# A Study of Break-even analysis for facility location planning

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**Abstract:** The point of facility location models is to choose an assortment of offices (distribution centers, plants, open offices, radio wires, and so on.) to be introduced over an offered zone to address the issues of all or part of clients around there. The point of this paper study was to decide the effect of utilizing breakeven point in planning, overseeing, and dynamic, location getting ready. The examination suggested that organizations use breakeven as a key dynamic and arranging oversight apparatus in light of its effect, effectiveness and precision in justification and control choices.

Keyword: *Facility Location Models, Break-Even Analysis*

## 1. Introduction

The problem of the location of the installations is important for a company to make strategic decisions. The efficiency in which the product (services) is passed on to the customer is unique of the main structures of the business system. This includes the determination of where the facility or facility should be located. Holmes defined the location problem as one by which 'the location which offers the company the greatest advantages obtained by location in the light of all factors affecting the product / service provided to customers and the product(s) to be produced.' The location choice is important because major investments are made in construction equipment and machinery. Changing the location very often is not desirable or unlikely. As a result, the plant can be poorly positioned and any investment in manufacturing and machinery can be unnecessary. Long-run conjectures ought to be made for the future needs of the organization before the location of the facility is chosen. The location of the facility should be built on the expansion and policy of the company, product diversification plans, changing market conditions, new sources of raw materials and many other factors that affect the choice of location. The aim of the location analysis is to find an optimal location for the company to make the most of the profits.

The executives accounts have numerous applications in arranging, checking, dynamic and money saving advantage investigation. Break-Even-Point is one of the key instruments of cost-volume esteem investigation (CVP). Break-Even-Point isn't a ultimate objective alone, yet is one of the key devices for estimating the benefit of an organization. Break-Even-Point is where generally speaking pay is equal to add up to variable and fixed costs. Because of the extraordinary significance of Break-Even-Point in dynamic, the focal point of our examination study will be on the utilization of Break-Even-Point in arranging, controlling and dynamic in office area arranging.

## 2. LITERATURE REVIEW

H. Tamura. et al .. [1] identified the position problems called a p-center problem, an r-cover issue and an undirected flow network p-median issue. To overcome these problems, they suggested polynomial time

algorithms. Goldengorin B. Et al. [2] Simple plant position problem branch and peg algorithm (SPLP). Such algorithms boost the basic branch and the bound method in two ways. Firstly. Firstly. A powerful pegging procedure is applied to each sub-problem created in a branch and bound tree to reduce the size of the sub-problem. Furthermore, the expanding capacity is evaluated by utilizing the Beresnev subproblem work. We note that branch and interfacing calculations outperform branch and restricting calculations with a similar association, taking on normal under 10 percent of the hour of the branch and associated calculations if the cost network of transportation is thick et al. [3] extended Simulated Annealing method (SA) in the case of zone-dependent fixed costs for the resolution of the disabled permanent location-allocation issue. Recreated recovery is one of the metaheuristic strategies got from a Strong's recovery. Numerous parameters, for example, beginning points, starting temperatures and cooling timetables will be checked for SANAM. The data collection for 50 literature consumer problems is used. C++ addresses the problems of finding 2 to 15 facilities. This paper articulates the stochastic and dynamic bank branches position problem, as a Markov Decision Process (MDP), and proposes a policy iteration algorithm to ensure optimal investment policies. The findings are promising. The paper Xia. L et al. [4] presented Numerical examples demonstrate the efficiency and efficacy of our algorithm and formulation. In addition, the language and algorithms have been integrated into an IPM asset called IFAO-SIMO and have been used as the asset optimization engine mathematical kernels. Chen Z. et al. [5] The current model proposed is extended to address the multi-supplier and multi-customer position problem that is compatible with the real condition. Be that as it may, this issue is partitioned into the stockpile stage and appropriation stage, which considers an assurance of the ideal DCs by the Max-Min subterranean insect grouping calculation and this algorithm is feasible with the simulation experiment. Ran M. et al. [6] has an improved optimum choice of network location. The model of location choice considers not only the maximum distances between vertices, but also the sum of the cost, which in our society is a common problem. The break-even point for a corporation is the volume of profits or revenues it wants to generate to balance its expenditures[7]. In other words, the company does not make any profit or incur a loss. Break-even point calculation can provide a valuable quantitative method for managers. Break-even analysis offers an assessment of whether or not sales from a product or service will exceed the actual costs of producing this product or service. Directors may settle on a wide scope of business choices, including evaluating, arranging serious arrangements and applying for credits [8], utilizing this information. Numerous different factors, for example, expected changes in business conditions, sway the budgetary steadiness of the association after some time. A break-even investigation can accordingly be viewed as a principal instrument to give a picture of where an organization remains at a particular time and to be utilized alongside other monetary pointers. Be that as it may, a break-even investigation will give us significant fundamental subtleties on the organization's state [9]. On the off chance that the consequences of the audit recommend that revenues are insufficient to take care of expenses, or that the overall revenue is littler than it ought to be, steps might be taken to lessen the expense of tax assessment. Start by discovering approaches to diminish the expense of purchasing or assembling products or administrations that we offer, or

