Research Paper on Location Planning Through Quantitative & Qualitative Techniques

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Abstract

Location planning for any Organization plays a very important role and has a critical impact on the performance of manufacturing companies. The planning for 'where' to locate the operation facilities should start from 'what' are organizations objectives, ,priorities,goals and the strategies required to achieve the same .In addition to raw material, nearness to market,water,power, labour ,economic,geographic and personal factors have influence on the decision. Both potential qualitative and quantitative criteria's are to be considered for selecting the proper plant location from a given set of alternatives. Both the Techniques have been applied for a practical decision on plant location.

Key words: Location Planning, Quantitative technique and qualitative technique

INTRODUCTION

Location Decisions refers to the selection of appropirate geographical sites for locating the various manufacturing and service facilities of an organization defined by Krajewski (2007, pp.404). These decisions form an integral part of supply chain for an organization as it determines the flow of materials from factories to warehouses, warehouses to wholesalers and wholesalers to customers. It affects the overall Profitability of the firm. This is because cost of manufacturing and the total cost of logistics and distribution are direct fallouts of location decisions. Plant location decisions are strategic, long term and non repetitive in nature. Location decisons are affected by many factors, both internal and external to the organization's operations. Many a times Enterpreneur ,makes decision based on qualitative assessment of the factors related to plant location. But many a times qualitative assessment does not work and the enterpreneur has to make Quantitative Assessment.

Once the decison of plant location is taken it is considered as the final decision as it is not possible to change the location very often. Such decisons have a long term impact on the overall growth of the organization. The selected choice of location may a give competitive advantage and can be a key success factor of the company. (Kumar and Suresh, 2008; Stevenson, 2007;Yang and Lee, 1997).

NEED FOR SELECTION OF THE LOCATION

The need for the selection of the location arises due to the following reasons:

1. Whenver Company wants to establish new plant with a New Product or existing Product with more volume.

2. New Socio_Economic_Political_Technical and Legal environment could suggest a change of Location of the existing plant.

3. in terms of very high appreciation of land, transport, material, manpower, easy access to expanding market and incentives in the proposed locations, etc. Some time, very high appreciation of existing land drives the management to arrange for the required fund and move to a different location with an eye on the future.

4. To take advantage of Government Policies, Subsidies etc to achieve an overall development of a developing country.

LITERATURE REVIEW

Plant Location decisions have been the most popular research topics among the years and numerous approaches covering both Qualitative and Quantitative have been suggested**(**Kinkel, S., Maloca S., 2009). According to Tompkins (Tompkins et al, 1984) Facility Planning has been a one of the most favourite subjects of seminar, publications and research.

As per their view "Facilities planning determines how an activity's tangible fixed assets best support achieving the activity's objectives."

Facility planning is a dynamic process. It keep on changing as a result of changes in technology. In (Tompkins et al, 1984) view it is part art and part science. They divide facilities planning into two fields, namely Plant location and Plant design. Facilities design is then separated into three components namely the structure, layout and handling system.

According to (Brown and Gibson, 1972; Erlenkotter, 1975; Rosenthal, White and Young,1978; Wesolowsky, 1977) Optimizing Methodology has been the key area of research in plant location.

Randhawa and West(1995) gave a solution of integrating analytical and multi ctiteria decision making models to facility location selection problems.

Another Mathematical model and Heuristic approach was developed by Hoshiyar and white(1997) that assigns N machines to N equal side locations on the site such that the the total adjacency flow between the

machines is maximized. Further Daskin (1998) provided a brief overview of the methodologies that were developed for solving plant location selection problems.

FACTORS AFFECTING PLANT LOCATION

Following are the list of factors that play an important role while deciding facility Location:

1. Proximity to customers: when a plant is located near its customers or markets the cost is very less. This reduces the product cost. It also allows companies to meet spurt in demand, thus providing an advantage over competitors located at far off places.

2. Proximity to Raw Material: Proximity to the source of raw materials is an important consideration for facility location, especially if the raw materials are bulky, and huge transportation cost will be incurred in transporting them. In cases it becomes necessary to transport them then the cost of material is equal to the transportation cost thus making the raw materials very costly at the point they are used.

3. Availability of Power supply and basic Amenities: Uninterrupted Power supply and basic facilities like sewage system, piped water supply, security etc are the basic requirement of most industries. Factories have to purchased their own DG sets if located in areas having power problems. It increases the cost of the product and affect the location decision.

4. Government policies: Relaxed taxation policies, excise duty exemption and various other promotional efforts help to attract industrial activity in a region. Pollution Norms and their effects
also affect the site location .

5 Size of Investment, Nature of product and process: Large investment usually requires large area which in turn requires land, water, Electricity etc. Urban areas do not have large areas so one has to go to rural areas for larger investment. Type of product also influences the location decision.

THE LOCATION DECISION PROCESS:

Generate a list of location options for the facility
↓
Find out factors relevant to the planned facility
↓
Screen location options using various models
↓
Select location that best satisfies the criteria

QUANTITATIVE TECHNIQUES:

There are several quantitative techniques for comparison and selection and applied in different fields. Some of them are briefly presented below:

1. Factor Rating Method: In this method, factor ratings are used to evaluate alternative locations. The following steps are involved in this method to find out the result:

1. Most relevant factors are listed in the location decision.
2. Each factor is rated on a scale of 1to 5 and location on a scale of 1 to 10 according to its merits on each factor.
3. Factor ratings are multiplied by the location ratings and the sum is calculated. Location is selected which has the maximum sum of the product ratings as the choice.

