Principles of Industrial Engineering
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Lecture-12
Plant Location & Layout Selection of Site

Hello, I welcome you all in this presentation related with the subject, principles of industrial engineering and in this presentation and will start a newer aspect related with this subject. And in this one we will be talking about how to select the location of the plant, how to design a layout of a plant for an organisation which is involved in manufacturing of some kind of the product for its customers.

So, we know the enterprise and the organisations, industries involved in manufacturing of the variety of the goods. Their primary goal is to manufacture the products and provide the services to their customers in such a way that they are in position to provide these products and services at the lowest possible price and the best possible quality so that they can effectively give the competition to their competitors and their customer base is increased.

So all the factors, which govern the total cost at which the product will be delivered to the customer that must be considered while choosing a particular plant location or the particular kind of the plant layout. The basically the point here is that we should select the location for a plant or a layout in such a way that the enterprise is in position to offer the product to its customers at the lowest possible cost.

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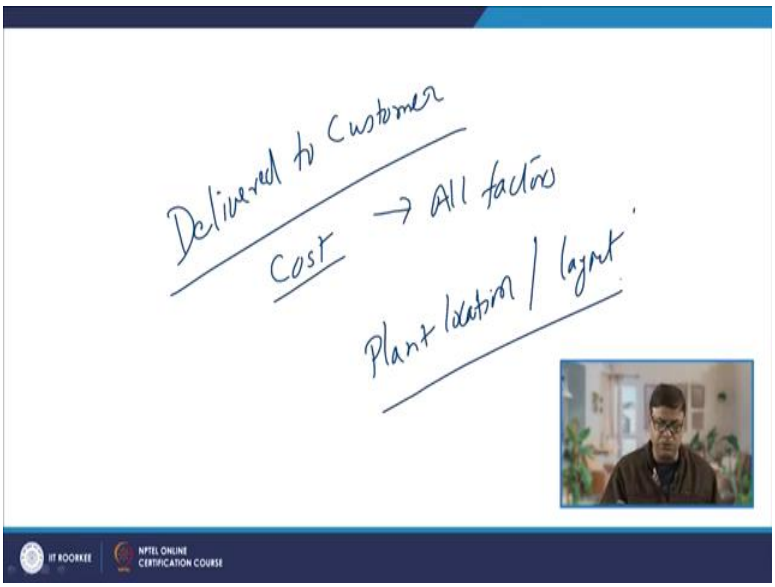

So the delivered to the customers, the cost at which it is being realised, the cost to delivery of the product to the customers that should be the minimum. And so all the factors which are affecting, the cost at which it is being delivered to the customer must be considered and accordingly we should suitably choose the plant location and the suitable layout for the plant so that it is in position to provide the product at lowest possible cost and the desired quality.

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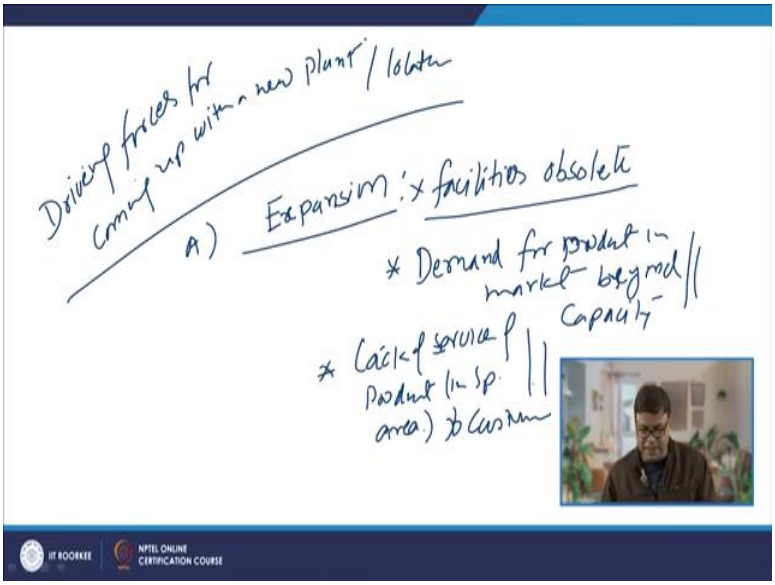