whether any providers can offer us the equivalent or something very similar for $2.75 rather than $3? When we make the commodity ourselves, are there less expensive manufacturing options? Or if we can take action to reduce operating costs without damaging our operations. Finally, will we look at price hikes? The usage of little changes in at least one of these territories could permit the organization to restore the breakthrough point and push it towards higher gainfulness [10].

### 3. Break-even analysis for facility location planning

There are two types of cost in the process of processing from inputs: fixed costs and variable costs. Capital costs are the capital spending (long-term fixed asset investment investment) such as land acquisitions, renovation, machinery and equipment acquisitions. In fig 4.1, we can see that the fixed cost remains the same at the prod auction of zero units, 500 units and 1000 Units (number of units generated with in a given duration) (Fig.1). Labor (directly involved in production) and raw metrics are variable costs. Fixed cost As production volumes increase more and raw materials are required for production and therefore variable costs increase.

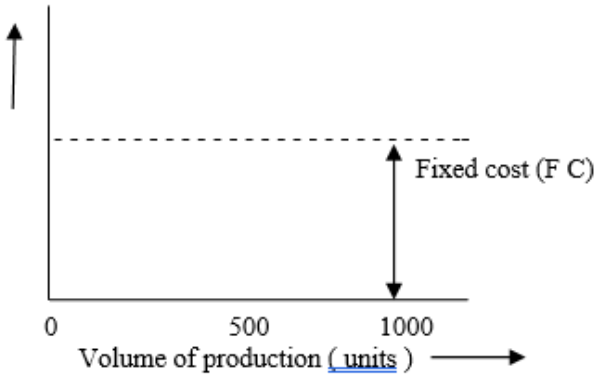



**Fig. 1 volume *of production vs cost***

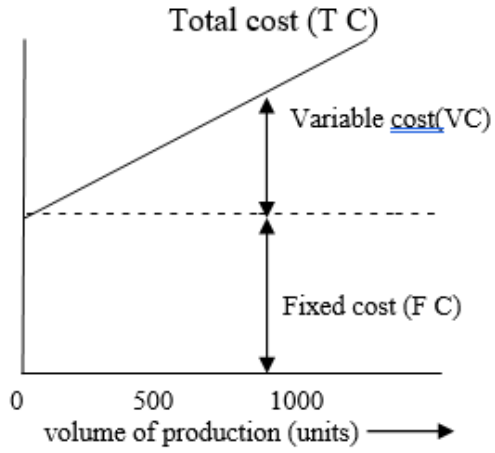



**Fig.2 *Total cost as a sum of fixed & variable***

At the point when the variable expense (VC) is added to the fixed expense (fc), we get the complete cost (Tc)

We are now developing the Total Revenue (TR) curve for a given output volume (Fig.2). Reveme is the money the company has received when it sells its goods at retail rates. The TR curve is a straight line at a

certain pitch of the origin reflecting the price of the object (Fig.3)

