CENTRAL PLACE THEORY - CHRISTALLER AND LOSCH.

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Central place theory is a spatial theory in urban geography that attempts to explain the rationale behind the distribution, pattern, size and number of cities and towns around the world. It also attempts to provide a framework by which these areas can be studied both for historic reasons and for the locational patterns of areas today. Despite having the same population number, one town might surpass another in its functional importance.

On this perspective two theories have been advocated – the Central Place Theory (CPT) by Walther Christaller and its modified version by August Losch. These theories suggest that there is a relationship between the functions of a settlement and its spatial locations with regularity in the distribution pattern within an urban system.

Walther Christaller, a German geographer, proposed his theory of central places in his book" Central Place in Southern Germany" (Die zentralen Orte in Suddeutschland) in 1933.

He divided this book into three parts;

the theoretical part,

concerned with the setting up of the theory;

the connecting part,

which considered practical methods whereby the theory could be tested in the real world; and the third as regional part, where southern Germany was examined, and the methods formulated in the second part were applied to substantiate the theory. Of the three parts, practical methods and regional application had limited value. It is the theoretical part which is of great attention. The introduction to the theoretical part of Christaller's book is entitled "Are there laws which determine the number, distribution and size of towns?"

He attempted to develop a deductive theory which reveals the "Ordering Principle" in the distribution of towns. It attempts to explain the number, location, size, spacing and functions of a settlement within an urban system.

Assumptions of the Model;

- There is an isotropic plane (flat surface) on which natural resources are evenly
- distributed.
- Population is evenly distributed on plane.
- All consumers have similar purchasing power and same taste or demand for the goods and services.
- There is no excess profit (perfect competition).
- There is a single means of transport and transport costs rises proportionately with distance.
- Consumers visit the nearest central place as this minimizes the distance travelled.

- The entrepreneurs are economic men with aim on profit maximization. As people will prefer to visit the nearest center, suppliers will locate themselves as far away from each other as possible to maximize their market areas.
- The central place hierarchy acts as a closed system.

Central Place Theory, concerning the development of cities as hubs for goods and services serving smaller, surrounding areas, and the size, number and distribution of urban areas. Christaller acknowledges that this basic assumption is derived from former work of Gradman (1916), who contended that the distinctive role of the town was to be the Centre of its rural surroundings and a facilitator of local commerce with the neighboring areas, collecting and exporting the local products, importing and distributing the necessary goods and services which the countryside demands. Though the population of town may be important by virtue of its size but it cannot be a measure of centrality.

Therefore, four major principles underlie Central Place Theory (CPT): Centrality, Complementary areas, Threshold and Range of goods and services.

The Centrality of a place refers to the extent, to which a town serves it's surrounding area and can only be measured in terms of goods and services offered. There are different orders of goods and services; for some are costly and rarely purchased (car) and will need large population to sustain them; others are every day need items and will require small population for its survival (bread). The variety and quantity of goods and services it provides for its population and neighbours underline its functional importance.

The Complementary area is the area for which central place is the focal point. This area would be larger for bigger and more important central places and smaller for the less important ones.

Threshold population is the minimum number of people required to support any good or service outlet established at central place. It is the minimum population which is required for the sale of good or to sustain any service. Some goods and services need large population and others a small population to achieve their threshold values. In an ideal case of uniform income, consumption and taste it can be stated in terms of population numbers. For example, a minimum varying population is needed to retain a doctor, bank or a post office. Also, a grocery shop needs a relatively small local population to keep up its business while jewellery or a car which is irregularly purchased needs a larger threshold population.
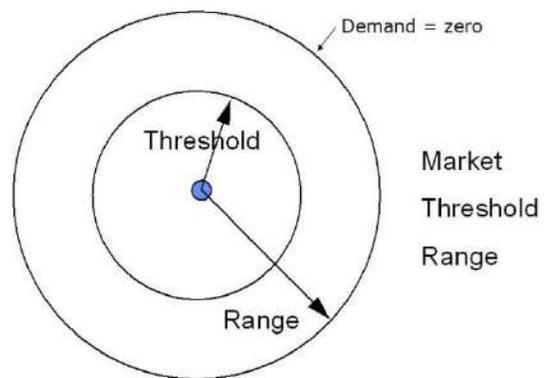
The Range of goods is the maximum distance that a consumer is willing to travel to obtain certain goods or services at some range from the Centre the inconvenience of travel measured in time, cost and trouble will outweigh the value or the needs for the good or alternative nearer Centre becomes available. Like a length of the journey to buy bread, will be very small and hence frequent trips may be afforded as against a journey to buy a coat or a car or jewellery. The

