Geography Optional - 2024

CLASSICAL LOCATION PRINCIPLES

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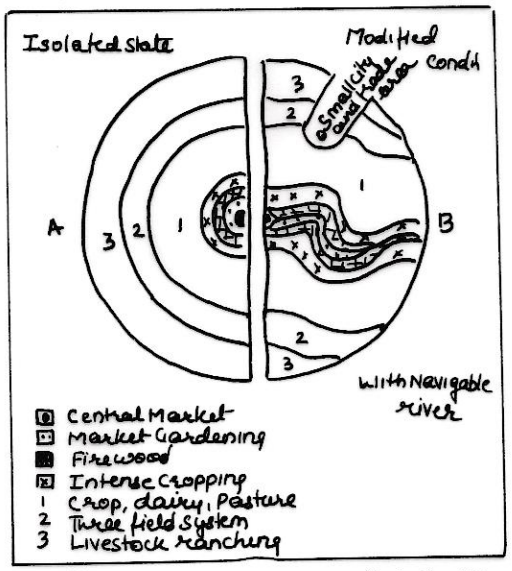
The Von Thunen Model is a theory fronted by 19th-century German economist, Johann Heinrich von Thunen which outlines an ideal state whose plan revolves around farming practices, focusing on a plan which would make farming most profitable. From the model, the economist was able to come up with a formula which he saw would make it possible for farmers to select an ideal location for establishing a farm, and which would maximize the farmer's profits. The equation used in the formula was L= Y (P-C) – YDF where L represents the location rent or the land value, Y represents Yield, P represents the Market Price of the produce, C represents the Production cost of the produce. Whereas D represents the Distance of the farm from the market, and F represents the Transport cost of the farm produce to the market. Johann Heinrich von Thunen conceived the model before the dawn of the industrial revolution before coal was used to fuel the industries. Johann envisioned an ideal urban plan where the sources of all the necessary provisions including grains, dairy, meat, and firewood, were located in regions surrounding a town. The model envisioned these regions as four rings which surrounded a central urban center, where different activities were undertaken in each of the four geo-economic rings.

The Von Thunen model of agricultural land use (also called location theory) was created by the farmer, landowner, and amateur economist Johann Heinrich Von Thunen (1783–1850) in 1826 in a book called "The Isolated State," but it wasn't translated into English until 1966. Von Thunen's model was created before industrialization and is based on the following limiting assumptions:



VONTHUNEN AGRICULTURAL ZONES

- The city is located centrally within an "Isolated State" that is self-sufficient and has no external influences.
- The Isolated State is surrounded by an unoccupied wilderness.
- The land of the State is completely flat and has norivers or mountains to interrupt the terrain.
- The soil quality and climate are consistent throughout the State.
- Farmers in the Isolated State transport their own goods to market via oxcart, across the land, directly to the central city. Therefore, there are no roads.
- Farmers act to maximize profits.

In an Isolated State with the foregoing statements being true, Von Thunen hypothesized that a pattern of rings around the city would develop based on land cost and transportation cost.

The Von Thunen Rings

The hypothetical state depicted in the Von Thunen Model was made up of four rings. Von Thunen came up with the arrangement to have an efficient system where the transportation of provisions required in the central urban center was efficient. The central urban region of the state represented the bull's eye of the rings. The innermost ring represented regions where dairy and horticultural farming would be best suited. Von Thunen argued that it was necessary that the location of the farms where these perishable commodities were cultivated be as close to the urban center as possible to avoid the spoiling of the produce while on transit. The next ring represented regions ideal for the production of firewood and timber, and therefore, the region would be made up of forests. In Johann's time (the 19th century), firewood was the main source of fuel for most industries as well as in domestic applications. Von Thunen thought that the source of firewood and timber also needed to be close to the urban center due to the logistical issues involved in the transportation of the bulky forestry products. The ring adjacent to the firewood ring represented extensive fields in which the large-scale farming of grains such as wheat would be practiced. The economist saw that since the grains were durable, not prone to spoiling, and were not bulky in transportation, the fields in which they were cultivated did not need to be close to the urban center. The outmost ring represented regions where ranching would be best suited to be practiced. The reason behind ranching being placed furthest away from the

urban center was because it was the economic activity which required the largest space (with forests being the notable exception) to be practiced. The economist also argued that ranchers did not to incur transportation costs since they walked their animals to the slaughterhouses situated inside the urban center.

H. Von Thunen's "model" remains relevant today primarily for the theoretical aspects that draw a direct connection between distance from market and profitability of product. Von Thunen noted the increasing costs of land the closer one got to a city, and postulated that the transportation costs associated with different agricultural products — taking into account the model's development prior to the full onset of the Industrial Revolution — would be determinative of the structure that would naturally emerge around the city. Assuming, as was one once reasonably could, that the city in question would lie in a largely empty space surrounded by great expanses of flat terrain, and that agricultural products, both animal and vegetable, would involve different costs to bring to market, with animal being the easiest, as they were self-mobile, then there was a certain academic logic to Von Thunen's model.

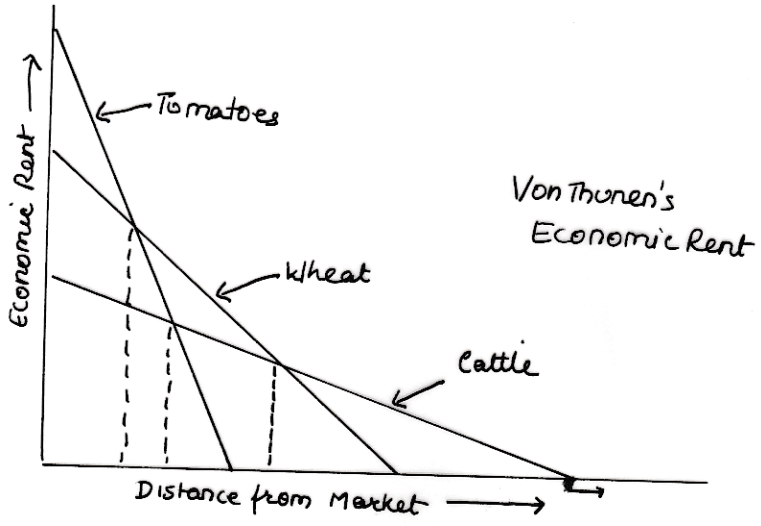
The relevance of the Von Thunen model to contemporary society remains broadly valid insofar as transportation costs continue to be determinative of some agricultural practices (see, for instance, the current "Buy Local" trend that emphasizes consumer purchases of locally-grown produce that didn't require fossil-fuel-burning means of transportation to arrive at market). The notion of concentric rings, however, was too convenient in the real-world of soil and climate considerations, and the fact of the majority of the world's population having settled within a couple of hundred miles of coastlines.

The basic principles involved in the model, though, remain valid. Transportation costs associated with agricultural products remain an important consideration, and land costs remain very much relevant to decision-making regarding myriad industries, the latter being directly responsible for the elimination of thousands of farms around the country that became increasingly encroached upon by ever-expanding metropolises. As land values increased in traditionally suburban areas due to demand for quality housing in such areas, the costs associated with agricultural activities became prohibitively high. Farmers couldn't afford the property taxes associated with quality land close to cities due to the latter's horizontal expansion.

In short, the Von Thunen model remains relevant today, but given the historical context in which it was formulated, its practical application is very limited.