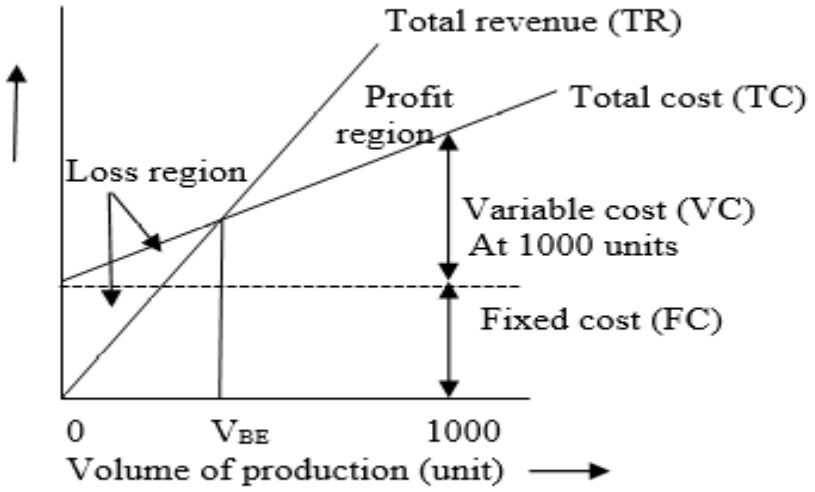
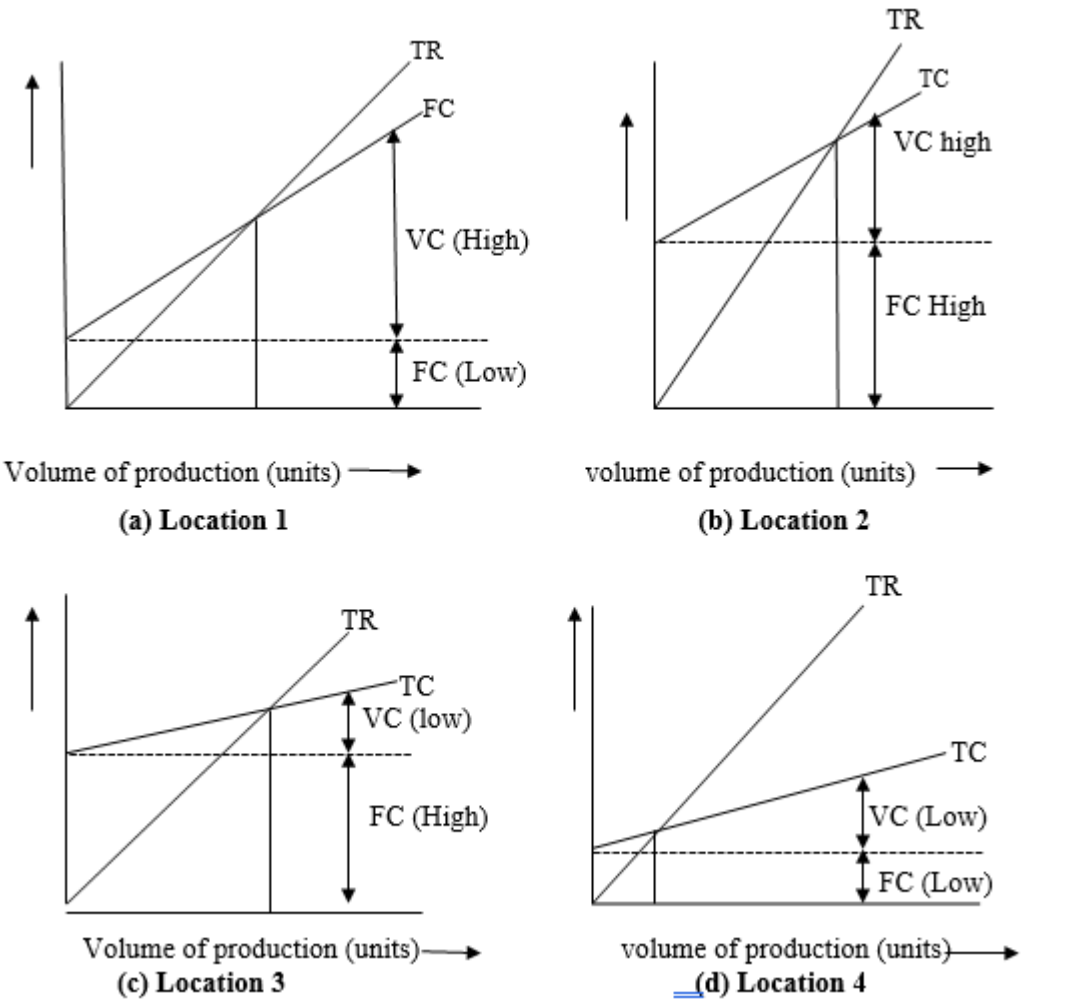