maximum range of goods and service is the farthest distance calculated in terms of time and money that a consumer would travel to provide it. So a consumer who has to travel all the way to central place to buy a good has less money available than the one living at close proximity to central place because the former has incurred transport costs and so will be able to purchase less. After a certain distance, people cannot afford to buy good at all because transport exhausts them of money. It is every day for something cheap and frequently needed like bread or daily newspaper; people do not spend much time and money travelling to obtain it. Therefore, it has a small range. As against, for goods which cost more and are less frequently required, people are prepared to travel longer distance.

But one cannot ignore the reality that most journeys fulfill multiple purposes, one can buy the bread and the coat on the same trip, but have been excluded from theoretical considerations. If the population is evenly distributed, the market areas determined by the minimum range will remain as small as possible and maximum number of firms will find space in the area served by the system. The marker area

closely packed equidistant distribution of settlement points

is circular because the transport costs increase proportionately with distance from the Centre.

Goods with low thresholds and small market areas are low order goods and will occupy low order centers; goods with high thresholds termed as high order goods and will occupy high order centers. In between the high order and low order centers are the intermediate order centers selling middle order goods. This denotes that the central places are graded according to the level of goods and services they offer. Therefore, high order Centre will cater services of high, middle and low order; middle order centers may provide functions of middle order and low order while, low order centers delivers the functions of only low order.

Urban Hierarchy

'The higher the order of the goods and services (more durable, valuable and variable), the larger the range of the goods and services, the longer the distance people is willing to travel to acquire them'. The entrepreneur, with an aim of profit maximization, position themselves as far away from competitors as possible, giving the market a circular shape, to ensure that at least one threshold value is covered under their market area.

As all entrepreneurs act in this way, they are evenly spaced over the plane in a triangular lattice pattern so they are equidistant from their six nearest competitors. In case of single entrepreneur, the maximum market area is circular.
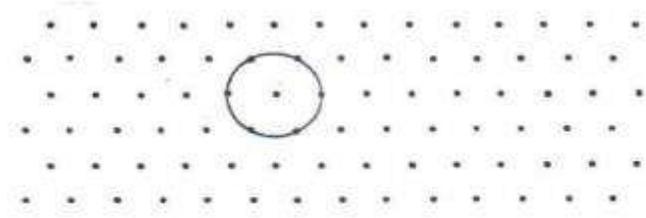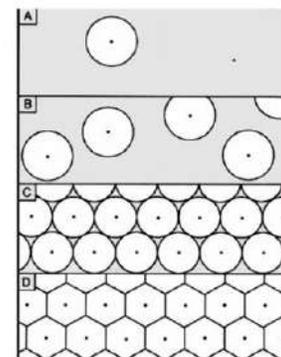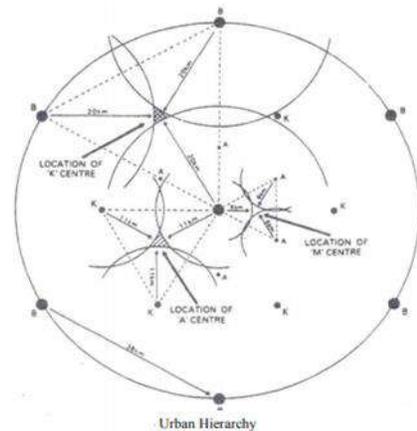
If there are many competitors, each with a circular market area and located at an equal distance from his six nearest neighbours, some area will remain unserved by entrepreneurs. In order to serve the unserved customers, suppliers or entrepreneurs come closer together causing the circular areas to overlap. Since the customers in this overlap zone will visit the nearest areas will be hexagonal. Higher order centers have bigger hexagonal market areas, and low order centers have smaller hexagons. This results in a mesh of hexagonal market areas where hierarchy of central places is functionally and spatially organized.

