Principles of Industrial Engineering
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Lecture-15
Plant Location & Layout Methods for Selection of Site II

Hello, I welcome you all in this presentation related with the subject, Principles of Industrial Engineering and you know we are talking about the methods for selection of the site so that the plant or an organisation can be located or developed at the site. We have seen that there are two broad scopes related with the selection of site. One is the selection of general territory and another is the selection of the specific site or location. So, the methods which are used for selection of the site, that includes like, there are 5 methods.

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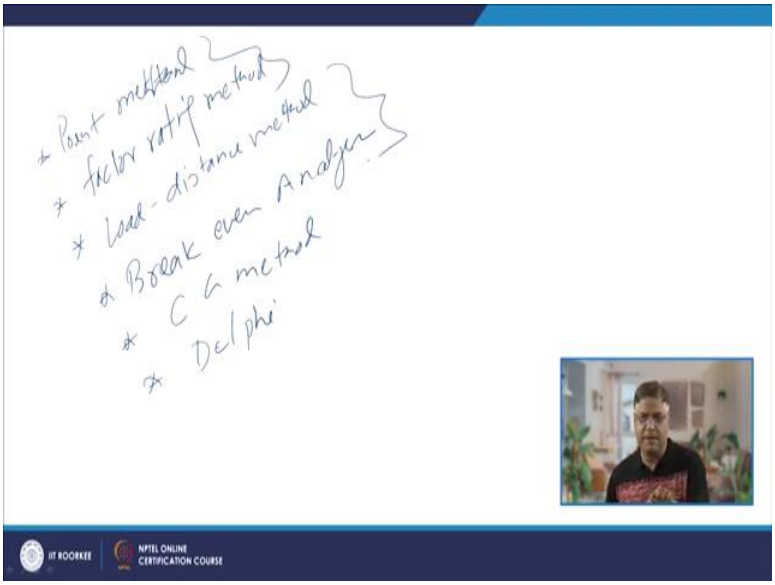

There was one point. Then there was like the factor rating, point method, factor rating method. About these two methods we have talked in the previous presentation. The other three methods are like load distance method, breakeven analysis method and centre of the gravity method, CG method, is also called CG method. There is also qualitative method which is called a Delphi method for selection of the site. So today, I will talk about the load and distance method, load distance method and the breakeven analysis method.

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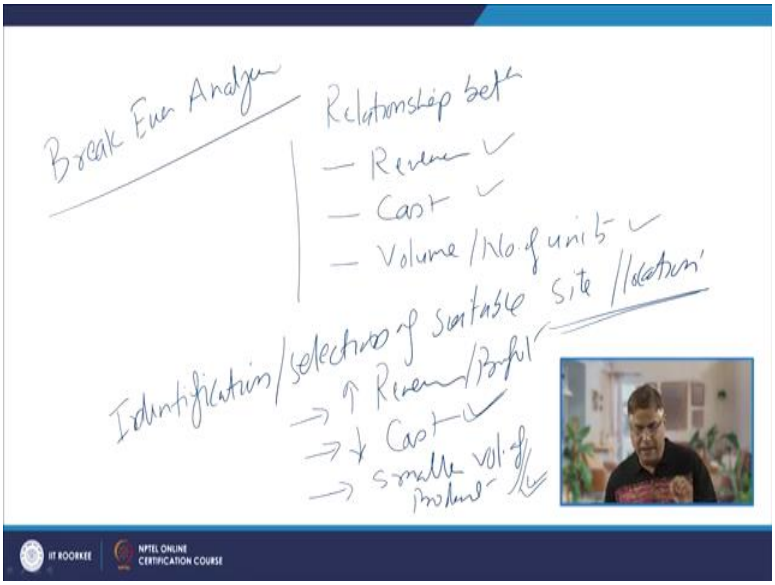

So the breakeven analysis, basically this breakeven analysis of a situation or of a company or for the site, it shows the relationship between revenue which will be generated through the production of a product or service, the cost which is being incurred on account of the production of goods or service and the kind of the volume or the number of units which are to be produced. So relationship between the revenue generated, total cost of the item at which it will be produced and the number of units that will be produced, a kind of relationship between these three is expressed in the breakeven analysis.