**Fig 3** ***Graph showing TR, TC and the break-even volume*** $V_{BE}$

Figure 3 shows that the area where TR is more than TC is the area where TR is less than TC is the area of failure. The point at which TR = TC is the break-even point corresponding to the break-even point value VBE of the x-axis VBE reflects the production volume at which there is no benefit or loss. All expenses incurred are fully generated by sales. A corporation often wants a low break – even volume, so that its investments can be recovered in the planning of the facility, where the break-even amount is less. Fixed costs and variable costs may vary in location options and therefore these choices may vary in different location choices and will therefore have different VBE values (Fig.4). Obviously, in fig.4, the best choice of location is position 4, with clearly the least VBE [fig.4(d)]].




Break-even analysis is more suitable for screening the better location options rather than for selecting the best one.

### 3.1 Facility Experiencing Very Demand Increasing at a High Rate:

If the demand for goods produced / offered by an installation increases at a high rate, an analysis of breaks is useful to determine whether to extend the facility by means of restricting steps, create more installations and operate more of them in changes. Find a case in point. A corporation recently ordered a plant X for famous goods to be produced. The product has a high demand in the plant-even point VMAX (X) with a total cost of TC (x) (fig.5)

The brand of the company becomes more popular and, in order to reach the market further, agrees to operate plant x in two shifts. Now the overall cost curve is steeper in parallel as the trade unions have agreed with management to give the workers working in the night shift higher pay. Variable costs also increase due to increased wear and tear of machines and equipment and therefore higher maintenance costs (fig.6)

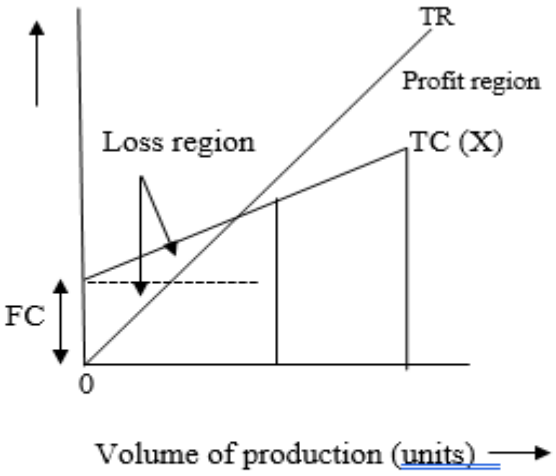



**Fig. 5** ***Graph showing initial values of and for plant X***

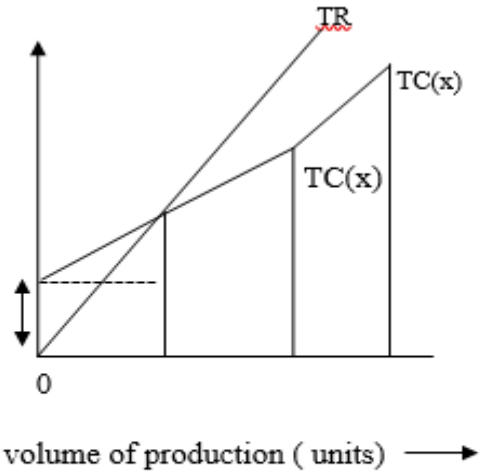



**Fig. 6 Graph** ***depicting change in after plant X introduce a double shift***

Plant X currently generates a maximum of Vmax (X) DS units by incuring a TC(X)DS total cost. Market demand continues to increase and the business continues to be forced to extend the capability of the plant by curing the FC(X)EXP fixed cost (Fig.7)

