SELECTION OF PLANT LOCATION THROUGH QUANTITATIVE TECHNIQUES

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ABSTRACT

The selection of location of plant is a vital decision for an organization. In addition to availability of raw materials, utilities and manpower, economic, geographic, demographic and administrative realities of locations have influence on the decision. As many of the factors are often related in diverse fashion, scientific methods are required for such a critical decision. A Quantitative Technique has been applied for a practical decision on plant location.

Key words: SEZ, Demand Centre, ROI, Job Evaluation, Utilities..

1. INTRODUCTION

Selection of location for a manufacturing unit is a vital decision. This strategic level decision is very vital as large investment is made in building, plant and machinery, utility, and other infrastructure for a reasonably long period. The selection process, therefore, should take into account the expansion and diversification plans of the company, market forecasts, concentration of customers, presence of competitors, changing sources of raw material, skilled labour, stability and reliability of state and central governments and their policies, etc. A wrong judgment in any of the above factors may lead to a very costly decision. Many a times, entrepreneurs make a qualitative assessment of the diversified factors and take decision on selection of plant location. If luck favours, the decision clicks; if not, the pang of delivery lasts long. Though many of the factors, tangible or intangible, are definitely considered by an entrepreneur before a decision on site selection is made, it is really difficult to come to a correct decision when a number of alternative sites compete with diversified factors. An attempt is made here to review the problems of plant location and suggest quantitative method to assist the decision maker in taking a better decision.

2. IMPORTANCE OF PLANT LOCATION:

The need for selecting a suitable location arises mainly due to the following reasons:
- a) The company wants to start a new Plant with a new product.
- b) The existing company looks for a new location for-
  - i) Meeting the higher demand of the product in terms of quality and quantity.
  - ii) 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.
  - iii) Policy of local bodies to free the cities from industries for planned development of the cities.
- c) To take advantage of benefits of industrial estates, SEZ, etc. and remain competitive.

Site selection determines to a large extent, the survival as well as prosperity of the business unit.
Hence, it is a very important activity and requires careful analysis of all the related aspects and take optimum decision.

3. IMPORTANT FACTORS FOR CONSIDERATION:

Three important aspects that require careful analysis by management are:

i) **Cost**: A good location helps reduce cost of transportation of raw material, finished product, lower inventory, and improves the availability of the required number and quality of man-power.
Setting up a unit near the major supply of raw materials reduces a lot of cost of transportation and stock.

Though cheap labour is one of the main attraction in favour of rural areas, the cost of infrastructure is generally high there. Often, many un-important jobs can be out sourced to small scale industries developed, thereby reducing the cost of production. Some time, the presence of good ancillary industries attracts the management to such locations.

ii) **Size of Investment, Nature of Product and Process:** Size of investment is an important factor as this leads to the requirement of land, water, electricity, etc. Large investment generally requires large area of land which is difficult to get in urban or semi-urban area. One has to go to rural area with such investment. Also type of product influences the decision.

iii) **Market Penetration:** A new location is capable of generating large demand for the product especially when the customer finds the manufacturer nearby and is assured of better sales after service. Market share of the company improves a lot if the location is in the midst of demand centre. The proximity to demand centre becomes more important when the product is perishable type. The company, as a result, becomes competitive and can flourish.

iv) **Government Policies and Incentives:** Stability of the Government and its policy of industrialization, development of backward areas, moratorium/relief on income tax, duties and levies, etc. need to be considered carefully. Some time, foreign collaborators, if any, may influence the site selection. Pollution norms and related matters also influence the site selection. People are more aware of pollution and their effects on the society than ever before. All the related costs are also to be considered and evaluated.

4. QUANTITATIVE TECHNIQUES:

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

a) **Dimensional Analysis:**
This technique as mentioned by M.Telsang, is valid for comparing two competing locations and find the better one. In this method, relative merits or cost ratios of the two locations for each of the cost factors is calculated and an appropriate weightage is given to each ratio and their product is found out as shown below:

Let $C_{m1}, C_{m2}, C_{m3}, ... C_{mz}$ are the costs associated with location M for z different cost factors,
$C_{n1}, C_{n2}, C_{n3}, ... C_{nz}$ are the costs associated with location N for z different cost factors,
$W_1, W_2, W_3, ...W_z, ...$ are the weightage for z number of cost factors, then -

Merit of location $M = (C_{m1})^{w_1} X (C_{m2})^{w_2} X .... (C_{mz})^{w_z}$ and

Merit of location $N = (C_{n1})^{w}{}_1 \times (C_{n2})^{w}{}_2 \times \ldots\ldots .. \; (C_{nz})^{w}z$

The relative merits of locations M and N are given by-

$$RM = \frac{Merit\ of\ M}{Merit\ of\ N} = \frac{(Cm1)^{w1}\ X\ (Cm2)^{w2}\ X \ldots\ldots..\ (Cmz)^{wz}}{(Cn1)^{w1}\ X\ (Cn2)^{w2}\ X \ldots\ldots..\ (Cnz)^{wz}}$$

If the value of **RM $\geq$ 1,** select location **N**, otherwise select location **M.**

The advantages of this method are :– It compares both subjective and objective (tangible and intangible) factors and gives a quantitative value for decision making.

b) **Comparison of ROI:**
 In this method, return on investment (ROI) for the various locations are evaluated and decision is made in favour of the location with highest ROI. This is explained with an example.