What are the different factors that should be considered for selection of the plant and under what conditions it is required to go for a new plant location? So we can say, there are three type of the driving forces for coming up with a new plant and so accordingly new plant location. These factors include like, the organisation wants to expand, expansion of the organisation is the one kind of the condition. Expansion may be needed in the different situations like the whatever facilities are there with the organisation, they have become obsolete.

So the old and absolute facilities may not be able to offer the required quality products or the productivity is less or they are not able to fulfil the demand of the customers. So, or the demand for the product has increased, so the demand or you can say the demand for the product in the market of the company has increased beyond its capacity. So it is simple to say that the demand has exceeded the capacity. So it is important to come up with the newer plant at the different location.

So absolute facility or the demand for, the product has gone beyond its capacity. And third situation for the expansion is that it wants to provide the services and products to the

customers at those locations where such kind of the services and products are not available. So we can say the lack of services and products in specific areas, products to the customers.

So in certain areas, locations, geographical locations, states, cities, it is possible that few products and services are not available and company wants to increase its reach to those locations so that it can really provide the products and services to those customers whom such kind of the products and services are not available.

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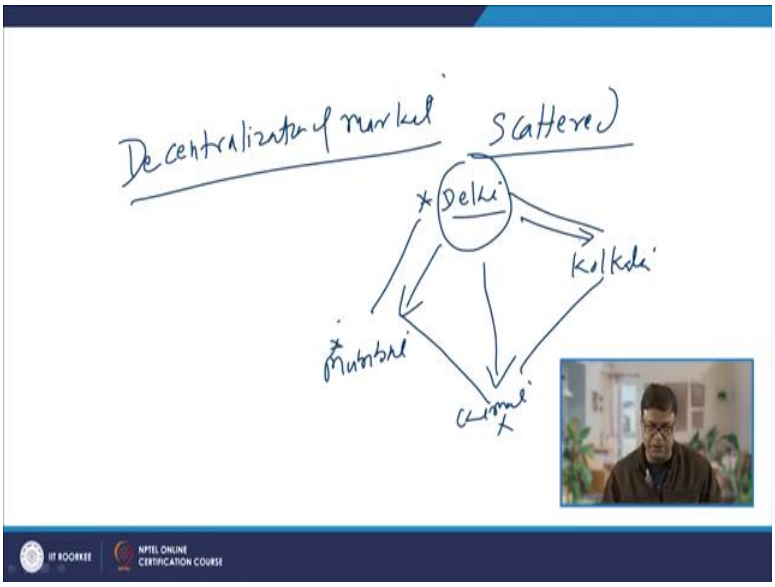

The second factor apart from the expansion, the second factor is the decentralization, decentralisation of the market. It is possible that the kind of the demand of the product which was localised in a very specific area that has grown over a period of time and the demand has become widely scattered. So in that case, to fulfil the demand of, scattered demand of the product of the company, it may be required to have more number of plants at different location so that it can effectively serve to the customers, effectively provide the things to the different customers who are scattered or the demand which is scattered and located in different roles.

Say in India in the north, it may be near Delhi, there are few organisations, few in Bombay or Mumbai, then in Chennai. So the companies locate their plant at different locations because these are widely spaced, different, located at a very large distances and here we have Kolkata. So for effective services, for effective dealing with the demands of the products, it may be required, like if the company had their plant just in Delhi, then it may think of having the

plants in Mumbai, Chennai and Kolkata as per that demand so that it can really fulfil those demands effectively.