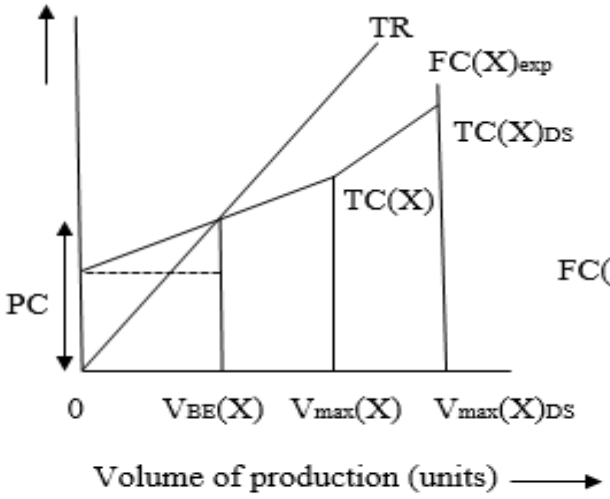



***Fig 7 Graph showing expansion Of plant X with fixed cost FC(X)exp***

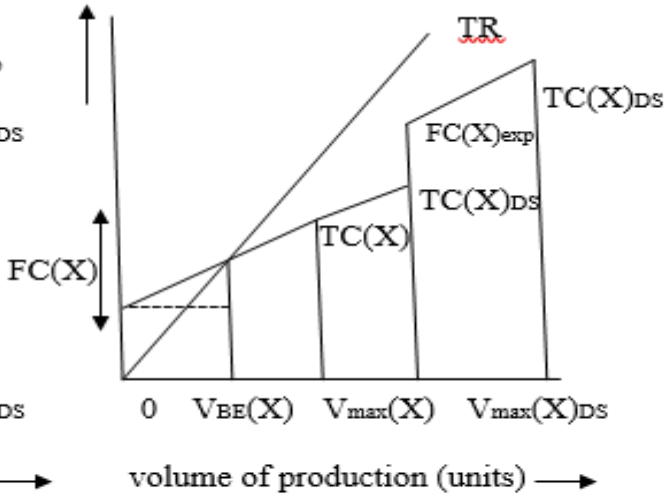



***Fig.8 Graph depicting plant X operating in its full capacity.***

Once the start operating in its fully expanded capacity, it produces a maximum of $Vmax(X)_{DS.exp}$.items with a total cost of $TC(X)_{DS,exp}$(fig.8)

The company's grabbed a big market share. In order to retain its market position, it decides to commission a second plant, y, by incurring a fixed cost of FC(Y) (fig.9.). Plant Y after commissions, increases the production cop city of the company to Vmax{(X)DS, exp+(Y)} at a total cost of TC {(X)DS, exp+(Y) The

combined break-even point of the two points is VBE{(X)DS,exp+(Y)}(fig.10)

