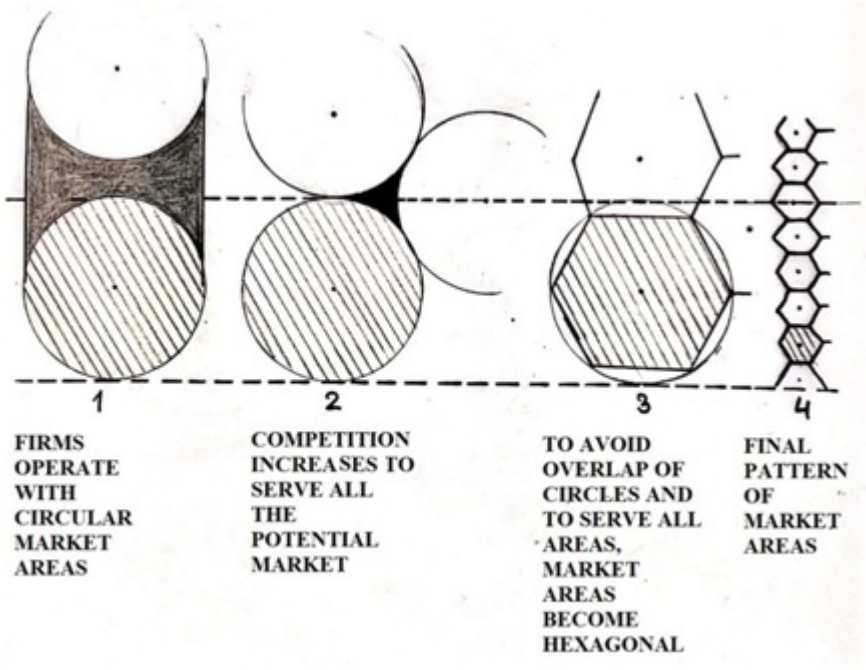

Fig. 16.8: Market Area as Hexagons.
(Source: Adapted from Losch, A., 1954)

According to Losch, when any area possesses several hexagons, lying upon each other and surrounding a particular centre, a metropolitan city will grow. In other words, it may be said that around the nucleus of a city, numerous hexagons or market areas of different commodity will grow. So, in this fashion, industries would concentrate within a region, each having different products. So, almost all types of materials including raw materials should be available on that point. Hence, any new industry would get its required raw material within near distance. Obviously, the total transport cost in that place will be minimum. In this way, "equilibrium conditions" as stated by Losch may be attained.

Criticism

Like Weber, Losch's theory is also not free from criticism. Some of the major criticisms are as follows:

1. Losch's theory considers industrial plant as discrete entity. It does not consider the problems arising from locational interdependence of plants.
2. It overemphasizes the demand factor.
3. It is also quite abstract and, therefore, detached from the actual process of industrial location in the real world.

Despite these criticisms, Losch's theory remains the pioneering contribution for considering market as a factor of industrial location. It encouraged the geographers and economists to propose further development of industrial location theories.

SAQ 4

In what ways the foundation of August Losch's industrial location theory is different from those of Alfred Weber?

16.6 RECENT TRENDS IN THEORIES OF INDUSTRIAL LOCATION

Decisions to locate industries are taken in the socio-spatial contexts. The various components of society, such as economy, technology (robots, artificial intelligence, information and communication technologies, etc.), and policy, etc., are undergoing vast changes. The frontiers of science and technology have also expanded. The structure of geographical space is also experiencing transformation in terms of its organisation and function. For example, more people are living in the urban areas in the present times compared to the past. The developed world is experiencing rapid demographic slow down while developing countries are still experiencing rapid growth of population. Due to climate change, there is renewed focus on environmental protection. The new industrial location theories have to take into consideration these realities of the fast-changing world.

- There is restriction in mobility of labour from developing countries to the developed countries. In contrast, the mobility of capital is relatively free. Therefore, many labour-intensive industries have shifted to China, India, and other countries of Asia.
- Due to improvement in means of transport, there is unrestricted labour mobility within the territories of the countries. It has obvious implications in the form of agglomeration of industries at market or near the source of raw materials.
- Due to concern of carbon emissions in the west and strict environmental laws, many hazardous industries have shifted to poor countries of Asia and Africa. One such example is ship-breaking industry in Bangladesh. Therefore, location theories increasingly incorporate environmental factors into the production-location frameworks.
- There is tendency of clustering of software industries in specific cities such as Silicon Valley (USA), Bangalore, and Hyderabad (India).
- The propensity for innovative activity to cluster spatially is also greater in industries, where creation of knowledge spillovers is important.
- Many economists and geographers have emphasized on the need to develop a transaction cost understanding of the internal and external technical and organisational relations of firm.
- They have also advocated for incorporation of spatial transaction costs, which go beyond the adoption of a simple dichotomy between transport costs and information costs.
- The recent revolution in GIS and remote sensing techniques has potentially created opportunities for technical sophistication in theories of industrial location.

SAQ 5

How robotization and artificial intelligence may influence the location of industry?