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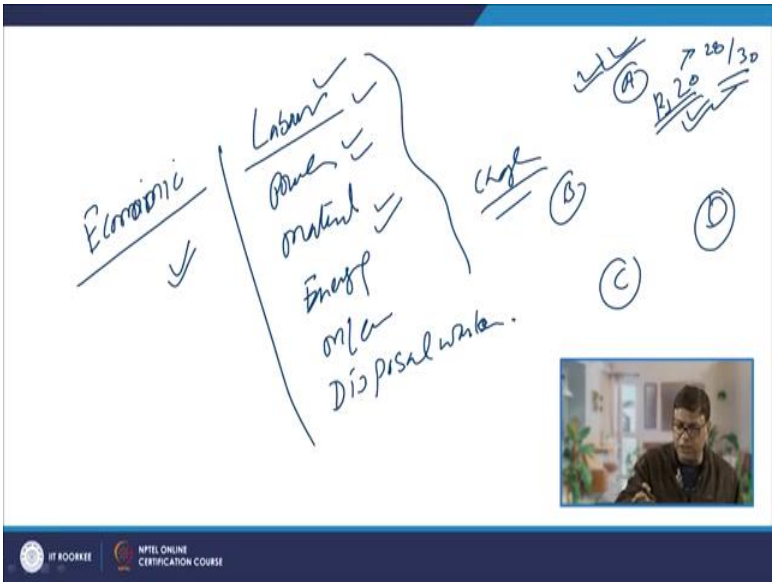

And the third factor is the economic factor. Economic factor is about what are like, for manufacturing a product it may be required to have the suitable labour, power, material, energy, machinery and also the kind of the disposal of the wastes which are being generated. So these things will be available at different prices, different rates to the company. With the time the things change.

The rates at which the workers were available, power or material, these facilities were available, these resources were available at a certain rate. So with the time these things may change and it may become possible that a particular location may not remain economically attractive, the cost at which the product is being manufactured at one location may not remain that attractive in terms of the price.

Say for example, if there are A, B, C and D, we have a plant at location A, where a company was able to manufacture a particular unit at rupees 20. So with the time it is possible that due to the heavy taxes and due to the increased labour costs, due to the increased power charges, it may not be able to afford to produce the product at rupees 20 and it may be costing like 28 or 30. So at such a high cost, the product saleability may get reduced and the demand for the product may get reduced.

So in that situation the A location may not remain economically attractive for manufacturing a particular product. In that case the company or organisation may think of, to go for some

other locations which will, which may be more attractive in terms of the economy due to the cheaper labour, cheaper power or the raw material is close to the source. So likewise. So the point here is the economics also governed significantly the location where the plants should be located. These are the general factors which govern the conditions for coming up with the newer plants at different locations.

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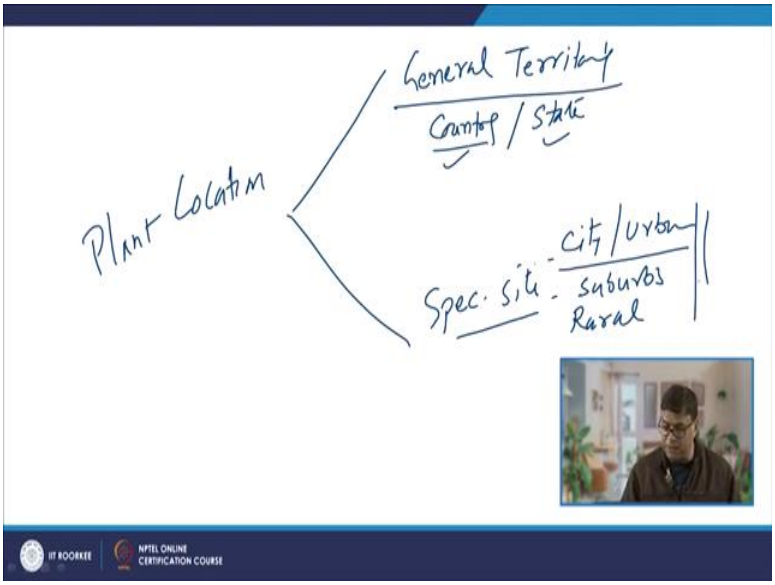

Then, as far as the plant location problem is concerned, it has the two aspects, two broader aspects. One is the selection of the general territory, selection of the general territory. So what will be the general area? Like, the world is very big. So it may think of like, which country organisations should go for manufacturing or locating a plant? If it is not thinking, if the company is not thinking at international level, then it would think of like which state will be more effective to locate the plant?

