Least cost theory has its roots in the work of Alfred Weber and includes some of the works of Tord Palander and Edgar Hoover.

The maximum revenue, market area or locational interdependence approach include some of Palander and Hoover, much of Losch and the work of certain economists interested in aspects of the theory of imperfect or monopolistic competition (Fetter, 1924; Hotelling, 1929; Robinson, 1934; Chamberlin, 1936; Lerner and Singer, 1937; Smith, 1941; and Ackley, 1942).

Least Cost Approach

The least cost approach emphqsizes the search for the least cost locations where the demand factor is held constant. Implicit in this approach is the assumption of perfect competition, with no monopolistic advantages with respect to the market arising from specific locations.

Alfred Weber's Theory

The most important theory based on least costs is that proposed by Alfred Weber in his book *"Theory of the Location of Industries" (Uber den Standort der Industrien)* in 1909. A number of other Germans had already written on this subject, the most important being Wilhelm Launhardt (1882, 1885). He attempted to show how the optimum location could be found in a simple situation with two sources of raw material and a market represented by the corners of a triangle and also developed an approach based on the concept of market areas. The influence of Launhardt and his contemporaries extended little beyond Germany but the translation of Weber's book in English in 1929 gave it a much wider reading. In any case, Weber's effort was a fuller and more rigorous exposition than anything that had gone before. His approach is **deterministic** and **normative.**

Main Aim

Weber aims to explain the location of industrial activity in terms of three economic factors

(i) transport costs,

(ii) labour costs, and

(iii) agglomeration economies.

His explanation is based upon finding the least cost point for production.

Assumptions

1. The unit of analysis is a single, isolated country that is homogenous in terms of climate, topography, race of people, technical skills of the people and is under one political authority.
2. Transport costs are a function of weight and distance increasing in direct proportion to length of shipment and weight of cargo.
3. Costs of land, building equipment, interest and depreciation of fixed capital do not vary regionally.

4. There is an uneven distribution of natural resources on the plain. The locations of sources of raw materials are assumed to be known. These raw materials are found only in some specific locations.

5. The size and location of centres of consumption of the industrial products are given. The markets, thus, are points on the plain.

6. Labour is geographically fixed. There exist a number of places where labour is found in definite, predetermined wages and in limited quantities.

7. The entrepreneurs seek to minimise the total cost of production.

8. Conditions of perfect competition exists whereby resources and markets are unlimited at their given locations and no firm may obtain a monopolistic advantage from its choice of location.

Principles

Weber's analysis of industrial location is divided into two major sections:

A. Identification of the point of minimum transport costs.

B. A discussion of the circumstances under which production will be attracted away from this least cost point.

A. Least Cost Location Principles

According to Weber there are three regional factors which affect the costs of production:

1. The cost of raw material,

2. The cost of transporting raw material, and

3. The cost of labour.

The cost of raw material varies according to the nature of the deposits and the difficulty of mining them. If the deposits are difficult to access and they have great overburden or are quite deep, then the cost would naturally be higher. On the contrary shallow deposits, which will be less difficult to mine, will have lower prices.

The cost of transporting raw materials depended upon the nature of the raw materials, whether it is

(a) **Ubiquitous**, one that is found everywhere such as water, air, clay, etc.

(b) **Fixed**, one that is found in a particular place, i.e., has a fixed location.

(c) **Pure**, localised materials that enter to their full weight into the finished product. Thread to be woven into the cloth is perhaps an example of this category.

(d) **Gross**, a localised material that implies only a portion of, or none of their weight to the finished products. Fuel is an extreme type of gross material, for none of its weight enters into the product.

All these variations are reflected in the cost of transportation so that regional factors affecting production are reduced to transport cost and labour cost.

He identified another local factor called **agglomeration** or **deglomeration economies**. Agglomeration economies refer to savings of the individual plants that result from their operating in the same location. This might result from the common use of such activities as auxiliary industries, financial services, public utilities, etc. In a single firm location, these processes and services have to be carried out or borne by the firm at a greater cost individually. As more and more firms cluster, linkages increase and there is increased flow of goods between plants, development of specialised labour force and savings due to bulk purchasing of materials and large scale marketing of products. Agglomeration economies can be attained when a firm increases its production or when many firms cluster together.

Deglomeration economies is just the reverse of agglomeration and include the increase in cost of land due to clustering.