This kind of analysis helps in identification or selection of suitable site or location where we can develop a plant so that for a given volume, our revenues increase or we are able to produce the goods and services at lower cost or the breakeven point is realised for very smaller volume of the products to be manufactured. So the goal is to find the suitable site, which will help in increasing the basically profit, making the products and the services at the minimum total cost and having a site for which the number of units to be produced for breakeven situation is minimum.

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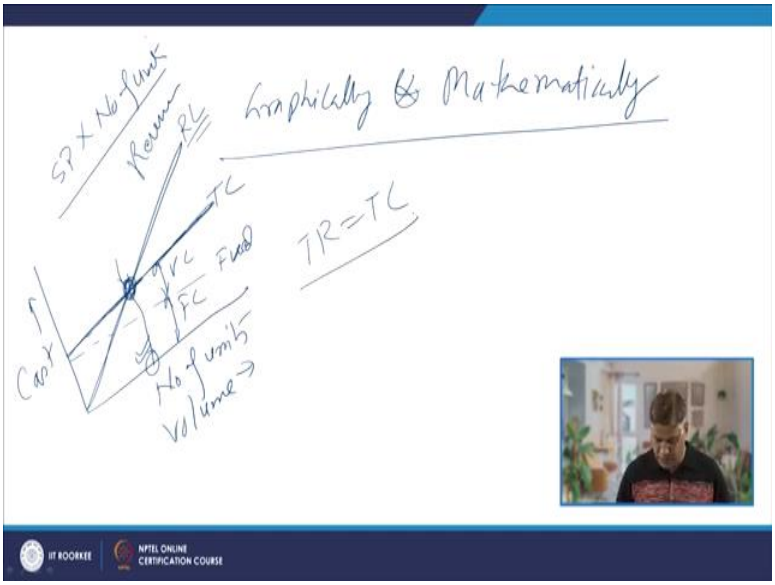

So this kind of the breakeven analysis is shown or expressed, both graphically and mathematically. So when we express the breakeven analysis with the help of the graphic representation, it uses the cost in the y axis and the number of units to be produced and that is the volume or number of units to be produced in the x axis and the different lines are plotted to show the kind of the fixed cost plus the variable cost. So sum of these two leads to the, so here this forms the fixed cost and this forms the variable cost of for a given volume.

So a sum of these two leads to the total cost. So initially one line which is shown in the cost versus the number of units relationship is the total cost. And if we draw just showing that revenue generation. Revenue generation means, the sale price of the product and the number of units which are produced. So it will be increasing linearly. Depending upon the sale price we will have the intersection of the total cost line with the revenue line and this intersection is taking place at this point for which the total cost will be equal to the revenue generated.

So this is the total cost line and this is the total revenue generated and where these two are intersecting, that leads to have a number of units corresponding to the breakeven point. Means, the total cost for this much number of units, this much volume of the units produced the total revenue generated will be equal to the total cost.

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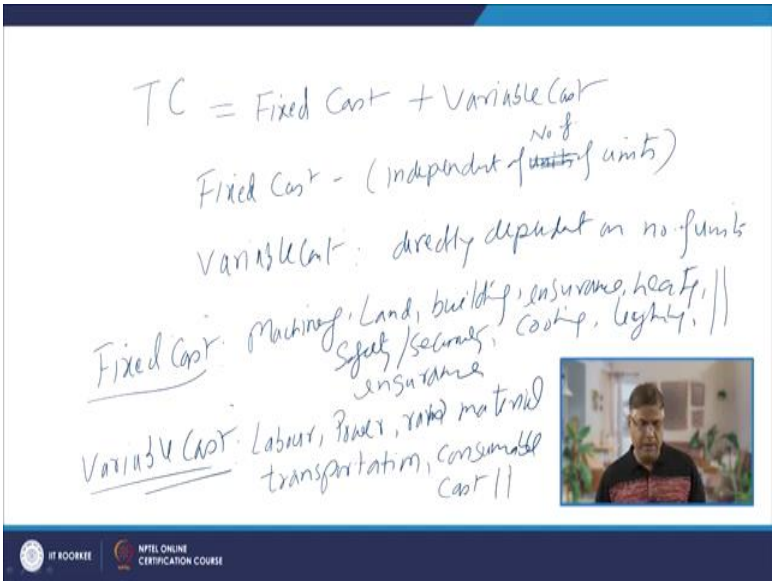

So to understand this clearly, we need to see what are the different constituents involved in in the total cost of manufacturing of good or service. So like say total cost comprises the two components, mainly one is fixed cost and another is variable cost. Fixed Cost basically found independent of the number of units produced. So, irrespective or independent of number of units produced, number of units produced. While the variable will be directly related with the number of units produced.