So this is about the selection of the general territory, which country or which state we should go for. Then coming to the specific, more specific site location selection. In that case, we need to see really the plant will be located in that state or in that broader area. It will be located near the city or in the urban areas or it will be located in suburbs or near the city or it will be located in the countryside or in the rural areas.

So these factors will also govern the economics and the access to the market significantly. So what are the various aspects related with the suitable choice of location? What are the factors that are favourable or unfavourable with regard to the selection of the plant location close to the city or in suburbs or in the rural areas? So those aspects we will be looking at.

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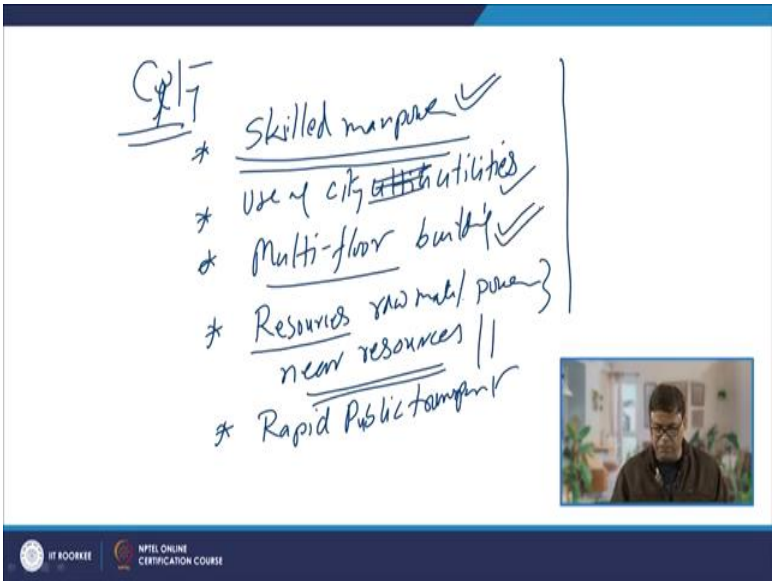

So as far as the city is concerned. So we will take up the first, what are the factors which are related with the locating a plant in a cities and when it will be more favourable. So if an industry or an organisation needs a huge skilled manpower, lot of skilled manpower is needed, then it will like to means the plant should be located near the city. Then the smooth functioning and the running of the plant or organisation needs the use of the city utilities.

Then it can survive or the kind of the layout that will be effective for locating a plant, which is the multi-floor type, like multi storey buildings kind of the layout will be more suitable for the plant to come out with its product and services effectively. So multi floor buildings. If needed then it will be good enough to… because there are so many benefits related with the locating plant near the city.

And the kind of the close to the resources. Various resources are needed for a smooth running, like the raw material, like the power. So the resources which are needed for smooth running of the organisation, so if it is required then these, the plant should be located near the resources. So raw material, labour, the power, et cetera, if it is required for effective functioning of the organisation, then the plant should be located in the city.

So especially if it is required to use various resources for effective functioning of the organisation then it is required to locate the plant, it will be appropriate to locate the plant near the city. It also wants to exploit, for a smooth functioning it wants to exploit the rapid public transport which is most of the time, is effectively available near the city.

So when the company wants to have mostly the skilled workers, it wants to utilise the city utilities, it wants to, it is the multi floor building, the layout will be effective for a smooth functioning, it wants to locate close to the resources and it wants to use the rapid public transport, then location of the plant close to the city will be more effective.