Example: Four locations, A,B,C and D are competing for selection as location for a manufacturing unit. Both tangible and intangible factors collected by experts are given in Table-1:

Money Values (Rs. X 10^5)   Table-1

Sl.No.	Particulars	Location			
		A	B	C	D
1	Total investment in land, building, plant & machinery	500	600	550	700
2	Total Sales	550	700	600	680
3	Cost of Raw material	175	250	210	250
4	Expenses on utilities	85	100	92	100
5	Cost of Sales	95	90	90	100
6	Wages and Salaries	60	55	60	80
7	Finance Cost	90	108	99	126
8	Total Expenses (3+4+5+6+7)	505	603	551	656
9	Return on investment (ROI) (%) = {[(2-8)/1] X 100}	9.0	**16.2**	8.9	3.4
10	Stability of Govt.	Bad	Good	Good	Very Good
11	Attitude of community	Indifferent	Very good	Good	Good
	Decision		**Select B**		

From the above table, it may be concluded that location B is the best choice having the highest ROI. In this case, no attempt has been made to quantify the intangible factors 9 and   10 above.

c) **Point Rating Method:**

This technique, was originally designed by Merill R. Lott for job evaluation, can be used with suitable modification for selection of location for a new company. The factors, weightage and degree of factors should be very carefully decided and FACTORI-POINT MATRIX be made as shown in Table-2. Some authors even applied linear programming technique for deciding the weightage, specially for job evaluation. Once the matrix is made, the Evaluation sheet can be prepared and filled up by competent personnel and decision on plant location be made on quantitative basis.

FACTOR-POINT MATRIX   Table-2

Sl.No.	Factors	Weightage	Degree of factors			
			1	2	3	4
1.	Cost of land	12	12	24	36	48
2.	Cost of labour	15	15	30	45	60
3.	Communication(Road, rail)	20	20	40	60	80
4.	Availability of skilled labour	10	10	20	30	40
5.	Availability of stable power	10	10	20	30	
6.	Proximity to market	6	6	12	18	
7.	Proximity to township	7	7	14	21	
8	Proximity to airport, sea port	5	5	10	15	
9.	.Availability of incentives	7	7	14	21	28
10.	Stability of the Govt.	8	8	16	24	
	Total	100				

5. **Practical Application:**

A large joint venture Indo-Japanese company was contemplating a new highly technology oriented manufacturing plant in India. When selecting the location of the plant, it was decided that quantitative technique should be used for a decision on the same as there was divergent opinions from the partners on the location. Then, it was decided that a joint committee of 8 senior executives (3 from Indian partner and 5 from foreign collaborator) would work out the factors, their weightage and degrees of factors and hence Factor-Point Matrix. After visiting 7 locations in 5 states and thorough discussion with respective state governments and others, the committee narrowed down the options to 3 locations in 3 states. All the 8 members filled the Evaluation sheet separately. A typical Evaluation sheet is shown

in Table-3 :

EVALUATION SHEET Table-3

Sl.No.	Factors	Weightage	X(N)	Y(K)	Z©
1.	Cost of land	12	12	36	24
2.	Cost of labour	15	15	60	45
3.	Communication(Road, rail)	20	20	60	40
4.	Availability of skilled labour	10	40	30	20
5.	Availability of stable power	10	10	30	30
6.	Proximity to market	6	18	18	12
7.	Proximity to township	7	21	21	14
8.	Proximity to airport, sea port	5	10	15	15
9.	.Availability of Govt. incentives	7	8	16	8
10.	Stability of the Govt.	8	16	16	24
	Total	100	1758	**3702**	2756

The responses have been tested and out layers have been rejected. From the Evaluation sheets, the point score for each Factor were added and the best location, Y(K) was determined. The best location was then recommended to the top management of the partners which **was accepted**. In spite of the divergent views of the partners due to their social, cultural and industrial background, the selection of the location was made comfortably by the application of the point ranking system.

6. CONCLUSION

The selection of location of plant is very vital for existence and prosperity of an organization. A large number of tangible and intangible factors are involved in a location problem that make the decision problem very complex. Only qualitative judgment or intuitive decision may not lead to a good decision. Quantitative techniques presented here are also not entirely free from drawbacks. But this helps in making a much better decision. Also, there is nothing like permanent good location. In reality, no location can be considered unique and can remain good for ever. 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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