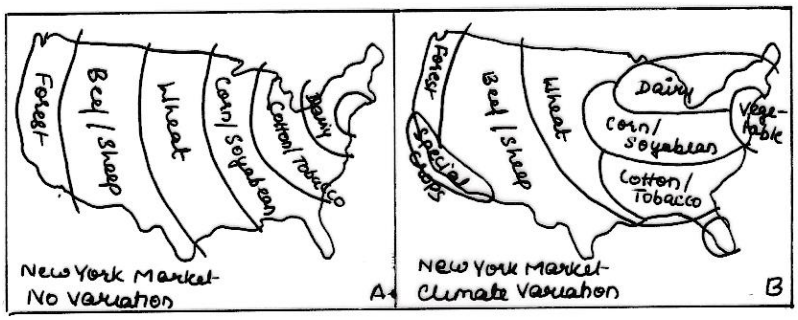
The von Thunen model of agricultural land use was developed in the pre-Industrialization era, and was a representation of the most efficient and economical use of land surrounding a metropolitan center, designed to maximize industry profit. The model consisted of four rings surrounding a central city – in the first ring were dairy farms and produce, things that could be quickly transported to market, where they could be sold fresh. The second ring consisted of timber – an important commodity which was difficult and costly to transport, thus earning it a position closer to the city. In the third ring was grown grains and other sweeping crops, placed further from the city because they had a longer lifespan than fresh produce and were lighter and easier to transport than lumber. Furthest from the city were ranches, placed so because animals may transport themselves into the city.

The model is based on many limiting assumptions – that the soil composition surrounding a city 360-degrees is uniform, that there are no geological anomalies such as mountains or rivers to disrupt the structure, that the city is indeed centrally, compactly located…there are many obvious shortcomings. And in our post-industrial society the shortcoming are even more manifold, due to the redistribution of jobs away from the agricultural sector and the emergence of the "suburb," among other obvious differences. It is easy to imagine that von Thunen's model would be obsolete in this day and age.



However, it still serves a prime example of the ideal distribution of land based on property cost and production. Alonso's bid-rent theory is based heavily on von Thunen's postulations on land rent costs for agricultural functions, work reflected in his model. The model lends itself well to modification, thus establishing itself as a jumping-off point for future models and arrangements.

The von Thunen model has weaknesses because it does not allow for things like roads or railroads that make it easier to transport goods over long distances. He also does not anticipate things like refrigerated transport that would allow even perishable things to be transported over long distances.



The von Thunen model is most relevant today in less developed countries. There, the development of transportation and food preservation is much less than in rich countries and von Thunen's model still applies to a greater degree. In the rich world, the model is also applicable in that it emphasizes that land near to cities is more expensive and therefore cannot really be used for uses that do not bring in a great deal of money per unit of land area.

Factors influencing the location of industries : Geographical and Non-Geographical Factors Many important geographical factors involved in the location of individual industries are of relative significance, e.g., availability of raw materials, power resources, water, labor, markets and the transport facilities. But besides such purely geographical factors influencing industrial location, there are factors of historical, human, political and economic nature which are now tending to surpass the force of geographical advantages. Consequently, the factors influencing the location of industry can be divided into two broad categories i.e.

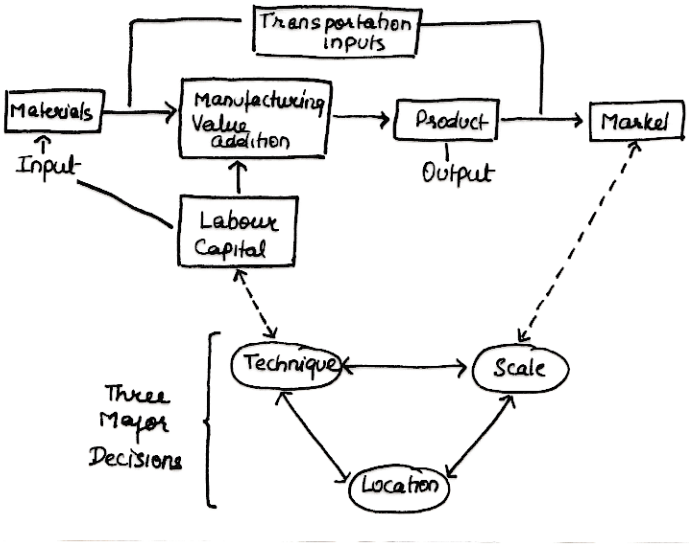
Geographical Factors:

Following are the important geographical factors influencing the location of industries.

Raw Materials: The significance of raw materials in manufacturing industry is so fundamental that it needs no emphasizing. Indeed, the location of industrial enterprises is sometimes determined simply by location of the raw materials. Modem industry is so complex that a wide range of raw materials is necessary for its growth. Further we should bear in mind that finished product of one industry may well be the raw material of another. For example, pig iron, produced by smelting industry, serves as the raw material for steel making industry. Industries which use heavy and bulky raw materials in their primary stage in large quantities are usually located near the supply of the raw materials. It is true in the case of raw materials which lose weight in the process of manufacture or which cannot bear high transport cost or cannot be transported over long distances because of their perishable nature. This has been recognized since 1909 when Alfred Weber published his theory of location of industry.

Some of the industries, like watch and electronics industries use very wide range of light raw materials and the attractive influence of each separate material diminishes. The result is that such industries are often located with no reference to raw materials and are sometimes referred to as 'footloose industries' because a wide range of locations is possible within an area of sufficient population density.

Power: Regular supply of power is a pre-requisite for the localization of industries. Coal, mineral oil and hydro-electricity are the three important conventional sources of power. Most of the industries tend to concentrate at the source of power. The iron and steel industry which mainly depends on large quantities of coking coal as source of power are frequently tied to coal fields. Others like the electro-metallurgical and electro-chemical industries, which are great users of cheap hydro-electric power, are generally found in the areas



of hydro-power production, for instance, aluminum industry. As petroleum can be easily piped and electricity can be transmitted over long distances by wires, it is possible to disperse the industry over a larger area. Industries moved to southern states only when hydro-power could be developed in these coal-deficient areas. Thus, more than all other factors affecting the location of large and heavy industries, quite often they are established at a point which has the best economic advantage in obtaining power and raw materials.

Labor: No one can deny that the prior existence of a labor force is attractive to industry unless there are strong reasons to the contrary. Labor supply is important in two respects (a) workers in large numbers are often required; (b) people with skill or technical expertise are needed.

Transport: Transport by land or water is necessary for the assembly of raw materials and for the marketing of the finished products. As industrial development also furthers the improvement of transport facilities, it is difficult to estimate how much a particular industry owes to original transport facilities available in a particular area.

Market: The entire process of manufacturing is useless until the finished goods reach the market. Nearness to market is essential for quick disposal of manufactured goods. It helps in reducing the transport cost and enables the consumer to get things at cheaper rates .It is becoming more and more true that industries are seeking locations as near as possible to their markets; it has been remarked that market attractions are now so great that a market location is being increasingly regarded as the normal one, and that a location elsewhere needs very strong justification. Ready market is most essential for perishable and heavy commodities. Sometimes, there is a considerable material increase in weight, bulk or fragility during the process of manufacture and in such cases industry tends to be market oriented.