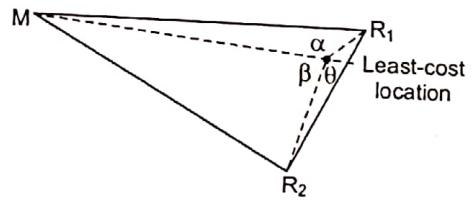
There are, thus, two parts of analysis:

1. Identification of the point of minimum transport cost.
2. Relocation of the production cost away from this point due to advantages of cheap labour and /or agglomeration.

Least transport cost point

In the absence of spatial differences in basic production costs, Weber observed that manufacturing plants will locate at the point where the total transport costs are minimised. He suggested that transportation costs are, in effect determined by two factors:

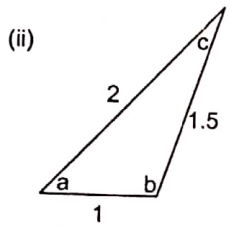
1. The weight of the materials to be assembled together with the weight of the final product to be shipped to the market.
2. The distances over which the materials and the product have to be moved.



(i)

M	product	1
R_1	raw material	2
R_2	raw material	1.5
Material index		3.5

Weight of material per tonne product



Triangle of weight

(iii)

$\alpha = 180° - a$

$\beta = 180° - b$

$\theta = 180° - c$

The solution can also be found by the construction of isodapanes

Figure 11.2. Locational triangles using two raw materials R1 and R2

The combination of these two elements results in a simple index of cost, the tonne-km or tonne-mile. The locational problem is, then, simplified to find the point where the total tonne-mileage is minimised for the particular production-distribution process.

To find the least transport cost location, Weber used simplified locational triangles, assuming two points where raw materials are found and a single market. From this locational triangle, angles a,b, and c can be found. The following calculations are made

Having established the triangle, Weber sought to explain the least cost location, either near the raw materials or near the market.

In order to find out whether industries are market oriented or raw material oriented, Weber devised a simple **Material Index (MI)** formula. The MI is calculated as follows:

$$MI = \frac{\text{weight of the localised materials used in the industry}}{\text{Weight of the product}}$$

For example, if it takes 4 tonnes of raw material to make 2 tonnes of finished goods the material index would be $4/2=2$.

When there is no weight loss in the production, the material index equals 1, while when there is substantial weight loss the material index is higher than 1. For those industries, where the cost of transporting materials is much higher than that of the product, the least transport cost locations will tend towards the material sources rather than the market. Industries with a material index of 1 or close to 1 are located close to the market, since the cost of transporting the product is much greater than the cost of transporting any one of the pure materials from its source. The type of production measured in terms of weight loss thus affects the location of a plant. This can be well exemplified in a couple of situations.