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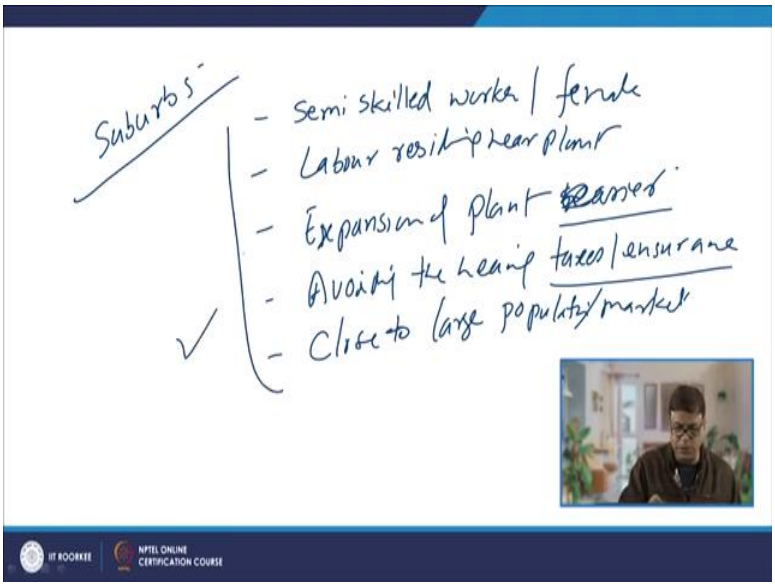

Then we have the various features related with the locating a plant in the suburbs. It is just like near Delhi we have Greater Noida, Ghaziabad, Gurgaon, et cetera, so these are the suburb locations. Locating a plant in the suburbs will be effective when a plant needs the, either semi-skilled workers or it needs the female workers for smooth running of the organisation or it is required that the labour residing near the plants so that they can easily move to and fro to their place of residence and the plant.

In these cases the land is relatively easily available nearby. So in this cases the expansion of the plant becomes easier. So easier expansion of the plant is possible when it is located in the suburbs. Another benefit is that it helps in avoiding the heavy taxes and insurance liabilities on the company if it is located in the suburbs. And another benefit is that since it is suburbs, close to the city, so here the plant is located close to the large population or market, large population or the market. So these are the few factors associated with locating a plant in the suburbs.

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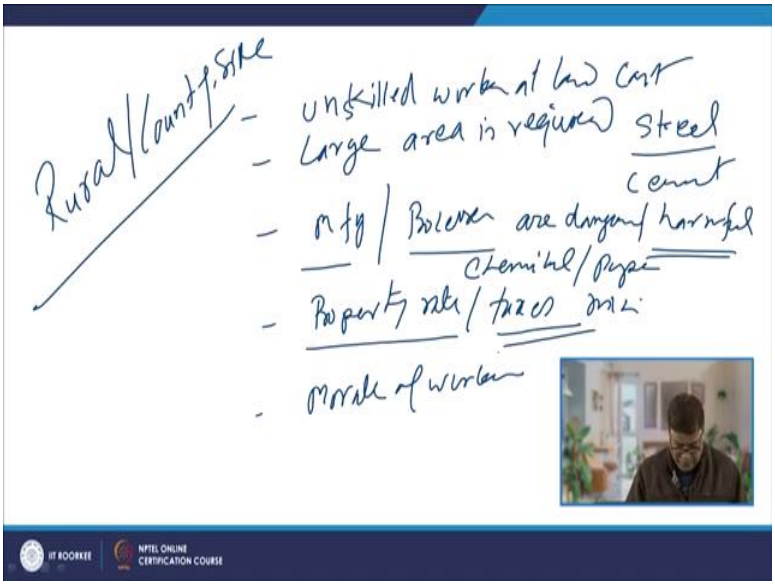

And as far as the rural, locating a plant in the rural or the countryside is concerned, the plant is located especially in the countryside or the rural areas when it needs a lot of unskilled workers at low cost. The second is very huge plant area is needed, like the cement plants, steel plants where very large area is needed. So the plants are located in the rural areas when the very large area is required for plants like steel plants or the cement plants.