Water: Water is another important requirement for industries. Many industries are established near rivers, canals and lakes, because of this reason. Iron and steel industry, textile industries and chemical industries require large quantities of water, for their proper functioning. Also it requires 36,400 litres of water to produce one kwh of thermal electricity. Further, it is worth noting that water used in industries gets polluted and is therefore not available for any other purpose.

Site: Site requirements for industrial development are of considerable significance. Sites, generally, should be flat and well served by adequate transport facilities. Large areas are required to build factories. Now, there is a tendency to set up industries in rural areas because the cost of land has shot up in urban centres.

Climate: Climate plays an important role in the establishment of industries at a place. Harsh climate is not much suitable for the establishment of industries. There can be no industrial development in extremely hot, humid, dry or cold climate. The extreme type of climate of north-west India hinders the development of industries. In contrast to this, the moderate climate of west coastal area is quite congenial to the development of industries.

Non-Geographical Factors:

Now-a-days alternative raw materials are also being used because of modern scientific and technological developments. Availability of electric power supply over wider areas and the increasing mobility of labor have reduced the influence of geographical factors on the location of industries. The non-geographical factors are those including economic, political, historical and social factors. These factors influence our modern industries to a great extent. Following are some of the important non- geographical factors influencing the location of industries.

Capital: Modem industries are capital-intensive and require huge investments. Capitalists are available in urban centres. Big cities like Mumbai, Kolkata, Delhi, and Chennai are big industrial centres, because the big capitalists live in these cities.

Government Policies: Government activity in planning the future distribution of industries, for reducing regional disparities, elimination of pollution of air and water and for avoiding their heavy clustering in big cities, has become no less an important locational factor. There is an increasing trend to set up all types of industries in an area, where they derive common advantage of water and power and supply to each other the products they turn out. The latest example in our country is the establishment of a large number of industrial estates all over India even in the small-scale industrial sector. It is of relevance to examine the influence of India's Five Year

plans on industrial location in the country. The emergence of suitable industries in south India around new nuclei of public sector plants and their dispersal to backward potential areas has taken place due to Government policies.

The state policy of industrial location has a greater hand in the establishment of a number of fertilizer factories, iron and steel plants, engineering works and machine tool factories including railway, shipping, aircraft and defense installations and oil refineries in various parts in the new planning era in free India.

Industrial Inertia: Industries tend to develop at the place of their original establishment, though the original cause may have disappeared. This phenomenon is referred to as inertia, sometimes as geographical inertia and sometimes industrial inertia. The lock industry at Aligarh is such an example.

Efficient Organization: Efficient and enterprising organization and management is essential for running modem industry successfully. Bad management sometimes squanders away the capital and puts the industry in financial trouble leading to industrial ruin.

Bad management does not handle the labour force efficiently and tactfully, resulting in labour unrest. It is detrimental to the interest of the industry. Strikes and lock-outs lead to the closure of industries. Hence, there is an imperative need of effective management and organisation to run the industries.

Banking Facilities: Establishment of industries involves daily exchange of crores of rupees which is possible through banking facilities only. So the areas with better banking facilities are better suited to the establishment of industries.

Insurance: There is a constant fear of damage to machine and man in industries for which insurance facilities are badly needed.

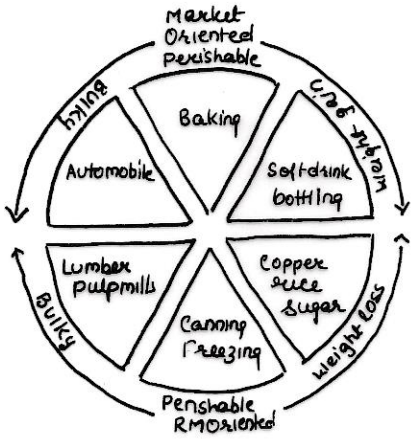
LOCATION MODELS

For the greater part of the twentieth century, geographers depended on theory to explain manufacturing patterns developed at a time when industrial processes displayed rather straightforward ties to raw materials and markets. Today, this work still serves us well as a point of departure for understanding manufacturing location, even though the scale and location of operations respond to far more complex forces. In fact, the location of traditional manufacturing processes involved with the refining of mineral resources, can still best be accounted for using classical approaches.

Generally speaking, classical industrial location theory assumes **perfect competitio**n among firms wherein no firms experience monopoly advantages arising from a particular location. Each firm is further assumed to have similar production costs. Some classical theories are discussed below allow for **imperfect competition**. Imperfect competition occurs when an oligopolistic or monopolistic situation exists, which provides some firms with an overwhelming advantage, thus giving them a chance to drive competitors out of the market. An oligopolistic situation occurs when a few firms significantly influence but do not necessarily control the market. Under a monopoly the demand and supply functions play a minimal role in determining market conditions. Rather, the market is manipulated and controlled by the monopoly firm(s). In addition, the locational constraint that exists in the situation of perfect competition becomes less important under the condition of market imperfection.

Least Cost

Least-cost industrial location theory dates back to 1909 with the publication of a book on the topic by Alfred Weber. Weber simplified real-world situations by making three assumptions in developing his theory. First, he assumed that raw materials occur at only a few locations. Second, he assumed that the market existed only at specific places. Third, he assumed that the labour supply was immobile and available only at several specific locations, but having an unlimited supply at a specific wage level.



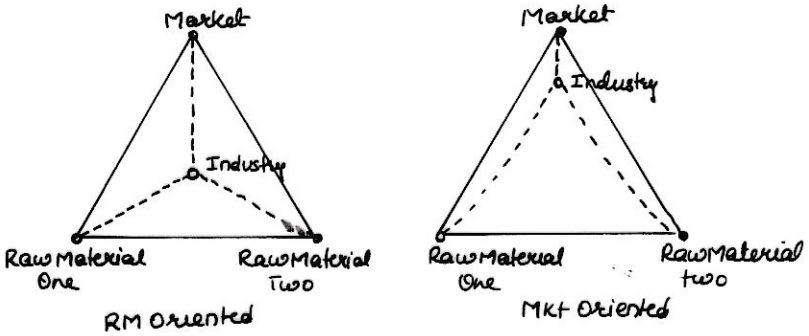
Weber distinguished between weight-losing (gross materials) and non-weight-losing (pure materials) industries in order to determine minimum-cost locations.

A further distinction between localized materials (restricted availability) and ubiquitous materials (available everywhere) also assisted in the determination of an optimum location.

According to Weber, the least-cost location for industry occurred near the market when manufacturing processes used commonly occurring materials. An example is the use of locally produced limestone for the manufacture of cement. In this situation, a market location eliminates unnecessary transportation costs. At the other end of the spectrum, raw material industrial locations predominate when limited alternative sources of material exist such as the mineral-processing activity.

The Weber least-cost location formulation suggested that firms located either at the **raw material site** or near the **market** in order to minimize distribution costs. Weber assumed that transportation costs varied according to weight and he did not discuss variations according to the stage of production. Later, the transportation cost concept was refined by others to distinguish between raw material and final product transfer costs. Hoover, for example, noted that raw material shipment rates often fell below those of finished goods due to increased fragility and higher packing and hauling costs for manufactured items. Higher final product transportation costs then came to be recognized as important factors encouraging market locations.