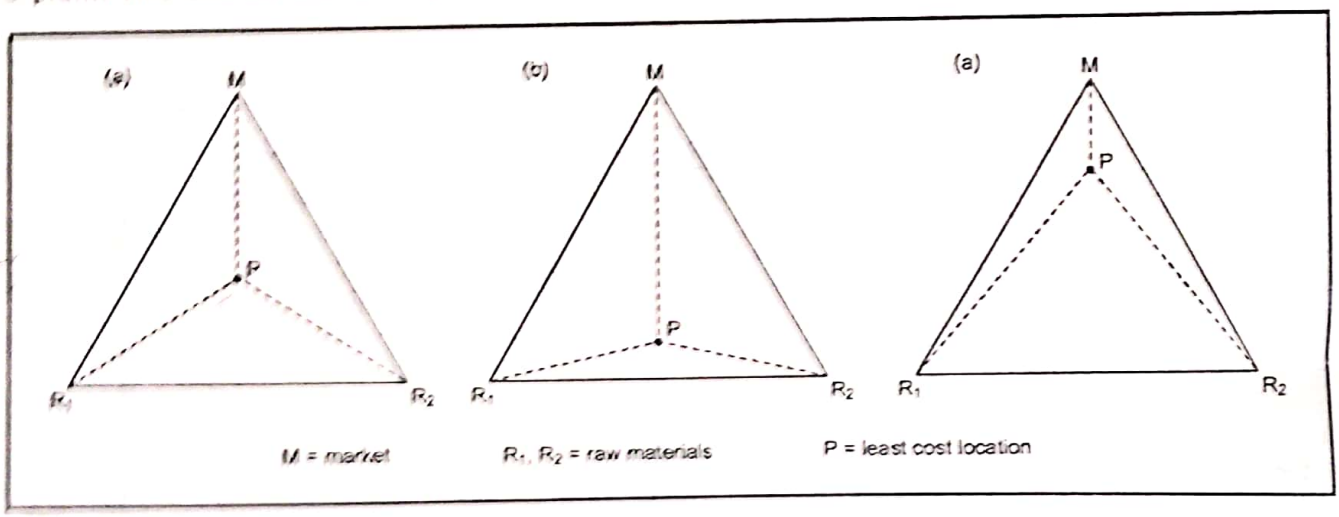


Figure 11.3. The orientation of the industries using the locational triangle and MI

Case A. *One market and one raw material (where the locational figure is a line)*

The first case supposes a raw material to be produced at a different location (R) and the finished product made of material to be consumed at a different location (M). The problem is to determine where the manufacture or processing is to take place. There are several possibilities

1. If the raw material is ubiquitous, then the factory will be located at the market since at this point the lowest transport costs would prevail on both material and product.

2. If the raw material is fixed (i.e., localised in a specific place) and it is pure (i.e., weight loss is zero), then the factory can be located in either the market or at the source of the raw material.

3. If the raw material is fixed and gross, then the factory will be located at the source of raw material.

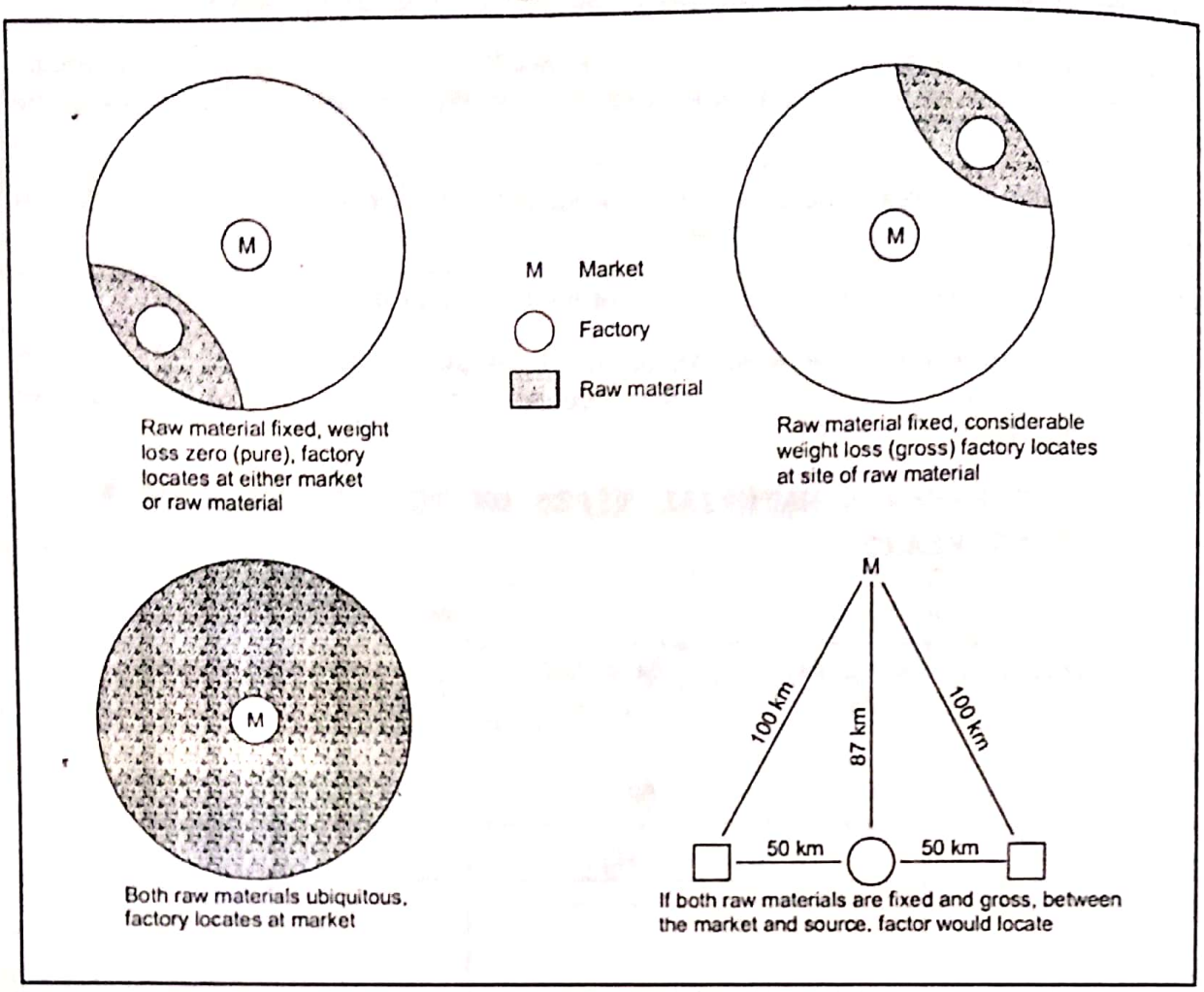
Case B. One market and two raw materials (where the locational figure is a triangle)