Example- Table given below gives the various factors considered for location decision and the factor ratings assigned to each factor based on its importance for location decision and location rating for the for the location alternatives.

Factor	Factor Rating	Location Rating			Product of Rating		
		Location X	Location Y	Location Z	Location X	Location Y	Location Z
Nearness to market	3	4	6	3	12	18	9
Nearness to raw material	5	10	5	4	50	25	20
Transportation Facility	4	9	10	5	36	40	20
Basic amenities	2	6	7	6	12	14	12
Acceptance of leather factory by local	4	8	3	7	32	12	28
Availability of cheap land	3	7	2	8	21	6	24
Low constuction costs	1	5	1	6	5	1	6
Easy availability of cheap and skilled labour	3	3	8	4	9	24	12
Total					177	140	131

The highest score is for location X. So it is the best location

2. Comparison of ROI:

In this method ROI of various plant locations are evaluated and that location is selected which has the highest ROI.

Example: A company has to take a decision for setting up of a new plant. It has listed down three locations A, B and C; data in respect of which is furnished below:

Data	Location A(Rs)	Location B(Rs)	Location C(Rs)
Wages and Salaries	10000	10000	10000
Electricity and water supply expenses	20000	30000	25000
Raw material and other supplies	80000	70000	60000
Total Initial Investment	200000	300000	250000
Distribution expenses	50000	40000	60000
Miscellaneous expenses	40000	25000	30000
Expected sales per year	225000	250000	225000

Based on ROI criteria

	Location A(Rs)	Location B(Rs)	Location C(Rs)
Sales Revenue	225000	250000	225000
Total expenses	200000	175000	185000
Profit	25000	75000	40000
Initial Investment	200000	300000	250000
Return on Investment(ROI)	12.5%	25%	16%

Based on ROI Criteria Location B is the ideal location for setting up of a new plant.

3. Centre of Gravity Method:

This method is also called as “Centroid Method”. Having plotted the coordinates of existing facilities on a grid coordinate, the coordinates of the centroid are then calculated which results in the minimum transportation costs.The centroid is calculated as follows:

$x=\sum dixwi/\sum wi$, $y=\sum diywi/\sum wi$

where

x is the X coordinate of the centroid

y is the Y coordinate of the centroid

dix is the X coordinate of the ith location

diy is the Y coordinate of the ith location

Wi is the weight or load moved from or to the ith location.

4. Qualitative Factor Analysis Method

If Economic criteria fails to account for location alternative a system of weighting the criteria is used for deciding the plant location alternative. In this method following steps are considered:

1. A list of relevant factors is considered.
2. Weights are assigned to each factor to indicate its relative importance.
3. Common scale (0 to 100) is assigned to each factor .
4. Potential location scores are multiplied by the weights to arrive the weighted scores.
5. Each location points are totalled and the location is selected with maximum points.

Example: XYZ company is evaluating three locations for a new plant and has weighted the relevant scores as given below. Using these scores qualitative factor comparisons for three locations are developed.

Relevant Factors	Assigned Weight	A	B	C
Production Cost	.35	50	40	60
Raw material supply	.25	70	80	80
Labour availability	.20	60	70	60
Cost of living	.05	80	70	40
Environment	.05	50	60	70
Markets	.10	70	90	80
Total	1.00			

Based on Qualitative Factor Analysis

Factor	Weighted Score for Locations		
	A	B	C
Production cost	17.5	14.0	21.0
Raw material supply	17.5	20.0	20.0
Labour availability	12.0	14.0	12.0
Cost of living	04.0	03.5	02.0
Environment	02.5	03.0	03.5
Markets	07.0	09.0	08.0
Total	60.5	63.5	66.5

Based on Qualitative Factor analysis Location c is preferred because of the highest weighted score.

5. Practical application: A company has five existing Production facilities. The company is now centralising its purchase system and establishing a warehouse which will supply materials to the five facilities. The loads required at each facility and its coordinates are shown in the table. The decision to locate the warehouse was selected on the basis of Centre of Gravity method.

A typical evaluation sheet is shown in the table below:

	X Coordinate	Y Coordinate	Load
A	25	40	450
B	350	400	350
C	325	75	1500
D	400	150	250
E	450	350	450

X=25*450+350*350+325*1500+400*250+450*450/450+350+1500+250+450=307.9

Y=40*450+400*350+75*1500+150*250+350*450/450+350+1500+250+450=155.1

6. CONCLUSION

Location issues have become more prominent in recent years on account of the globalization of markets. Multinational corporations have more opportunities to identify candidate locations for their manufacturing facilities. Factor cost advantages and expanding markets in developing countries have made these nations attractive for locating new facilities. Various tangible and intangible factors involved in a location problem makes the decision problem very complex.Solely Qualitative judgement may not lead to a good decision. Quantitative Techniques whixh are also not free from drawbacks helps in making much better decision. Also there is no fixed term as Permanent good location. Business uncertainty and dynamism may convert a good location of today into an inferior one tomorrow. Hence location study should be carried out and monitored at intervals.

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