Using the Weber approach to plant location, one can argue that intermediate plant locations between the raw material and market locations are undesirable because they induce higher costs of production due to the effect of increased freight-rate changes. It seems that two short hauls, which an intermediate location requires are more expensive than one long trip, due to the variation in the proportional impact of **fixed costs** and **variable costs** on transportation.



Fixed costs refer specifically t the terminal costs incurred in maintaining such facilities as ports, rail-road stations and airports. These costs are largely fixed since they are not directly

related to the level of movement and cannot be allocated readily to specific users. An increasing use of terminal facilities as well as of capital equipment (trucks, railroad cars, etc.) results in decreased average fixed costs.

Variable transportation costs are over-the-road costs which increase with the level of movement and can be allocated specifically to users. Some examples include wages, fuel, wear and tear of capital equipment, and tolls, which generally increase with distance. Route maintenance costs may also be regarded as variable costs since these are directly related to traffic volume.

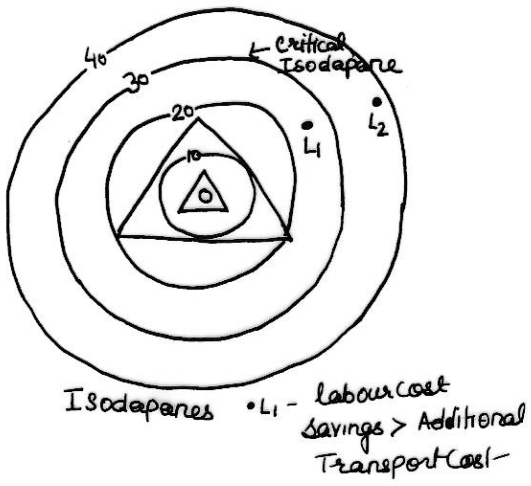
Total transport costs – the combination of fixed and variable costs – are curvilinear rather than linear functions of distance. This curvilinearity is caused by scale economies in long-haul transport which make it possible to average fixed costs over longer distances. The fixed-cost component for each mode varies greatly and once the fixed costs are accounted for by large movement, the increments in variable costs are very slight with increasing distance.

One circumstance that does encourage intermediate manufacturing locations occurs with **break-of-bulk** sites. 'Break-of-bulk' refers to the transfer of product from one mode of transportation to another at locations where the mode of transportation changes. Since reloading is required at such places, including ocean port terminals and river/rail junctions, producers often establish manufacturing facilities at these break-of-bulk locations.

Substitution

Several locational analysts in the Weber tradition have synthesized location theory into a general framework in the face of increasing complexity. Isard, for example, incorporated all relevant locational and spatial factors into a general theory of the space economy. He considered all the costs of inputs and outputs over time and space as well as selling prices in order to create a more generally theory.

Isard's **spatial equilibrium through substitution** approach allows for substituting any of the factors in the production process, not just transportation. Cheap coal might be



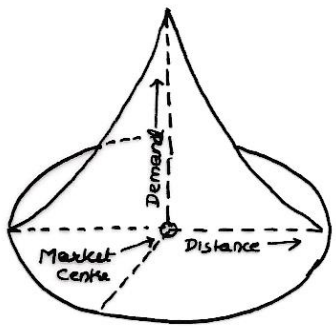
exchanged for higher-cost natural gas in determining an optimum location for one firm, while another might respond to changing costs by adjusting the mix of its output. In general, Isard grouped location factors into three categories: (1) transfer costs, (2) labour, power, tax costs, and so on; and (3) agglomeration economies and diseconomies. The latter factor reflects the advantage offered by urban areas in the cheaper provision of services and information. These savings are somewhat offset by the increases in cost of other factors, referred to as diseconomies.

Profit Maximization

An alternative to the Weber least-cost location approach was provided by Lösch, who applied the **profit-maximization** approach to the industrial location problem. The central theme of the Lösch theory is that industrial location is characterized by conditions of monopolistic competition, not perfect competition as envisioned by Weber. Lösch indicated that firms locate so as to maximize revenues, not necessarily at locations having the least cost. By avoiding an emphasis on production costs, such firms can concentrate on sales and the market demand.

Market access is the major location consideration for firms according to the maximum-profit theory. When a relatively uniform demand exists for a product, firms locate in the centre of this demand. Lösch developed the notion of a **spatial demand cone** to demonstrate this approach. The demand cone indicates that the quantity demanded decreases with distance from the center of the market.

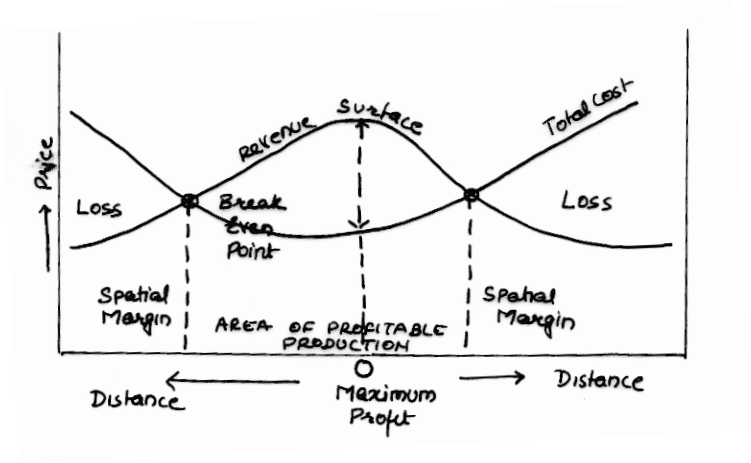
One problem, with Lösch's approach is that markets for products do not occur in isolation as they overlap. Location equilibrium between a firm and its market therefore rarely occurs using the profit-maximization philosophy because as more firms appear, profits are eroded and optimal location circumstances change.



Spatial Demand Cone – Losch

Spatial Margins : Manufacturing location theory approaches that emphasize least-cost production fail to consider market demand, and similarly, market demand approaches ignore the production side. To overcome these narrow approaches, the **spatial margins** perspective combines features from both the production and revenue sides. Smith and others argue that this approach is more realistic, as it

allows for locational flexibility within a range defined by the intersection of space cost curves (SCC) and space revenue curves (SRC). In this example, which evaluate costs and revenues for a steel mill operation in Itabirits, Brazil, distances from Rio de Janeiro, the market, are shown on the vertical axis. At all locations within the shaded area between the SCC and SRC curves, profitable sites occur for the mill. These site possibilities expire at A and B, the spatial margins for profitable steel facility locations. The actual steel plant location at Itabirits, 600 miles from Rio, occurs near the optimal profit location.



A problem with the spatial margins approach is that costs and revenues for a firm are rarely linear as indicated here. It is much more likely that market demand factors are not uniform with distance, due to income and taste and preference variations. The impact of advertising and mass-media exposure further complicates demand factors. But the advantage of this approach is that it combines market demand and production cost variabilities. The problem is also simplified by the fact that only a linear market is considered. Increased competition would change the situation, as could the interaction between supply and demand and economies of scale.