16.7 SUMMARY

In this Unit, you have learnt the following:

- Location of industrial plant is a major concern of economic geographers. In the beginning, they focused on the descriptive study of industrial location.
- Subsequently, they started developing explanations for the location and shifting of industries in geographical space.
- This resulted in the development of industrial location theories.
- In this regard, Alfred Weber's least cost location theory is considered as pioneering.
- Subsequently, many geographers and economists have developed theories by considering factors such as transportation, market, labour, and agglomeration, etc.
- These theories are variously based on least cost, maximum demand, and locational interdependence or maximum revenue.
- All industrial location theories start with certain premises about the real world.
- As a result, these theories fail to provide full explanation to the complex process of industrial location.
- Despite, these theories are helpful in providing understanding about the principle that governs the industrial location.

16.8 TERMINAL QUESTIONS

1. Describe factors of industrial location with suitable examples.
2. Explain main premises of Alfred Weber's Theory of Industrial location.
3. Critically examine the limitations of Alfred Weber's Theory of industrial location.
4. Discuss three distinct phases in the development of economic landscape as identified by August Losch.
5. Describe recent trends in industrial location theories.

16.9 ANSWERS

Self-Assessment Questions (SAQ)

1) False; b) True; c) True; d) False.
2) a-iv; b-iii; c-I; d-ii
3) Numerical value obtained by dividing the weight of input (raw materials), by the output (finished products). If the material index is greater than 1, the location tends to be toward the source of raw

materials. If it is less than 1, the location tends to be towards the market.

4) Losch had put a major emphasis on both cost of production and demand whereas weber took into consideration three factors namely transport cost, labour cost, and agglomeration economies. He tried to apply the principle of 'Profit Maximization'.

5) Recent technological advancements spanning GIS and remote sensing techniques are helping various stakeholders to decide the best possible location for setting up industries, industrial hubs and complexes as well as market zones. Besides, some more crucial factors including labour, capital, and environment also plays a vital role.

Terminal Questions

1. Highlight the essence, role and importance of various factors of industrial location in your answer. Refer to Section 16.2.
2. In your answer, try to bring out the main premises behind the Weber's theory of Industrial location. Refer to Section 16.4.
3. While answering this question, you are required to provide a critical evaluation in context of the limitations of theory of industrial location, as postulated by Weber. Refer to Section 16.4.
4. To answer this question, you are required to discuss three distinct phases in the development of economic landscape, as identified by August Losch. Refer to Section 16.5.
5. Highlight the key recent trends that have taken shape to determine the theories of industrial location. Refer to Section 16.6.

16.10 REFERENCES AND FURTHER SUGGESTED READING

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GLOSSARY

Aromatic : Having a pleasant smell.

Backward and forward linkages : These linkages are reflecting the relationship on an industry with its supply chain in the form of raw material while forward linkage shows relationship towards end consumers.

Concentration : Large number or amount of something in the same place.

Contaminate : To add a substance which will make something dirty or harmful.

Cost space : Geographical space in which movement of raw material, products or people incurs transportation cost.

Critical isodapane : A cost line joining the places where savings from labour is equal to extra transport cost.

Dock : An area of a port where ships stop to be loaded, repaired, etc.

Durability : The quality of being able to last a long time without becoming damaged.

Entrepreneur : One who organizes, manages, and assumes the risks of a business or enterprise.

External economies of scale : Larger changes outside the firm (but inside the industry) that bring down marginal costs of production.

Factory : It refers to the unit of production.

Firm : It refers to the unit of organization.

Growth poles : It refers to the concentration of highly innovative and technically advanced industries that stimulate economic development in linked businesses and industries.

Industrial plant firm : The unit of production (the factory) and the unit of organization (the firm), are combined in the form of the single plant firm.

Industrial region : Geographical area where concentration of industries has occurred due to favourable factors of industrial location.

Infrastructure : The basic systems and services, such as transport and power supplies, that a country or organization uses in order to work effectively.

Internal economies of scale : Firm-specific changes (or caused internally) that bring down marginal costs of production.

Isodapane : Equal total transportation cost lines.

Isotims : Equal transportation cost lines.

Labour-intensive crop : Some crops require more labour for managing them. Seedling, sowing, irrigation, levels of input and output per unit.

Monopoly : Exclusive possession or control.

Monocultural crop : It is a type of cropping in which only one type of crop is grown at one time on a specific field.

Manufacturing : The production of goods using of raw materials, labour, capital, machinery and tools, etc.

Market : A place where products are sold.

Material index : It is a measure considered by an industrial enterprise when deciding where to locate the industrial plant– near source of raw material or market.

Nerve-centres : The control centre of an organization or operation.

Outmigration : To leave one region or community in order to settle in another especially as part of a large-scale and continuing movement of population.

Perishability : Perishability is the capacity of an item during which it gets spoiled easily or decay and doesn't remain safe for eating purpose.

Raw materials : Any material, such as oil, cotton, or sugar in its natural condition, before it has been processed for use.

Renewable energy : Renewable energy is energy that is collected from renewable resources that are naturally replenished on a human timescale. It includes sources such as sunlight, wind, rain, tides, waves and geothermal heat.

Sludge : Sludge is a glutinous watery material produced during biological aerobic or anaerobic treatment of wastewater.

Small-scale farmers : Owner of the small holdings. FAO defines those who manage and agriculture on less than 1 hectare of land.