The second case assumes that raw materials are available at two places, R1 and R2 at equal prices and the finished product is to be consumed at M. Where will the manufacturing or processing take place?

INFLUENCE OF WEBER'S MATERIAL TYPES ON THE LOCATION OF A MANUFACTURING PLANT

			Location*	
Types of materials used	Material index	Material source	Intermediate location	Market
Ubiquitous material only				*
1 pure material	1	*	*	*
1 pure material + ubiquitous material	<1			*
>1 pure material	1			*
>1 pure material + >1 ubiquitous material	<1			*
1 gross material	>1	*		*
1 gross material + ubiquitous materials	<1			*
>1 gross material	>1	→		
Gross material + pure materials ubiquitous materials				→

* indicates definite location, = indicates equally possible locations, → indicates a tendency for production to be attracted toward a particular type of location.



1. If both R1 and R2 are ubiquitous, then the manufacturing will be at the market since at this point the transport costs on both, material and product are the lowest.

2. If R1 is ubiquitous and R2 is fixed elsewhere than at the market, and if both are pure, then the manufacturing will be at the market. R1 being ubiquitous transport charges will have to be paid only on R2. At the other alternative location R2, transport charges would have to be paid on the finished product, which since both materials are pure would equal their combined weights.

3. If both the raw materials R1 and R2 are fixed and pure, then the factory will be located at the market. Both the components would be sent directly to the consumption area for processing, since this gives the lowest aggregate transport cost. Otherwise if the factory would be located at either the source of R1 or the source of R2 additional transport charges would have to be paid on that leg of the journey on which the product moved to the market.

4. If both the raw materials are fixed and gross, the solution is complex. Weber sought to achieve this by the application of his locational triangle.

There will be two circumstances under which location would be attracted away from least cost point either due to advantages gained from cheaper labour or due to agglomeration.