It is possible to isolate two limits in relation to each good and service as lower and an upper limit. *The lower limit is noted by the minimum demand for a commodity or service that is threshold;* upper limit is that beyond which a good will no longer be obtained from the centre, the range. In an isotropic surface of equal population density and with uniformity of income, in a model of town distribution, a settlement is given a rank B. This B serves the surrounding area in such a

way that it's one of the good number 51 shows the upper limit, or range of 51 kilometres, and if the lower limit or threshold is such that it can only be offered at B, then it will be supplied over an area of 51 kilometres radius about B. If the next good numbered 50, has a range of 20 kilometres, then there will emerge a ring 1 kilometres wide unserved from B with that good. If the most closely packed equidistant distribution of settlement points as suggested by Christaller is adopted, then there will be a six of these on a

Contribution of hexagonal market areas
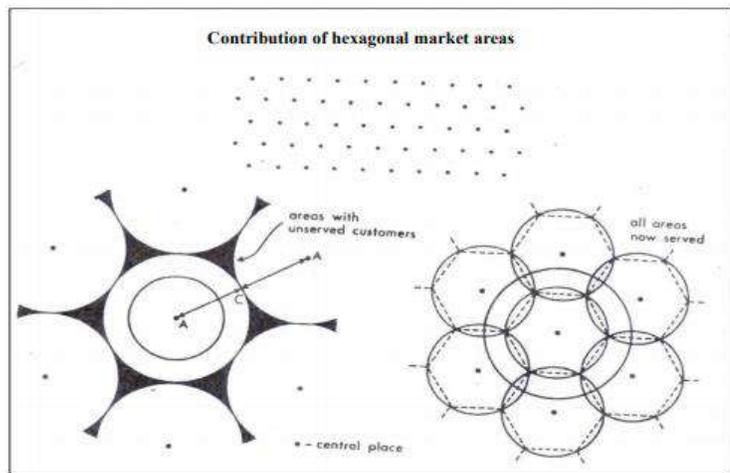
ring about B. Christaller gives the distance between the centres as 36 kilometres. For still lower order goods the next location will be those at the centres of equilateral triangles joining the B centres, at these points K centres will emerge. Now the goods number 19, 18, 17, 16, 15, 14, 13, 12 with ranges of 19, 18, 17, 16, 15, 14, 13, and 12 kilometres can be offered effectively at B and K centers but the good number 11 cannot, for once more the unserviced 1 kilometre ring will emerge. And so a further series of lower order service centers has to be introduced. In this way a whole hierarchy of central places emerges with towns of equal rank equidistant from each other. The area which a town served is termed by Christaller as "complementary region" and under the above conditions, these are circular shape regions.

In an attempt to avoid overlap and to match the densest distribution of settlement points, the circular regions were converted into hexagons. Now if there are further goods for which the threshold population required is greater than that provided by the B system, then one place alone from the system may be sufficient and will acquire higher value as a central place and given the designation of D Centre with a range of 36 kilometres. Also, newer and higher order centers will have ranges of 62 kilometres and 108 kilometres respectively as the range and threshold population is increased.