Interdependence

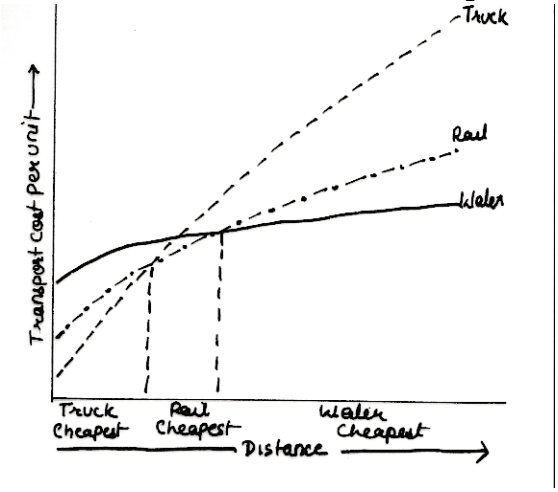
As the scale of industrial production has increased so has **interdependence** among firms. The interaction level of the firm with the external environment has also increased. Such factors include a diverse array of circumstances: the role of labour unions, government, changing trade policies, import-export restrictions, embargoes, growing environmental consciousness, ideological differences and economic factors, including monetary policy, interest rates, and inflation. The interdependence of firms can best be accounted for in a systems framework because it includes the operating units (firms) and their relationships with one another and the external environment.

One manifestation of the increased interdependence characterizing manufacturing activity today is the ever-lengthening chain of processing, fabricating, and assembly between the raw material and marketing strategies. In some cases, single firms control all the stages in this process through **vertical integration**, but in other instances, complex ties have evolved between suppliers (subcontractors) and producers that make them very dependent on one another. An instance of this situation is the large subcontracting industry that has evolved in the automobile industry in the United States and Japan. The greater Detroit area provides this function in the United States, while the Nagoya area of Japan serves a similar function for Toyota and Tokyo for Nissan. In northern Ohio and southern Michigan, highly skilled and sophisticated automotive-linked firms keep in close contact with major automobile corporation design teams to keep abreast of changes and provide rapid adjustments in the component parts required by model specification changes. These information and supply linkages remain very strong and have helped maintain the dominance of Detroit in the industry.

Forward and **backward** linkages also stabilize manufacturing operations by enhancing marketing (forward linkage) and production (backward linkage) economies. Automobile producers exhibit both of these tendencies. Labour supply linkages are another form of connections that exist in areas requiring a skilled on unskilled labour pool, whichever is the case.

Other types of linkages also encourage interdependence, not among producers, but between firms and their external service providers. Firms using the same support infrastructure, such as that found in an industrial park, illustrate a **commensal linkage**, as has been noted in the retail service industry. In such situations, trucking, warehouse, computer, and financial support service mechanisms, among others, can exert strong locational ties among businesses occupying a common setting.

From a demand or revenue perspective interdependence occurs in the form of **competitive marketing**. Manufacturers in competition with one another often consider the location of other producers because their sales level can be adversely affected by the presence of nearby competitors. Hotelling developed a classic location



strategy that two firms might follow when choosing locations. It is presumed that these firms are free to move and sell identical products to a market, providing a consistent demand. A perfectly competitive market is assumed to exist in the area and no firms act in collusion with one another. These circumstances yield a stable location for these firms back to back at the center of the market, with each serving customers to one side. With any other location, one firm could move and capture a greater market share than the other. For example, in case B, with each firm having a quartile location, each shares half the market, but one firm could move closer to the other and claim a larger market share because each would dominate all the area nearest it and split the market in between. For situations involving three, four or more firms, equilibrium locations change, but they do exist, assuming no collusion.

Industrial Complex

Firms supplying raw materials or consuming by-products from one another can also benefit from locations in close proximity. Such a circumstance is illustrated by an **industrial complex** and a **territorial production complex**. The industrial complex is an example of linked firms clustering together to create their own cost competitive environment. The petrochemical complex on the U.S. Gulf coast illustrates this situation. About 30,000 persons in the New Orleans area directly employed by these industries, consisting of more than 40 firms producing chemical and oil products in the New Orleans area alone. The Carolina Piedmont industrial crescent, within which numerous textile mills and their suppliers, including synthetic fibre chemical plants and machinery assemblers, have blossomed around a textile core, is another example of an industrial complex.

In developing the notion of the industrial complex, Isard linked the Weber least-cost approach to the analytical completeness of **input-output analysis** to show interfirm linkages and monetary flows. Input-output analysis, developed by Leontief in the 1940s, monitors the flows of goods and services in an economy. Sales and purchases among all activities are assumed to be confined to a closed system in this model such that total purchases (inputs) are equal to total sales (outputs). One of Isard's early studies dealt with the potential for establishing a petrochemical complex in Puerto Rico. It was determined that Puerto Rico had a labour cost disadvantage for the petroleum-chemical combination in comparison with the U.S. Gulf coast.

But when a textile industry combine was added to the petrochemical facility, the Puerto Rican disadvantage disappeared, illustrating the fact that a larger integrated facility can be more efficient than a smaller, simpler operation.

The synergism created by the linkages among related activities creates remarkable diversity in output for many manufacturing regions. Petrochemical areas are perhaps the best example. In addition to the affinity of pharmaceutical, chemical, plastics, and rubber industries to such areas, many also have nonferrous metal processing firms, fertilizer plants, and other users of sulfuric acid, clustered together to use by-product materials and gases. Similarly, a tendency exists for synthetic fiber producers, textile firms, and power plant facilities to locate in petrochemical areas. Advantages accrue to these firms from the cogeneration of power and the use of similar production technologies.

Central Place Theory

Central place theory, developed by Christaller, also provides a framework for explaining the location of industry, even though its major contribution has focused on the explanation of the location of tertiary activities. Firms with widely dispersed branch plant locations in various sizes of cities can best be accounted for with central place theory. Many industries deal with products that can be produced in both large- and small-scale plants and are found in all sizes of communities in direct proportion to their population. Typically, these industries have relatively high transportation costs and their products have a low value per unit of weight, or else perishability considerations require dispersed locations. The dispersed locations of soft drink bottlers in various sizes of cities demonstrate this principle.

The concept of threshold also assists in the explanation of manufacturing locations. Threshold refers to the minimum market size required to support an activity in terms of sales level. Manufacturers serving a local market are particularly sensitive to this minimum-market-size requirement. Food and beverage processors such as bakeries and soft-drink bottlers can operate successfully only in cities where a minimum threshold market size for that activity exists.

Larger cities provide access to larger markets and often support larger-scale operations of similar firms, as noted above, as well as those of firms having a larger threshold level. Beer

production, for example, involves a greater entry threshold than that of a soft-drink bottler. Book publishing is an extremely high threshold industry associated with a very few large firms located in only the biggest cities, such as London, Tokyo or New York.

Critique of Classical Theory

Weber's and Lösch's work, from the early twentieth century, speaks most directly to the location of firms having far simpler locational ties than those experienced by many modern corporations. The emphasis in both approaches is on economics. They are deterministic theories that prescribe a specific, fixed location for firms. They do not anticipate the impact of complicated noneconomic forces – or the large multifunction, multinational conglomerate firms of today that can create their own markets and infrastructure by internalizing many operations. For these reasons, classical theory has been supplemented with more realistic behavioural and structural theory alternatives that attempt to identify more closely with the present business climate, recognizing that firms face more uncertainty, incomplete knowledge, and more interdependence with government and foreign competition than acknowledged with the classical approach. These approaches allow for many goals other than minimizing costs or maximizing profits.