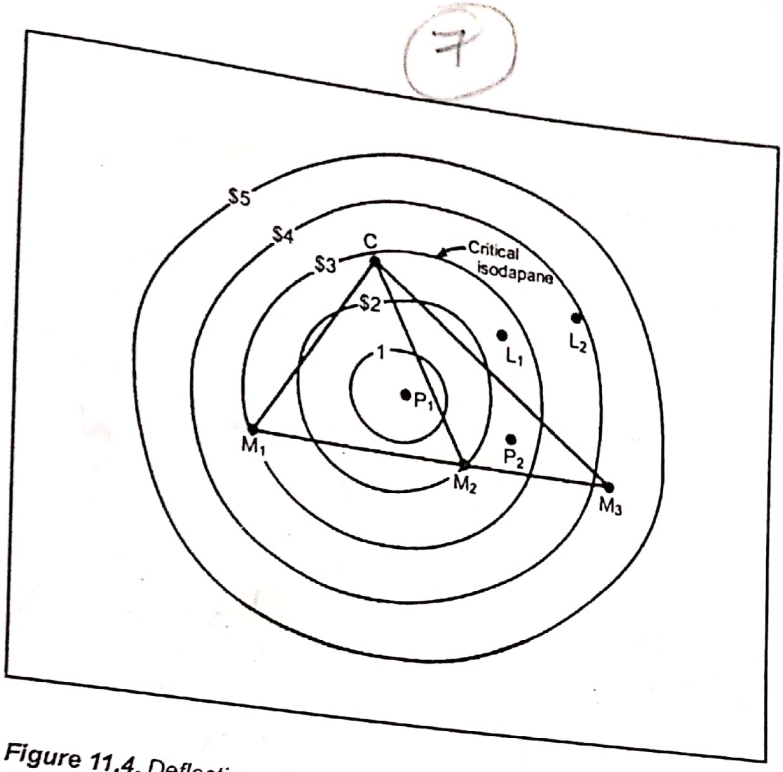


Figure 11.4. Deflecting effect of labour in industrial location

Role of labour

If, at some other place in the region, the cost of labour per unit of product is less than it is at the optimum transport location, perhaps because an established industry closed down or an unusually high rate of population growth occurred or a pool of particularly skilled workers is available, and if the increment to transport costs at this alternative location is less than the labour savings, a deviation from the 'optimum' least transport cost location will arise. (Fig.11.4)

Role of agglomeration

Agglomeration tendencies also deflect a factory from least cost transport point. There are two main ways, according to Weber, by which a company can gain the benefits of agglomeration:

Firstly, it may increase the concentration of production by enlarging its factory, thus obtaining savings through a larger scale of operation. Secondly, it may benefit by selecting a location in close association with other plants. This agglomeration yields benefits from sharing specialised equipment and services, greater division of labour and large scale purchasing and marketing.

This is illustrated in the Fig. 11.5 where five firms (A, B, C, D, and E) are in business each occupying a separate location inside its own locational triangle. The firms find that they could cut their cost on products by Rs.200/unit if at least three of them operated in the same location taking advantage of economies of agglomeration. But in order to gain from this a firm must not incur more than Rs. 200 of additional transport costs. In the shaded area where three firms (G, D and E) can be located together and still incur less than Rs. 200 of extra transportation cost. Agglomeration is thus, possible here but neither A nor B would reduce

transportation cost where only two isodapanes intersect because they cannot attract the minimum requirement of three firms.