Each settlement serves its own hinter land and, in addition, a distinctive range of goods related to the increased size of its hierarchy i.e. an area or population equivalent to the hinterlands of two other settlements in addition, hence called the "rule of three" or expressed through the constant

k. Christaller's devises a relationship between every two connective levels in the hierarchy symbolized by a K value (K constant), which denotes a discrete number of lower order Centre and market areas which every higher order Centre dominates in addition to its own.
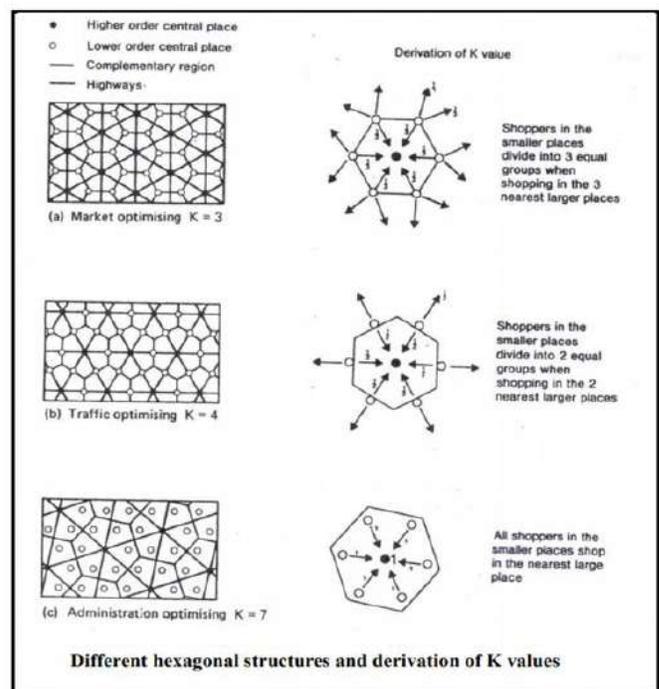
K=3, Marketing Principle:-

Under the marketing principle, an urban settlement reveals consumer demand. Each consumer would try to be as close as possible to every level of the hierarchy so as to minimize the amount of travelling for the consumer. Thus, a settlement of every order would be surrounded by six other settlements of the next order. The low order centres position themselves on the boundaries of market areas of middle order centres. People at lower order centre will have a choice between three higher order centres since all three are equidistant. Each higher order centre then receives one third of the customer of six immediately lower order centres which are located on the boundary of its market area. It serves a

Central Places showing different Hierarch

- ◉ G – place
- ◎ B – place
- ⊙ K – place
- ○ A – place
- · M – place
- ▬ Boundary of the G-region
- ▬ Boundary of the B-region
- ▬·▬ Boundary of the K - region
- ▬▬ Boundary of the A - region
- ······· Boundary of the M-region

population equivalent to two lower order centres (6*1/3), besides its own population. Therefore, overall it serves a total of three central places (6*1/3=2+1=3). For each one of the largest settlements there would be three of the second grades, nine of the third grade, twenty-seven of the fourth grade and so on. Thus, there is only one centre of the highest order and number of centres at every level below it increases by a factor of three
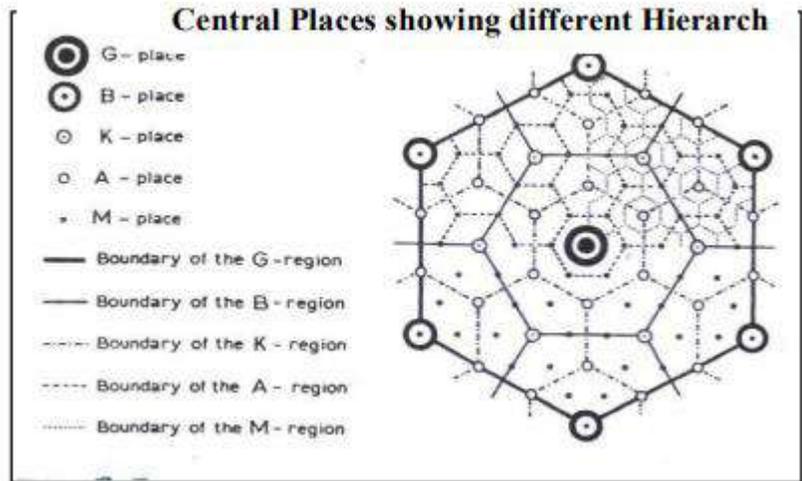
K=4, Transport Principle