Contemporary Behavioural and structural approaches

Geographers have increasingly turned toward an analysis of the ownership, organizational structure, and management objectives of the firm when studying industrial activity in response to the inadequacy of traditional explanations of firm behaviour. This behavioural approach emphasizes the dynamic and uncertain environment in which firms operate. It has grown out of the awareness that today's larger and more diversified multinational firm exerts greater control over its business environment.

The behavioural approach also has limitations. It fails to take into account the impact of the political and social environment in which these decisions are being made. The structuralist approach overcomes this weakness by attempting to explain behaviour using a historical-political perspective. The **structural approach** looks at the political economy of economic development in its broader context, encompassing regional development processes, urbanization/suburbanization, and technological innovation. It often follows a Marxist

orientation, with its emphasis on location as a consequence of historical and structural conditions governing the utilization of capital allocation or investment over space by firms.

Behavioural Location Theory

By focusing on firm decision-making processes, the behavioural approach provides an alternative perspective on the role of industrial location to the firm. Not surprisingly, the specter of alternative locations often appears to be rather low on the list of options facing a firm, especially in the short run. Many firms are uncertain and defensive in their behaviour, which leads them to be very conservative and consider a shift in the location only as a last resort. Other options more frequently utilized include changing the firm's organizational and management structure, changing the product mix, or diversifying output.

Even in the long run, firms often implement de facto locational decisions rather than wholesale shifts. Frequently, this process simply involves on-site expansion. In other cases indirect locational strategies involve closures or establishing branch locations. Stafford has indicated that a **spatial increment model** can be useful to account for the behaviour of firms. Typically, firms first locate branches just beyond the previous operating realm. In other words, they place branches no further away than necessary, typically within a 200-mile distance, which is a one-hour trip for a corporate jet.

Diffusion Model:

The spread of a phenomenon over space and through time is known as diffusion. The main objective of diffusion model is to account for the dispersal of cultural traits, agricultural practices, crops, and disease from a given region. It was Sauer (1941) who advocated the approach of diffusion model in cultural geography.

The diffusion model advocated by Hagerstrand may be applied in the adoption of an agricultural innovation. Information about an agricultural innovation may be diffused either by personal contact or technological means of communications. The adoption and imitation of new agricultural technology varies over space and time owing to the physical, socioeconomic and cultural barriers. However, personal contact plays a vital role in the adoption of an innovation.

Apart from distance decay the innovations are diffused step by step. In fact, the educated, progressive big farmers adopt an innovation first while the small farmers with orthodox attitude adopt them slowly. The risk taking capacity differs from large to small farmers and that also hampers the adoption of innovations by the small and marginal farmers.

Uncertainty

In the face of uncertainty, firms often strive to internalize more of their operations – partly as a defense mechanism. This process can lead large multiregional and multiproduct firms to acquire their own material sources and even manipulate the market for their goods. The scale of such operations can broaden to include a multinational presence, allowing firms to control more resources than a host country. By developing vertical integration, firms remove many unknowns but still face coordination and forecasting problems relating to the demand for their products.

Vertical integration in fact reduces a firm's vulnerability to business cycle changes, making the firm more like a diversified conglomerate. Vertically integrated firms tend to stabilize market conditions because output at every stage can be coordinated with market demand conditions.

The growing scale of industrial operations, the amount of capital commanded, and the leverage that such firms exert over their external environment have become important factors in world industrial geography. The number of firms with more than $1 billion sales in the United States in 1977 was 242 or 15 more than in 1976. From another perspective the concentration is even more dramatic. In the United States, 500 firms now control four-fifths of the manufacturing assets.

The increasing scale of firms leads to higher thresholds of entry for competitors. It also means that a greater quantity of industrial activity in a local area is controlled from the outside. Such externally controlled firms may not be as involved in the local economy in terms of making purchases from local suppliers, nor be as responsive to local civic and business needs. One study of industrial firms in Israel, for example, indicated that medium-sized plants (employing about 350 persons) would be better for the growth of a local economy than large ones because the former are not large enough to internalize sources of supply and services. Therefore, medium-sized firms patronized local businesses more often than did larger ones.

Corporate acquisitions provide an excellent means to expand and solidify external control for the firm. Sometimes this control even leaves the country, following acquisition. Foreign control, for example, has long been a concern in third-world countries. Even in highly developed areas such as Canada and Australia, foreign domination is an issue. Frequently, administrative control flows to major metropolitan areas as growth occurs. The case of New York provides a good example of the concentration of international industrial corporate headquarters in a major financial center. Similar processes have increased the importance of Toronto in Canada and Tokyo in Japan.

Business decisions of a firm result from corporate strategies that may or may not be related to profit maximization of least-cost locations or other classical motivating factors. Other goals could be to increase the market share, drive out the competition, enhance producer diversity, or simply increase the security of the firm's management by promoting growth.

Some researchers suggest that industrial behaviour is governed as much by **risk minimization** as by cost accountability. The uncertainty associated with risk can generally be reduced by concentrating operations in larger urban areas because of greater access to supporting services and professional advice, as well as easier access to markets. Uncertainty normally increases with distance from urban areas because access to the stabilizing factors just described decreases. Uncertainty also encourages firms to maintain smaller plant sizes. In centrally planned economies, uncertainty is minimized by eliminating firm competition. Some observers say that this helps explain the weaker tendency for concentrating activities closer together in planned environments.

As a defensive measure, firms often make 'safe' choices by selecting locations near other firms producing similar products, rather than by dispersing. For example, rival cereal manufacturers clustered in Battle Creek, Michigan (Kellogg's and Post). The potential for learning the competitor's secrets and creating an atmosphere of intimidation and bluff is reinforced when firms are in close proximity, which in turn enhances market competitiveness and innovation. A certain **pooling of reserves** also occurs in such locations. This concept refers to the greater likelihood of a successful divestiture of buildings and equipment for firms located

in existing urban industrial locations should potentially adverse future business conditions dictate closing the business.

Operating Environment

For many industrial firms a core region exists within which most operations are conducted. That area has been described as the **task environment** for the firm. It is the territory the firm calls its home, the territory that it knows well. It is the area 'identified with the company'. The region can exist at two or more levels. First, at the executive network level, the corporate administrative realm deals with management decisions. This network may include other major firms, financial and legal consultants, as well as the board of directors. Research and development operations frequently accompany the headquarters administrative function. Often this interaction occurs around a major national headquarters city, such as New York, Tokyo or Paris.

A second type of linkage is that which exists between the core region and subsidiary production plants in the periphery. Branch operations located remotely from the headquarters typically maintain strong communication linkages between the production center and the headquarters office, as well as between the production facility and its suppliers. Once these contact patterns are established they reinforce existing locational ties between the core and periphery.

Plant Location Decisions

The location decision process facing firms typically involves top management personnel choosing among alternatives following a thorough review of information available to them, which includes data on firm operations, forecasts, and their own opinions and preferences. Such decisions are necessarily judgmental but they are informed, logical, and rational, if not optimal, given the complexity of the issues involved.