So directly dependent on the number of units produced. So the different the items which you will be falling under the fixed cost includes, so which this fixed cost is independent of the number of units. Whether we produce two units or 10,000 units the fixed cost is not going to change in the organisation. So the fixed cost includes like cost of the machinery which is involved in production of the goods and services.

The cost of the land, the investment in needed in construction of the building, the insurance, the heating and cooling requirement, heating and cooling requirement, lighting requirement, safety and security. So expenditure on these heads will be independent of the number of units to be produced. Insurance. So expenditure on account of these heads will be fixed and it will not change with the number of units which are being produced.

On the other hand, the variable cost will be directly linked with the number of units produced or the number of goods to be produced, the amount of the consumable things to be produced. Like the manpower, which is directly involved in production of goods and services. So labour

cost, the power consumed. So the cost related with the power on account of the running of the machines for production of the goods and services.

The kind of the raw material cost, like the metal systems or the consumable items, raw material cost. Then the transportation cost, consumable cost which will directly be related with the number of units or the volume of the goods and services to be produced.

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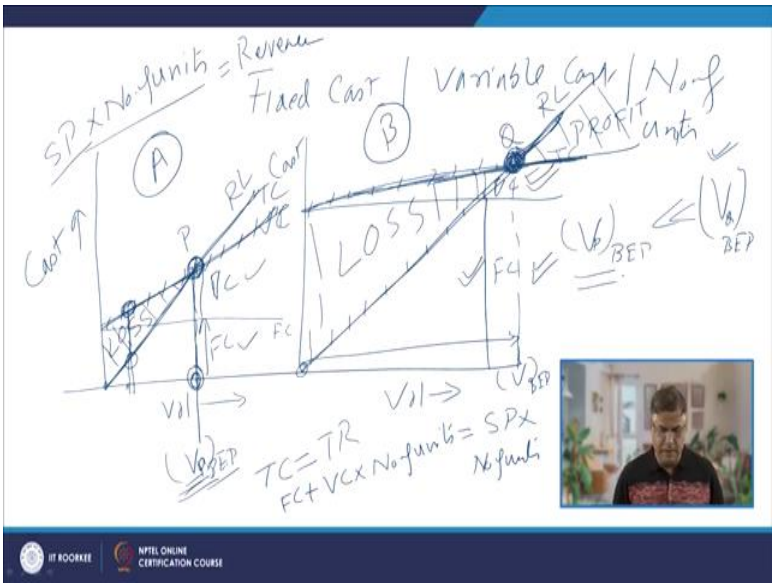

And to a great extent a direct relationship is observed between the fixed cost, variable cost and the number of units to be produced for breakeven point. In general higher the fixed cost, lower becomes the variable cost, but it in turn increases the number of units to be produced for breakeven situation. So, if we plot a diagram corresponding to the, like volume or the number of units in the x axis and the cost in the y axis, so here let us say very low fixed cost, FC.

So, when we have low cost, in general the variable cost is high, so leading to the higher total cost. So this slope will be indicative of the variable costs, the rate at which the variable cost is changing for unit product. So it will remain constant. So this line will be the sum of the fixed cost, FC and the variable cost and sum of these 2 will be leading to the total cost. And if we are able to sell the unit, per unit at a particular price, then that is termed as sale price.

So sale price into the number of units produced, that gives us that revenues generated. So it will be if zero volume sold, then the total revenue generated is nil and then it will be increasing linearly, like this. So this is a revenue line or total revenue line. What it shows that if the number of units is this much, then this is the total cost, this is the variable cost. So the

total cost and this is the fixed costs and this is the variable cost and this will be leading to the total cost while the revenue generated is just this much.