The transport principle states that the distribution of central places is most favorable when as many places of concern or importance lie on one traffic route between two important towns, the route being established as straight and as cheap as possible. The more unimportant places may not be taken into cognizance. The central places would thus be lined up on straight traffic routes which radiate out from central point. Central places are so located that lower order centres lie along the straight line paths between higher order centres. In the transport principle, a lower order centre is equidistant from two lower order centres (6*1/2) plus, its own (1) making a total of four. When central places are arranged according to

- · Higher order central place
- ○ Lower order central place
- ▬ Complementary region
- ▬ Highways

(a) Market optimising K = 3

(b) Traffic optimising K = 4

(c) Administration optimising K = 7

Derivation of K value

Shoppers in the smaller places divide into 3 equal groups when shopping in the 3 nearest larger places

Shoppers in the smaller places divide into 2 equal groups when shopping in the 2 nearest larger places

All shoppers in the smaller places shop in the nearest large place

Different hexagonal structures and derivation of K values

transport principle, the lower order centres are located at the midpoint of each side of the hexagon rather than at the corner. Thus, the transport principle produces a hierarchy organised in a k=4 arrangement in which a central place is nested according to the rule of four. This is termed as K=4 network principle. The number of settlement serving as central places at each decreasing in the hierarchy would be 1, 4, 16, 64,256...and so on.

K=7, Administrative Principle

The market areas of each of the higher order centres include the higher market area of each of the six neighbouring lower order centres. This is because law and administration in theory do not experience exponential decay with distance but remain fully enforced up to the boundaries of the administrative units in which they are applied. This is the most efficient if each higher order place clearly controls the territories of those places beneath it in the system. For the administrative principle the numerical progression would be as 1, 7, 49, 343… and so on.

Central Place system

Disapproval:-

- The Central place theory is majorly criticized for its oversimplification of the real world by making a number of assumptions.
- Large areas of flat land are rare.
- The positioning of settlements is generally random and not evenly spaced contrary to even spacing of settlements suggested by Christaller.
- The hexagonal pattern is suited for theoretical development but in the real world many other complicated factors are at work.
- The concept of perfect competition is untrue in reality with some firms making more money than others.
- A hierarchy of central places. Central places are grouped into order (second, third, and fourth) but these do not match with the theoretical expectations as there is a definite and clear ranking of centres within each other.
- Equal sized sphere of influence. As per the theory it is expected that two third order centres will have equal sized squares of influence. Central place theory suggests that each centre's sphere of influence for its activities at any specific level will be equal in size to every other centre's sphere of influence. But in reality this has rarely been the case.
- Every higher order centre also functions as a lower order centre in the CPT, but often lower centres have some activities which some higher centres have in Central place theory.
- Consumer travel behavior cannot be projected. Affluence, changes in taste, and preferences and greater mobility enabling people to travel farther to do their shopping and obtain required services have altered demand patterns for services and goods.
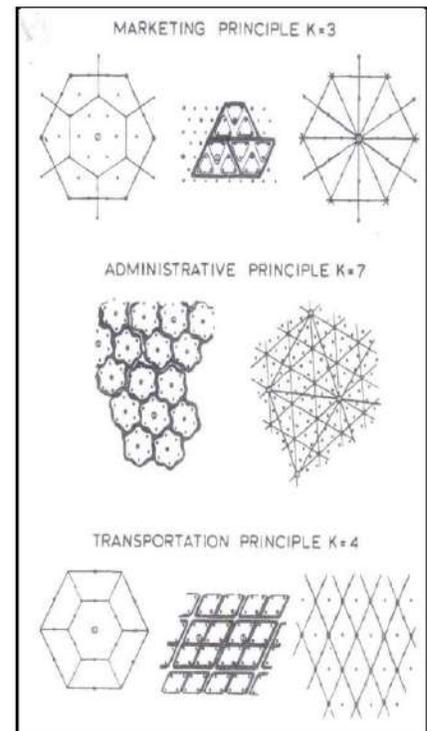
- Technological change has also brought about changes in the ways provision of goods and services are organized and located. Examples supermarkets, mall culture, online shopping.
- The government intervention (setting up of economic or residential base), planning and policy making (decentralization) and legislation (environmental, housing laws etc.) affect future growth of various settlements outside the town.
- Christaller envisaged each Centre with a particular function whereas they have many which also changes over time.