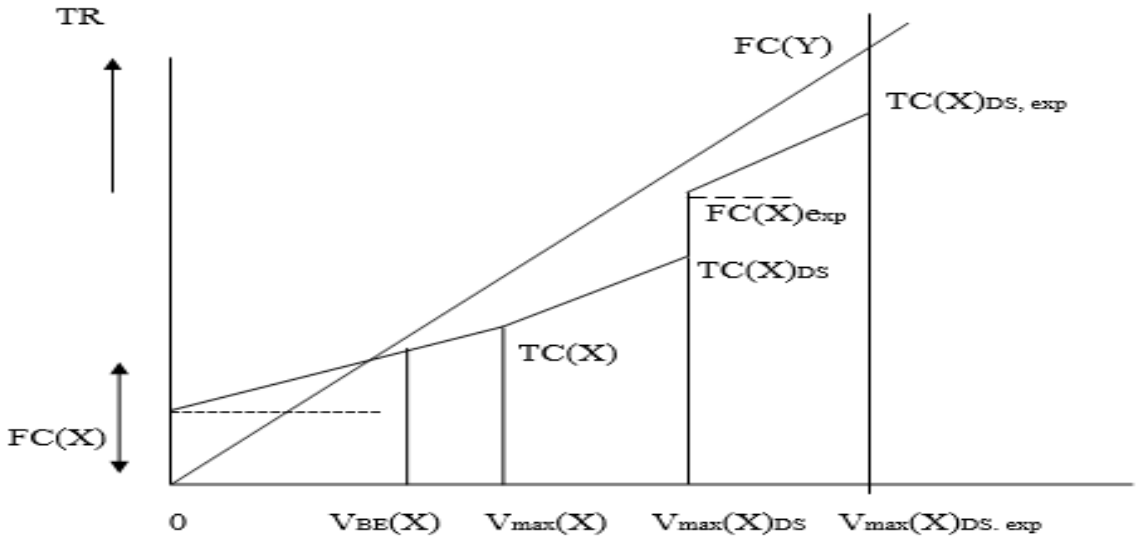



*Fig.9 Graph depicting the commission of a second plant, Y*

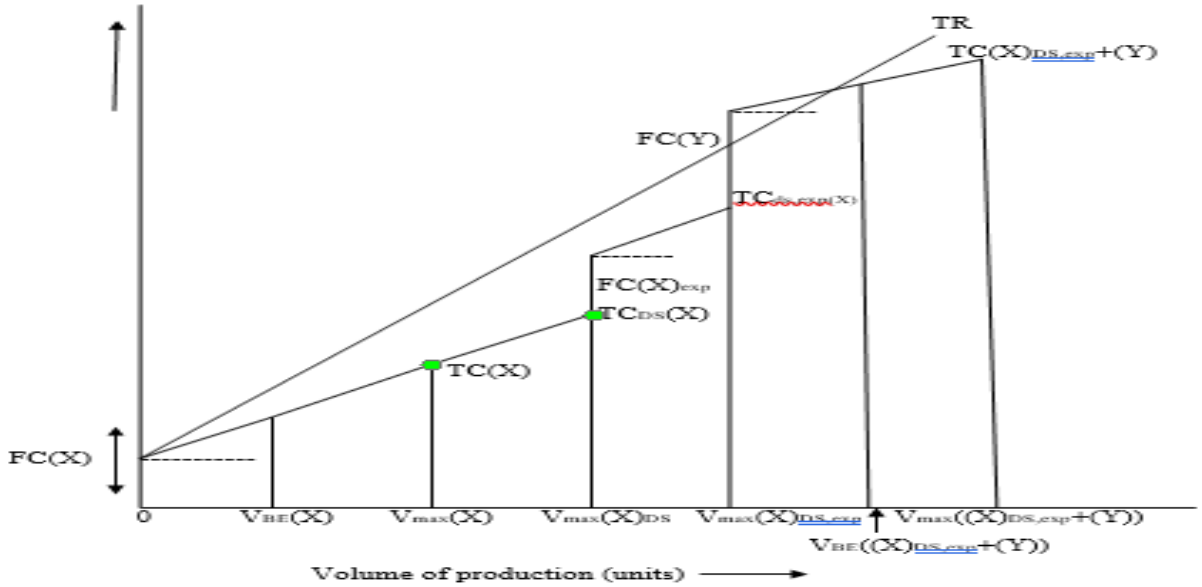



*Fig.10 Increased production capacity after commissioning of plant Y*

The company know that, if need be it, can operate plant Y also in two shifts pushing the Maximum production capacity to VMAX {(X) DS, EXP+(Y) DS} units by incurring a total cost of TC {$(X)_{DS,exp}$ +$(Y)_{DS}$ } (See fig.11)