The necessity to relocate to new sites occurs in only about 40 percent of the cases where location decisions are involved, because most decisions (60 to 80 percent) involve on-site expansion. When the need to move does occur it is undertaken to solve a problem and needs to be exercised smoothly and efficiently. Top management decision makers like to avoid detailed and difficult analysis and protracted negotiations in these circumstances. Although the process

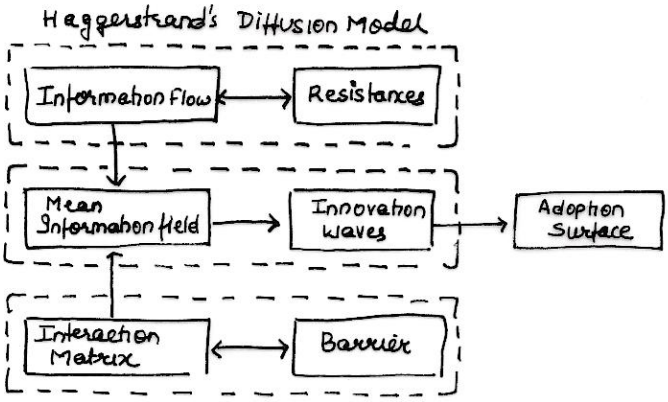
does not necessarily entail crisis management, it is likely that an atmosphere of stress does exist during this process. The pressures facing executives contemplating locational changes are very difficult to evaluate because so many subjective decisions are necessary in terms of both internal operations of the firm and its environment. Smaller firms can potentially do a better job in this assessment process than larger ones because they have simpler external ties with other firms (supplies and customers).

As mentioned earlier, the location decision can take various forms, ranging from on-site expansion or closure to partial movement of operations, establishing branches, or even moving the entire operations. Quantitative adjustments in the size of the firm can be made relatively frequently. Mergers, acquisitions, and decisions to build branch plants involve location decisions that are also undertaken relatively more frequently than complete firm transfers. When complete firm transfers occur, they normally involve only short-distance shifts. A sample survey of firms in the plastics industry in Great Britain, for example, found that the median distance of a complete transfer move was 13 miles, whereas the median for the establishment of a branch plant was 179 miles, and 128 miles for acquisition. These findings reinforce the notion that **locational inertia** is indeed a strong factor and that once the roots of a firm become deeply entrenched in an area, complete relocations is rare.

The organizational structure of the firm can affect company expansion policy. Family-owned firms, which accounted for 42 percent of the top 108 U.S. corporations in the early 1970s, often prefer branch plants as an avenue for expansion. In contrast, professionally managed, publicly owned firms, such as General Motors, typically prefer acquisition as a growth prospect. Branches have the advantage of maintaining the family influence factor, while acquisitions appeal to corporations that must maintain a strong profit posture for their stockholders.

Branch plants frequently produce standardized, mass-produced, assembly line items that do not require highly skilled labour. Typically, the production of more specialized products continues in established facilities. Branch operations do not require close top-level communications with headquarters locations and offer lower costs of production, as they can operate in lower-labour cost locations. Dispersed branch facilities might handle mass-marketed consumer products for a firm, while special-order industrial machines and equipment remain

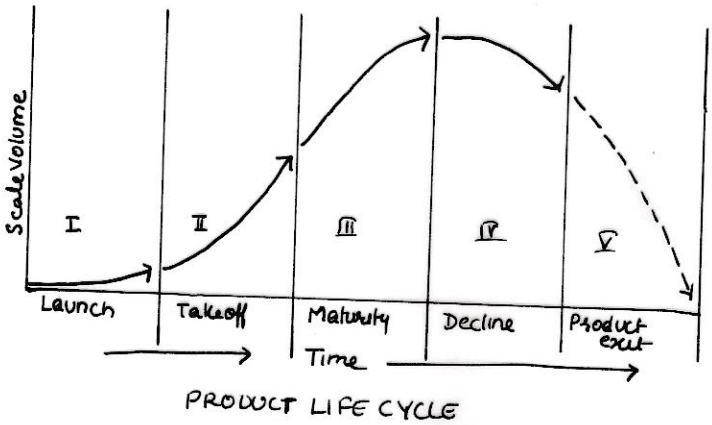
competitively produced at traditional sites. The dispersion of home-air-conditioning-unit production away from the manufacturing belt in the northeastern United States to sunbelt plants provides an example of this split. Output of larger, more specialized commercial and industrial air-conditioning units remains tied to traditional production areas in upstate New York, Pennsylvania, and Ohio.



Branch plants often gravitate to rural environments that have lower land and labour costs. Much of the decentralization of the U.S. machinery industry to the south in the 1970s can be explained in this context. This situation helps explain why manufacturing growth in non-metropolitan areas expanded more rapidly in the United States in recent years than in metropolitan areas, particularly for traditional activity not associated with the high-technology revolution. When choosing new locations, firms typically follow a three-step process that begins with regional assessments, followed by more localized city-by-city comparisons and finally, site level decisions.

Product Life Cycle

Changes in manufacturing patterns due to births and deaths can dramatically affect the distribution of activity over time. Using the product life of the firm concept, one can observe not only patterns of spatial change in industry, but structural changes as well. The product-life-cycle concept refers to the birth, growth, and death of products. Several stages in the life of a product can be depicted through a graph. An S-shaped curve generally captures the growth and decline of the product, which is not unlike a



diffusion process. Phase 1 of a product launch typically involves slow sales following its commercial introduction into the market place. In phase 2 growth increases rapidly, followed by a maturing stage in phase 3, followed by a decline in phase 4, and a withdrawal (decline) of the product in phase 5. Each product would obviously have a different experience in the market place – some with much longer life spans than others. Among the variables influencing its longevity would be the size and stability of the market served, the degree of 'innovativeness' of the product, the rate of technological change that affects its use, and its ability to adapt to new applications.

Studies of the product cycles have relevance not only for sales and marketing but also for evaluating economic development processes and structural changes in economies. One aspect of product development on which these studies focus attention is **research and development**. Although the role of development on product life is not well understood, it has become important in innovations in high-technology activity in recent years.

In marketing terms, a similar developmental scenario can be observed for a product. In the early or launch phase of the product strong competition occurs with other products and firms. Many widely dispersed companies often manufacture a product in its formative years. Some producers enter a field as a sideline pursuit. During the takeoff stage, a producer gains market share and the market itself grows in size. Typically, a consolidation in the number of firms producing the product occurs in the stabilization phase. Over time, most producers are typically forced out of business or merge, leaving only a few producers in a few locations. Some products pass through these phases in a few years to a decade, while others evolve over a period of 20 to 50 years.

Just as a sifting out of firms and locations occurs in the early phase of product development, another locational dynamic encourages dispersion of facilities in later phases. The emergence of a few dominant manufacturers often leads to the decentralization of plants to many locations to take advantage of production cost and distribution savings. This dynamic arrangement demonstrates an **hourglass effect**. The automobile industry in North America provides a case in point.

Early locations of automobile producers exhibited wide dispersion. Some early participants were wagon and buggy makers, while others were machine tool businesses. Gradually, the small, weakly managed, weakly financed, and poorly located firms faltered, especially those not offering cars with gasoline engines (steam, electric) and a centralization, gradually occurred. This consolidation of the industry unfolded in the 1910-1940 period, mainly around Detroit. The creation of many branch body assembly plants throughout the country followed World War II. Three parent firms (General Motors, Ford, and Chrysler) fostered this development, whereas dozens of firms accounted for the original dispersed pattern. This dispersion-concentration-dispersion process also characterizes many other industries. It amplifies the importance of branch plants in serving local and regional markets as an industry matures and becomes dominated by a few companies.