Central place theory may not have a universal validity. It also cannot be pressed to explain a settlement pattern in any region. The purpose of the Central Place Theory is to identify a few salient features, found in certain types of settlement patterns and tools available when seeking to describe and understand a particular pattern found in the real world.

Applicability:-

- It provides a rationale for selective location and efficient space and functions.
- In terms of functional and behavioural dimensions it has drawn attention to country and inter-town interdependence.
- It encourages order in the spacing and inter-relatedness of settlements where settlements are seen in wider contexts.
- The central place theory seeks to analyze the functional and hierarchical orderliness in the settlement landscape.
- Settlements vary in size, function and number but the centralistic function is sought in the location economies, social and administrative structure and their visible and not so visible forms and is evident in location of the structures like church, community hall or university.
- The central place theory helps us to identify more clearly the role of settlements as places of trade exchange and the extent to which this has influenced the nature of emerging settlement pattern in region.
- The Central place theory has been used as a guideline for relocation policy and this was incorporated as an integral part of regional planning in Germany, in north east polders, location of settlements, population size, linkages, hierarchy and allocation of market and service functions were determined by central place principle.

August Losch

In 1940, famous economists August Losch published book titled "Economics of Location" in which he established a general theory of location. Losch sought to draw attention to the marketing factor and the idea of maximum profits related to sales revenue. He claimed that it's not a single economic pull that influences most settlements rather a complex combination of market, communication or administration. He attempted to explain the size and shape of the market areas within which a location would command the largest revenue. He based theory on set of assumptions like

Circular market area

- An isotropic surface
- Constant supply of goods and services
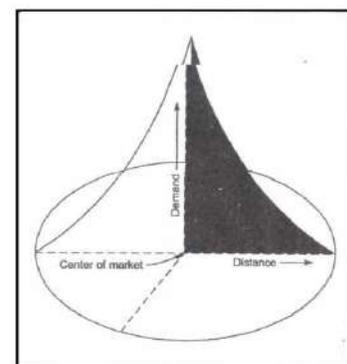
- Population is evenly distributed
- Demand decreases with an increase in price. If the price increase is the result of an increase in the transport costs, demand would decrease with the distance from a production centre, the demand curve would be cone shaped and the market area circular.

- Entrepreneurs act as an economic man, their main aim being profit maximization. He oversimplified the world to a flat uniform plain, held supply constant, and assumed that with increase in price the demand for a product decreased and if this price increase was because of an increase in transport costs, the demand would decrease with distance from the production centre.

He pointed that there are many producers located on the plane. Each producer located on the plane being equidistant from the other in such a way that their market areas are circular. The size of the market area is dependent on the number of entrepreneurs. As producers or entrepreneurs increase in number their market area becomes smaller and smaller, and profits are competed away. Also, the producers move further close as circular areas leave some places unserved between circles and eventually takes the shape of a hexagon. Each product will represent a different sized market area and so the size of the hexagons will also vary. "August Lösch was a German economist, known for his seminal contributions to regional science and urban economics. Born in Öhringen, Württemberg, Lösch obtained his doctorate from the University of Bonn in 1932".