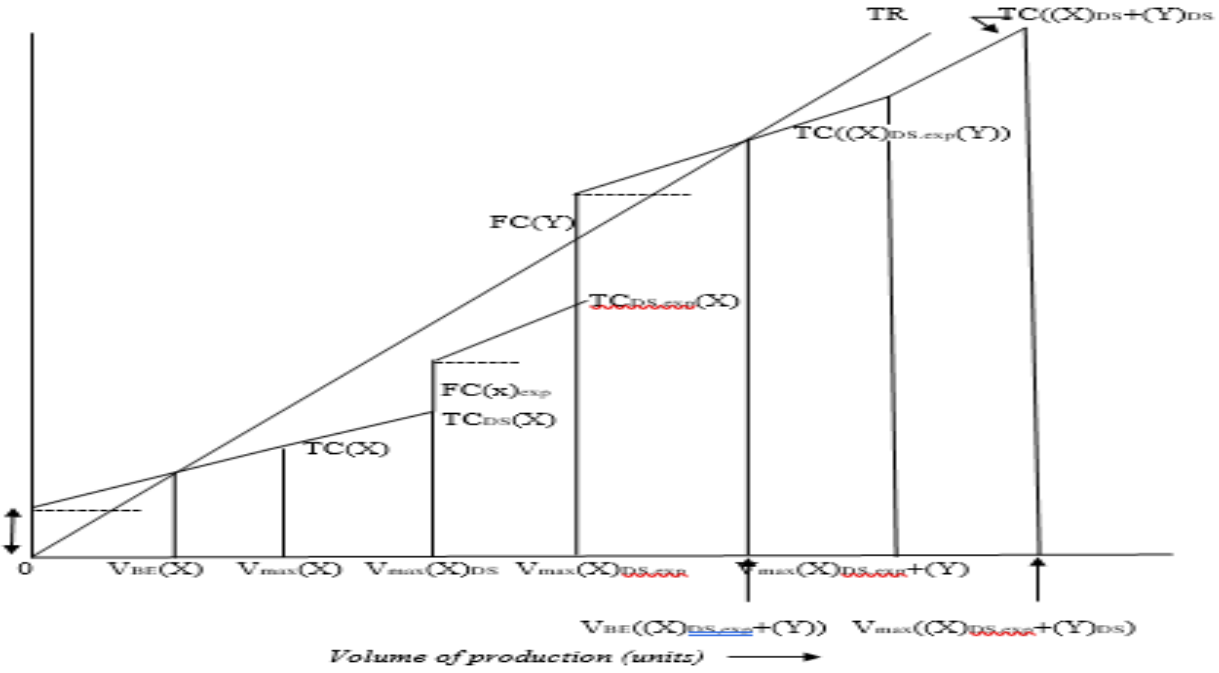



**Fig. 11** *change in Vmax after plant Y introduces a double shift*

## 4. Numerical Examples:

### Example 1

In Delhi, the new health center will cover seven census tracts. The following table shows the co-ordinates estimated in thousands for the middle of each census tract along with the population predicted. When they need medical care, consumers must move from the seven-census tract center to the new hospital. Two sites for the new facility are named (5.5, 4.5) and (7, 2), which are the census tract C and F centres. The descriptions of seven census centers and the distances for each center are listed below, along with the population. Find the center of gravity of the goal location for the health-care treatment facility.

**Table:1**

| *Sl. No.* | *Census tract* | *(x, y)* | *Population (l)* |
|---|---|---|---|
| 1 | A | (2.5, 4.5) | 2 |
| 2 | B | (2.5, 2.5) | 5 |
| 3 | C | (5.5, 4.5) | 10 |
| 4 | D | (5, 2) | 7 |
| 5 | E | (8, 5) | 10 |
| 6 | F | (7, 2) | 20 |
| 7 | G | (9, 2.5) | 14 |

***SOLUTION:***

Break even analyses indicate that overall income is equal to the total expense at any stage in operations. Break also analyzes are aimed at determining the exact relationship between sales and costs. It is known as the break-even point. The Fig. The Fig. 12 Break-Even Chart represents Breakeven point: is the production

value, where there is no benefit or loss. Through the use of the reference, the break even point (BEP) in units can be calculated:

BEP=Fixed Cost Contribution per unit =Fixed Cost Selling Price- Variable Cost per unit

=FS-V

The Break Even Point (BEP) in Rs. can be calculated by using the relation:

BEP=Fixed CostPV Ratio=F Rs.Φ

***Units of yield or level of limit***

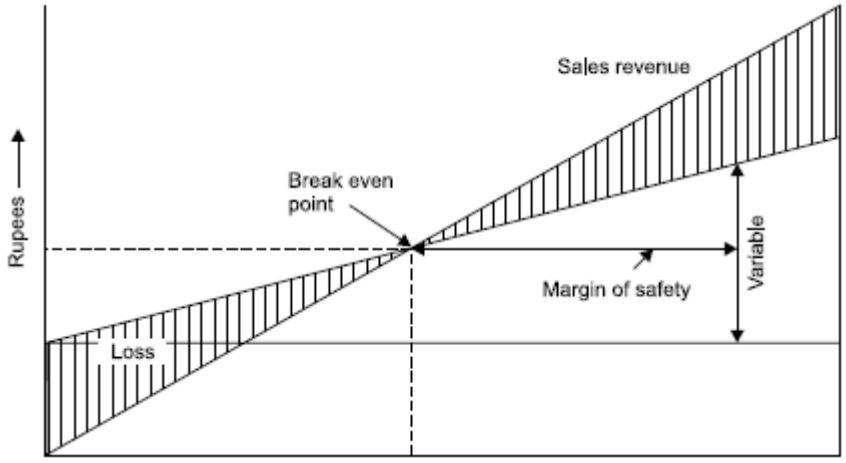



Figure:12 ***Units of yield or level of limit***

Plotting the breakeven chart for each area will allow economic position comparisons. This will help define the output volume range from which location can be selected.

**Example** **2**

Potential locations *X*, Y, and Z display cost structures below. ABC corporation demands 1,30,000 units of a new drug. There are three possible locations X, Y, and Z with identified cost structures. Select which location to pick and define the volume ranges where what location fits?

**Table:2**

| | *Location X* | *Location Y* | *Location Z* |
|---|---|---|---|
| Fixed Costs | Rs. 150,000 | Rs. 350,000 | Rs. 950,000 |
| Variable Costs | Rs. 10 | Rs. 8 | Rs. 6 |

***SOLUTION:***

Solve for the crossover between X and Y:
10X+ 150,000 = 8X + 350,000 2X = 200,000 X = 100,000 units

Solve for the crossover between Y and Z:

8X + 350,000 = 6X + 950,000 2X = 600,000 X = 300,000 units

Therefore, Y is the correct strategy for a volume of 1,30,000 units. The graph shows that location X is up to 100,000 units suitable, location Y is up to 100,000 to 300,000 units and location Z is suitable if the demand is over 300,000 units.

***BEP chart***

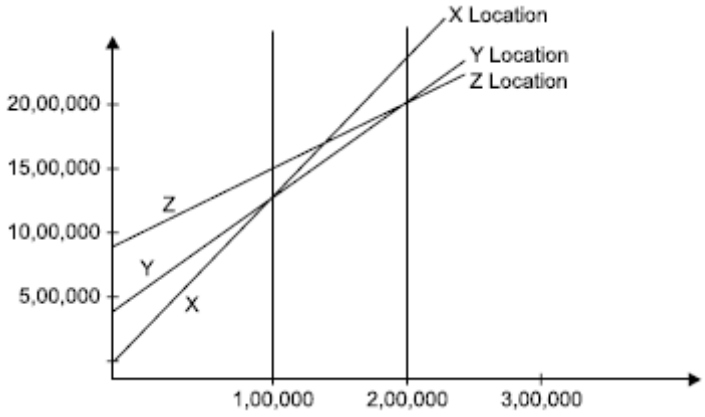



**Figure :13**

## 5. Conclusions

Facility location problems utilizing Break-Even-Point in arranging, the board, and dynamic. The associations likewise direct BEP survey in the arranging stage for human asset the board, including spending planning, development and execution inspecting. The facility's position problems lead Break-Even-Point investigation to make long haul, transient choices. The outcomes additionally show that they use BEP examination to control accounts and kill unfortunate behavior.

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