So the total cost is much higher than the revenue generated, which means this is the loss region. So the region which corresponds to loss is this region which is falling in the left side between the total cost line and the revenue line, this region is the loss region and the line where the revenue line is intersecting the total cost line at this point p. So the number of units corresponding to this point p is termed as volume corresponding to the breakeven condition breakeven point.

For this point, the total cost to produce this much number of the items or this much volume of the items will be equal to the total revenues generated TR, which means the total cost which is the sum of the fixed cost plus variable cost per unit into the number of units produced equal to the sale price into the number of units sold, that is equal to the number of units produced.

So for the breakeven point this value, total cost and total revenues generated will be equal and that is happening to this much volume, VBEP. On the other hand, if we assume that fixed cost is very high and variable cost is really low, so this will be leading to the total cost okay. So for any volume if we see, for any value here the fixed cost is very-very high, that is FC and variable cost is low and that is how it is forming to the total cost.

As compared to the earlier case now the total cost is significantly high. So, now if we are selling at the same price, then the slope of this line will be the same. So, here we will be drawing another line. So here, total cost line is cut by the revenue line at this point, say Q. Now this point Q is very far, at a very far distance from this origin line which is indicating the volume to be produced for breakeven situation, this is the revenue line.

This is the total cost line and it is cutting at this point Q. Corresponding volume is this VB breakeven point Q, right? So this if we see, the volume corresponding to the point P, BEP is significantly is smaller than the volume corresponding to the BEP at the Q point. So here we can say Q and here we can say P. And this large difference is primarily attributed to the high fixed cost for another situation.

So let us say if location A is having the lower fixed cost and little bit higher variable cost and then the breakeven volume corresponding to the breakeven point comes up to be VP BEP okay. And another location where fixed cost is very high and variable cost is low, but still the

total cost is coming too high. Then for the same selling price, the volume corresponding to the breakeven point will be obtain at much higher volume or number of units.

So if we see all this region between the total cost line and the total revenue line, all this region will be the loss making region. For all these volumes, the company will be making the losses at this location say B. While in case of A, this region is comparatively small. On the other hand, if we see the region between the total cost line and total revenue line on the right side of the breakeven point, this will be the profit region. So to make the profit an organisation must produce the number of units at a particular site greater than the breakeven volume, volume corresponding to the breakeven point.

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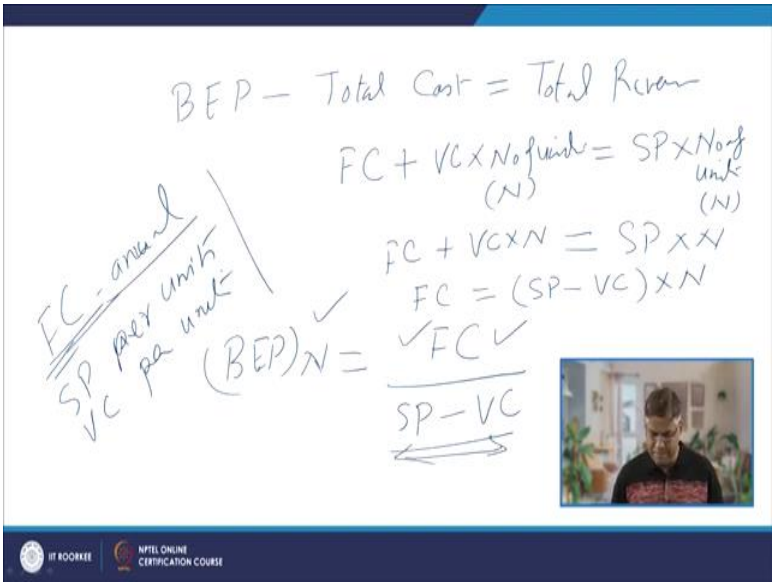

So here, if we see this situation like for breakeven point, the total cost will be equal to the total revenues generated and we know that the total cost is the function of the fixed cost into the variable cost per unit into the number of units produced for the breakeven situation. This is a call to the selling price into the number of units produced before breakeven point. So on simplification say this number is n number of units.