The derivation of hexagonal market areas

hexagonal market area

● Market

Losch attempted to find a spatial structure that would be competent for both the producer and the consumer. To identify it, he chose one production centre from the entire set of production points established on the planes. He then arranged the hexagons in such a fashion so that this one centre was common for all. He then rotated the hexagons around the central point and brought them to the rest where the maximum number of hexagons coincided, forming points of maximum demand, which should ideally develop for concentration of industry. Thus, like Christaller's hexagonal pattern, though smaller in size, twelve sectors developed. Of the twelve, six sectors emerged in which many settlements existed and numerous services were offered and other six sectors where settlements and services were scanty.
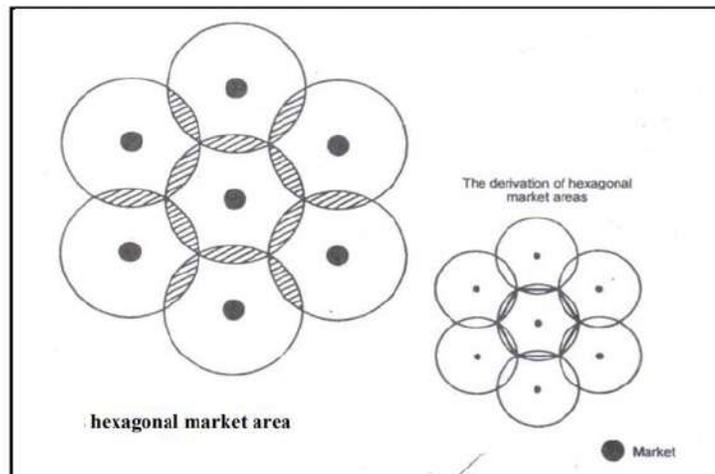
Christaller's pattern is best suited for those cities which developed in sparse settlement regions but that of Losch's for densely populated regions. The hexagonal structure is dependent on the number of the units required to institute the production of a commodity. This number will fluctuate considerably from commodity to commodity. Losch unlike Christaller, allows for this fact and adapts it into his structure. He opines that given the closest packed distribution of farms or units and their hexagonal market areas the smallest number of farms which may be served will be three in number. This being the minimum threshold and thereafter the succession will

continue through four and seven. This is in consensus with the argument developed by Christaller, but Losch continues to the whole series of succeeding arrangements. Christaller only isolated the three smallest cases 3, 4, and 7. But for Losch the whole series continues as 3, 4, 7, 9, 12, 13, 16 etc. He proceeds to contemplate the ten smallest areas and tabulates the relation between them. Thus, the points of maximum demand will emerge as concentration of industry.
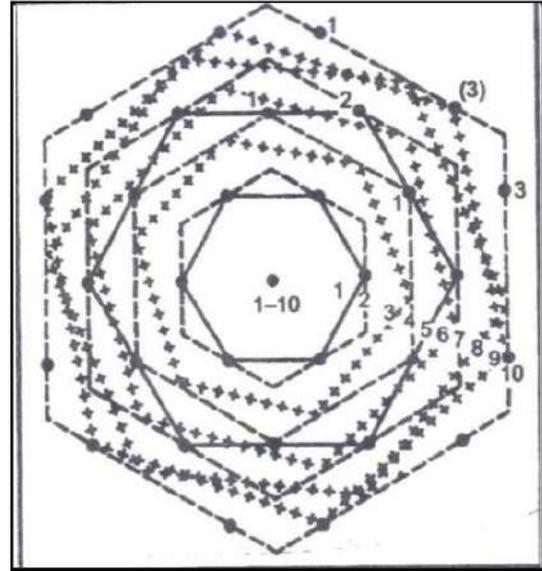

Rotation of hexagons around the central point

Hexagons are used in theory to delineate market areas because:

- Circles are equidistant from centre to edge, but they overlap or leave gaps.
- Squares nest together without gaps, but their sides are not equidistant from the centre.
- Hexagons offer a compromise between geometric properties of circles and squares.