One manifestation of product-cycle changes visible on the landscape today is the transition to a post-industrial society. This shift continues to involve significant plant cutbacks in 'smokestack' industries in all developed countries. In most countries, this shrinkage has involved a downsizing of the workforce, but in the United States, newer jobs are being created faster than the smokestack loss. Small and medium-sized businesses are leading this expansion, not large firms. Some of the jobs are innovative high-technology activities, but most are low-technology or no-technology businesses. Many new jobs are not occurring in the manufacturing sector at all, but in service-related businesses such as restaurant employment.

Some observers argue that employment is growing rapidly in the United States because it has successfully shifted its economy to a strong entrepreneurial base that rewards risk and innovation. The plentiful availability of venture capital, a relatively low inflation rate, and stable political environment also favour this expansion. By the mid-1980s, this dynamism in the United States exceeded that in western Europe and appeared much more vibrant than the expansion in Japan.

Structural Approach

The structural approach to industrial location focuses attention on the political economy of economic growth and its impact on industrial location. Advocates examine the cause of economic growth and technological innovation starting with a broad top-down view of the

economy rather than one focusing on the firm and its environment. A complex organizational structure for industry is assumed, one that strongly influences firm behaviour. Conditions in the free-market economy that influence the firm, for example, include the profit motive and a high level of competitiveness.

From a Marxist perspective, the structuralist arguments suggests that competitive processes lead 'to a fall in the general rate of profit, forcing firms to find whatever means may be available to keep up profits and accumulate capital in the interest of survival.' Massey and Meegan, for example, studied problems associated with the electrical engineering industry in Great Britain in the late 1960s from this perspective. That industry, best with excess capacity, faced eroding profits. This in turn led to cost cutting and plant closures to reinstate higher profit levels. Less productive units shut down to lower overhead costs. Labour costs savings accrued by moving plants to cheap-labour locations and the introduction of more efficient standardized production techniques. This process in turn decreased skill-level requirements in the workplace and led to a disenfranchisement of labour. Many skilled jobs disappeared and those that remained led to the assignment of skilled workers to caretaker work no longer requiring their skills, due to the introduction of computer-controlled machine tools and product standardization. We can use the term **de-skill** to describe this process of downgrading work assignment due to the obsolescence of skilled labour.

The Marxian theory that crisis and cyclical instability such as that discussed in the preceding paragraph operate as normal capitalist processes plays a central theme in the overall structuralist argument. According to this thinking, as capital accumulation occurs, dysfunctions accumulate, creating a crisis of overproduction. Overproduction results from plant expansion promoted by the extension of credit, which in turn lowers profits and encourages management to increase labour productivity. Technological change in this context is viewed as a product of competition and of the desire to control labour and raise productivity. As long as new industry can evolve to replace jobs lost to technological change, some would argue that this process it not only inevitable but healthy. Nevertheless, these short-term and even long-term structural changes must be made to overcome excess-capacity in declining industries. The structuralist argument therefore helps us understand problems created by product-cycle theory and the changes in entire economies.

In the British electronic industry case it is apparent that industries responded to higher costs by seeking both cheaper-labour location and mechanization to reduce labour costs. It is interesting to observe that responses to such changes vary from country to country. In Japan, for example, higher labour production costs in the 1970s encouraged increased mechanization, such as the introduction of automation and robots. By contrast, in the United States, industry typically moved south and offshore to cheaper labour locations rather than aggressively incorporating automated plants. In Japan, because of its small size and a relatively uniform high cost structure for production throughout, the low-cost-location alternative did not exist. Today, the Japanese pursue offshore locations more aggressively, and U.S. firms have turned to an emphasis on automation, reflecting a convergence of industrial strategies in the two countries. Japanese investments in automobile plants in Europe and the United State illustrate this point, as does the greater use of robots in the U.S. machinery and automobile industry.

In recent years, the greatest willingness by the Japanese to accept technology innovations than by their American counterparts reflects contrasting responses to change in the two countries in the past. Cultural and religious differences between the two peoples partially explain these alternative approaches. The Japanese people, for example, do not fear technology as much as do many Americans. They see technology as a natural companion for a people working together for the mutual good. The emphasis in Buddhism, for example, on interconnection and compromise makes it much easier for the Japanese to welcome change than does the more confrontational teaching of Christianity, which emphasizes good and evil, debate, and argument.

Organizational contrasts

Strong contrasts in the structural organization of manufacturing exist between free-market and centrally planned economies. Although common production and technological processes prevail worldwide, the organizational and spatial characteristics of that activity display differences. Contrasts in the relative strengths of horizontal and vertical linkages between free-market and centrally planned countries provide one means of comparison. In free-market countries such as the United States, the competitive work environment yields close horizontal linkages among firms. This situation arises from the strong competition among firms for access to raw materials and the marketing overlap that exists in product distribution. This is not to say

that strong vertical linkages do not exist as well. Such vertical ties are typically overshadowed, however, by horizontal ties.

In the planned economy organizational structure, vertical ties similarly overshadow horizontal linkages because competition is minimized. The planned economy organizational structure operates almost exclusively in a top-down command environment, as in the Soviet Union. National economic plans typically guide state executive authorities in planned economies, such as councils of ministers and state planning bodies. The Gosplan in the Soviet Union is an example. Under this umbrella, ministers, directorates (GLAVIK), and associations of enterprises or production unions implement goals. Enterprises from the grass-roots production function, the counterpart of the firm in the capitalist world. There is no segmentation or overlapping of markets in planned economies. Each enterprise maintains a monopoly in its particular field. Often the market is split up into regions, for which a particular enterprise is a sole supplier.

Vertical ties exist in free-market economies when firms establish downstream (raw material) supply sources and upstream marketing arrangements, as occurs with firms involved in mineral resource recovery. Automobile firms frequently develop similar arrangements. As the scale of firms has grown in recent decades, the tendency to intensify vertical linkages has grown. The point being made here is not that these ties are insignificant, but that horizontal linkages are much stronger in comparison to those in planned economies.

Conclusion

Although many traditional and contemporary manufacturing location principles and theories assist in the explanation of industrial patterns on the landscape, none by themselves are completely satisfactory in accounting for the enormously complicated pattern of activities today. Not only have additional stages in the production process added more complexity but so has the increase in the scale at which firms now operate.

Changes in technology, and the increase in the number of countries seeking expanded manufacturing activity, also come at a time that the entire structure of economies is shifting to less dependence on the manufacturing sector. Political and ideological factors related to the role

of capital, planning, and international trade and investment strategies also play a more visible part in manufacturing.

The contribution of classical location theory to an understanding of manufacturing location has been downplayed in recent years; nevertheless, raw material costs, transportation, and labour considerations which are emphasized in these theories remain central topics in discussions of manufacturing activity. The growing importance of horizontal and vertical linkages and ownership patterns has changed the focus of analysis to be sure, but the multinational firm which can internalize many factors must still consider the same variables that the small entrepreneur did a century or more ago when making business decisions. Indirect locational decisions such as firm closings, openings, and on-site expansion occur much more frequently than a complete shifting of firm operations. The establishment of branch plants or simply changing the product mix can also be used as a substitute for moving to a new location.

Behavioural studies of the firm increasingly emphasize decision making and management objectives when discussing location strategies. The product life-cycle concept points out that all manufactured items experience stages in expansion and contraction. Some firms must also endure fixed locations in both the short and long run and must make adjustments other than spatial shifts as changing business conditions dictate.

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