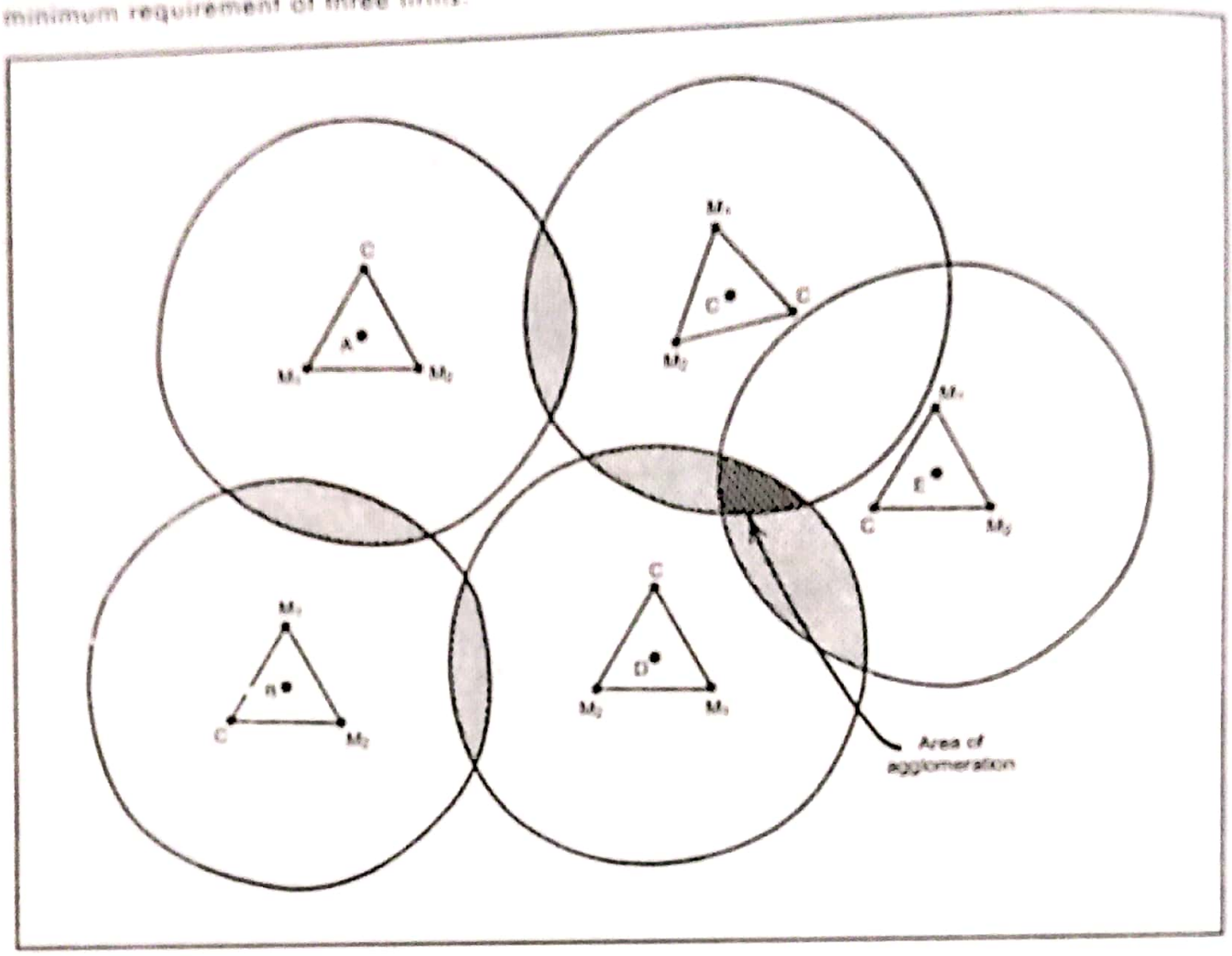


Figure 11.5. Deflecting effects of agglomeration economies.

Agglomeration also acts to divert manufacturing from either a least transport cost location or a least labour cost location depending upon which was originally the dominant locating influence in a given instance.

Since the attractions of agglomeration and labour cost savings, both represent deviations from the least transport cost location, these two influences may conflict. The decision will go to the one that provides the greater savings.

Weber went on to show the combined effects of the three factors— transport costs, labour costs and agglomeration economies—on the location of a set of industries, which produces the industrial landscape of economy.

Criticism

Whilst Weber's Theory identifies certain basic influences on industrial location, it is open to criticism. Its value is now limited - partly because of certain inherent weaknesses in the theory and partly because circumstances have changed since the turn of the century, when Weber published it.

1. Many of the assumptions made by Weber are quite unrealistic.
   - Transport costs do not rise proportionately with distance and weight. Because of fixed costs, especially terminal costs, long hauls cost less per unit of weight than short hauls do.
   - Perfect competition rarely exists.
   - Man does not always behave rationally.
   - The market is in the form of points and one plant serves only one market.
2. Weber's material index was too crude a measure of transport cost which do not rise proportionately with distance and weight. Moreover, transport costs are rarely a basic criteria for the location of a firm today. Though varying from one kind of firm to another it is estimated that, on an average, transport costs makeup only 5-12 per cent of a firm's budget. It is not only that technological improvements have relatively reduced transport costs, but it is also because of changes in other things making up total costs, particularly those to do with the actual manufacturing process, the internal organisation and external links. Labour is, now, the most important industrial location determinant. This is most obvious in firms producing high value and high tech products. For these firms, transport costs are relatively unimportant.
3. Weber concentrated too much on minimising costs. He failed to identify the revenue aspect of a firm's operation, which also directly affects the profitability of a firm. On the question of location, the theory, therefore, gives an unbalanced approach.
4. Weber's concept of the nature of industrial organisation and its decision making process (for example, the agglomeration analysis) is inconsistent with the conditions in the modern industrial world.
5. Weber suppressed many of the secondary influences, which have an important effect on industrial location. Political, social and other human considerations including imperfect knowledge of situations, all are recognised today as significant in deciding the location of a firm or its branch.
6. Market orientation is accentuated by freight rate structure complexities which leads to higher cost of transporting finished product. As a result, raw materials are often shipped nearer to the market to reduce the distance that finished goods must be shipped.
7. Increased complexity of industrial organisation—as the single product, one factory, private firm is replaced by multi product, International Corporation. In this condition Weberian theory is difficult to apply. Manufacturing is more complex than it was in the early 20th century. Many plants begin with semi-finished items and components rather than with raw materials. Producers' goods seldom lose large amounts of weight; therefore, there are not many tendencies toward material orientation.

Brainpower is producing muscle and machine power and transforming natural resources. Natural resources are no longer as important in the growth of economies. Instead, there is transmaterialisation of resources as smaller, lighter, "smarter" products are manufactured from resources to which high technology and brainpower have been added.