Every good sold and every service offered will have a different lower and upper limit, a different threshold and a range and could be offered at a variety of different points, thereby, resulting in a chaos of different meshes designed over the supposed uniform plain. Some order can be introduced by arbitrarily centring all the meshes on one point, which will represent the metropolis. Further by rotating the various nets (hexagons) about this point, city rich and city poor areas can be produced with maximum degree of coincidence. That is between the city rich and city poor sectors Losch located the main transport routes. It is these routes that radiate outwards from the metropolis at the centre, and are termed as Loschian Economic Landscape.

But it must be emphasised that with oversimplification, so that the uniform structure is presupposed with a fixed k, can Christaller's model be derived. The functional array of services falls into distinct groupings in all cases, it is only when a fixed k is assumed that a strict hierarchy in the Christaller's sense is attained. It may be noted that under Losch's scheme a hierarchy, as in that, with equal and regular addition of the number of subsidiary places served, does not emerge rather a distinctive groupings of the subsidiary places can be found and hence distinctive ranks identified. The adoption of the Losch approach seriously modifies the notion of a clear cut unequivocal hierarchy. Even more pertinent
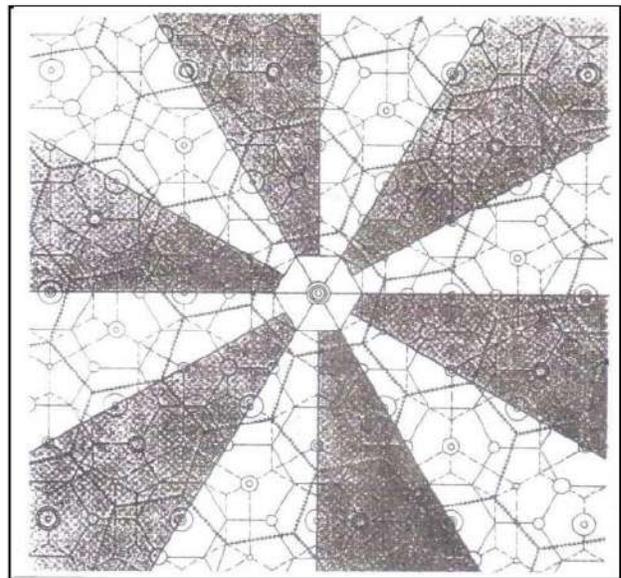
Theoretical arrangement of market areas and their derivation

however, is that at least two other ways of ordering towns in a system have been propounded from an inductive, empirical basis and there appears a marked unconformity between these observances and theoretical models.

Disapproval: -

- Losch's theory is abstract in nature.
- It over stressed on demand.
- It has failed to take into account, problems arising from locational interdependence of plane.
- Markets often overlap and do not occur in isolation. Therefore, as pointed by Losch, location equilibrium rarely occurs between a unit/entrepreneur and its market. As more firms appear, profits are competed away.
- Losch's notion of the market demand was too simple. In reality an entrepreneur will have to deal with several issues before he estimates demand as a basis for their locational decisions.
- The empirical study might show no such pattern as that envisaged in the theory

Comparison-

- Christaller's theory attempts to realise retail business and services better whereby, Loschian model sought to explain the spatial distribution of market based on manufacturing.
- For Christaller the hierarchy is composed of a series of discrete levels. Each centre in the same hierarchical level produces exactly the same array of goods. For losch the centres present in the same hierarchy may produce completely different combination of goods.
- Also, Christaller began his hierarchy from the highest centres such as metropolis while, Losch did the reverse by beginning at the lowest level of hierarchy.
- Christaller did not take into account the presence of specialised production centres but, was not overlooked by Losch. He considered it.
- Christaller's pattern is best suited for those cities which developed in sparse settlement regions but that of Losch's for densely populated regions.

Though postulating unreal conditions, oversimplification and limiting various factors operative on town distribution, the theories nevertheless, gives insight into the nature of the town distribution and of the way in which the national territory is served by towns. It also attempts to search for unified principles rather than describe individual

Both Christaller and Losch`s model agree that the triangular arrangement of production site or retail stores and hexagonal market areas represent anoptimum for a single good under the assumption of uniform densities on an unbounded plain with equal access in all direction