So this situation is reduced to FC Plus VC into an equal to SP selling price into N. So VC becomes equal to SP, selling price minus VC, variable cost per unit into the selling price that is also per unit into the number of units produced. So number of units to be produced for breakeven situation, N will be equal to the fixed cost divide by selling price minus the variable cost. So number of units to be produced for breakeven situation, that will directly be the function of the fixed cost and the difference of selling price and the variable cost.

We need to clarify here, fixed cost may be the annual expenditure which can be used to produce any volume of the units as per the capacity of the plant. Selling price is in terms of the per unit, the price per unit and the variable cost is the cost per unit while the fixed cost is the cost related with the different items on the annual basis. So higher the fixed cost greater with the number of units to be produced for the breakeven situation. Likewise greater is the difference in the selling price and the variable cost, smaller will be the breakeven point, number of units to be produced for breakeven situation.

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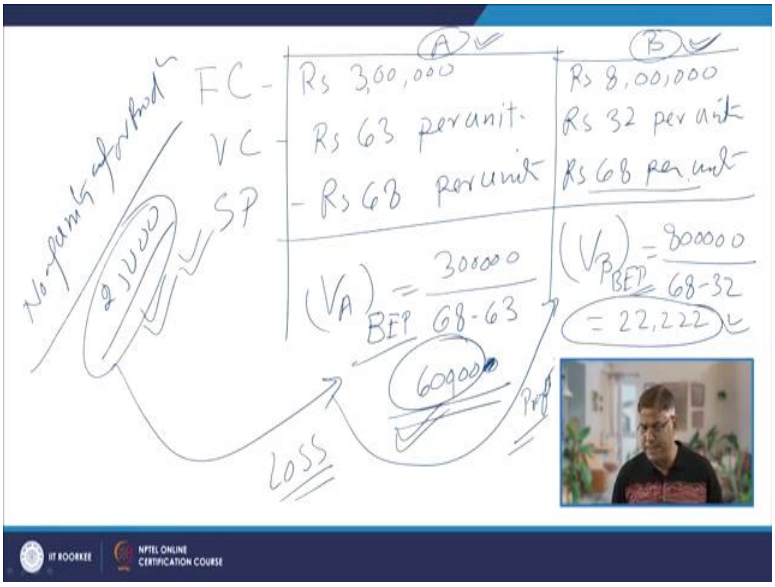

So now here if we see an example, like there are like in a particular example, like say the fixed cost for producing few items is like Rupees 3 lakhs and the variable cost to produce per unit is 63 rupees per unit. And the selling price SP is Rupees 68 per unit and the number of units to be produced, this is for like say site A and there is another site B for which the fixed cost is 8 lakhs, the variable cost to produce per unit is Rupees 32 per unit and the selling price is same Rupees 68 rupees per unit. So if we see, the fixed cost is a very high leading to the very low variable cost. So in this situation there are two locations offering the different fixed cost, variable cost, same selling price.

Then we have to identify which site will be good if the number of units to be produced. The number of units for production is a 25,000 then which site will be good. So if we determine the breakeven point, volume A corresponding to the breakeven point then the fixed cost that is 3 lakhs divided by selling price minus the variable cost. This comes out to be 60,000. So for breakeven situation means not loss and no profit situation we must produce 60,000 units at a location A for breakeven situation.

On the other hand the volume or the number of units to be produced at the site B for breakeven point, 8000 that is fixed cost, 8 lakhs that is the fixed cost divided by selling price, 68 minus the variable cost, 32. So the volume that we are getting is 22,222. So according to this if we have to produce 2500 units or no, 25,000 units are to be produced, then the site B will be more beneficial because the volume to be produced from for breakeven situation here is 22,222 while the number of units to be produced for breakeven situation at the site A is 60,000.

So if we take a decision to produce 25,000 units at Site A, then the company will be making loss, while if the same volume is reduced at the site B then company will be making profit. So according to this analysis, the selection of the site B for producing 25,000 units will be profitable if the selling price is 68,000 and the variable cost is 3, selling price is Rupees 68 per unit and the variable cost is Rupees 32 rupees per unit and the fixed cost is 8 lakhs rupees.

So now here I will summarise this presentation. In this presentation basically I have talked about the way by which the breakeven analysis method works for selection of the suitable site. Thank you for your attention.