Those really need huge area for locating the plant or the kind of the processes whether manufacturing or any other processes involved in manufacturing certain goods and services, so the processes and the steps involved in manufacturing the goods and services are dangerous and the harmful gases are emitted.

In that case also it is preferred to locate such kind of plants, like chemical plants or the paper industries, breweries, so those are located away from the cities so that those odourness and that harmful gases being released, can be disposed off without much harm to the public. Then here the property rates and the related taxes are minimum.

So when very large land is needed for locating a plant, for establishing a plant, so in rural areas, property rates will be lower and the taxes will also be lower. And the morale of the workers living in a countryside is also good. So those are other benefits. Now, we will see the kind of the, when which kind of the factors should be considered.

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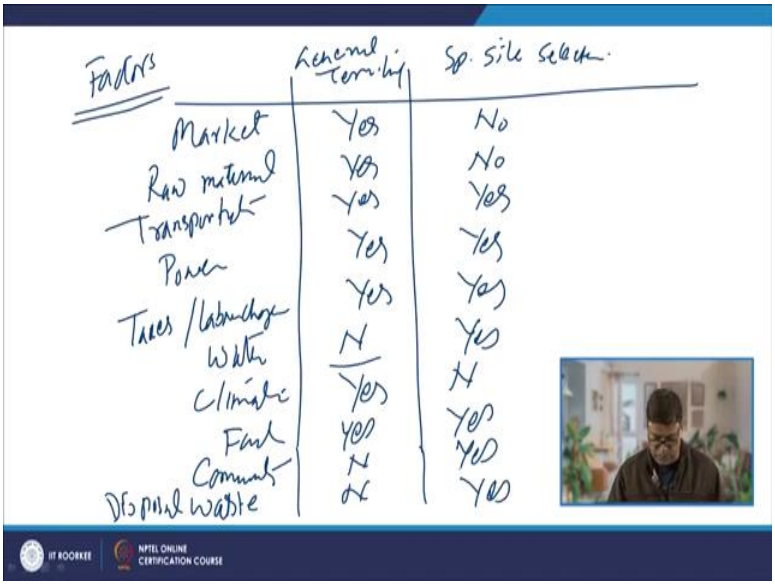

So when we are going for selection of a particular location, for establishing a new plant, the few factors are considered with a decision, where plant should be located so that it can produce the goods at the lowest possible, the cost at which the product or services are being provided to the customers. So the different factors are important, the factors which are considered for selection of the plant location.

So the different factors are important for locating the plant at the different levels. For example, here if we see the specific site selection, like city, rural or urban area or the general territory selection. So although these factors are common, but their relative importance can vary significantly. For example, the market where the market for the product or the services is located, that is what is seen, especially in case of the general territory.

So here we say ‘yes’. The market must be considered, but for a specific site selection it does not matter much because this is a very, this is just like, whether the plant will be near the city or away from the city. Then we have the raw material, where from raw material will be coming for processing so that it can produce the goods and services. So it is also important in case of the general property selection, general territory selection, but not in case of the specific territory selection.

Then what kind of the transportation is available? So this factor is important for both. There is a need of the transport from one site to another, for transport of the raw material and then dispatching the goods and services to the different cities, different dealers and up to the customers. So it is important for both general territory as well as specific site selection.

Then next point is about the power. For power it is important that the power availability is… Must be considered for both general and specific site selections. Yes. And then we have the taxes, labour charges. That should be considered for both the general territory and specific site selection. Then the availability of the water. In general it is available everywhere, but for a specific set it must be considered.

So that is important in case of the general territory selection. Likewise, we have the climate The climate must be considered in general territory selection, but not in case of the specific site selection because it may not be very different. Then we have the fuel availability for both, the general territory selection and the specific site selection. And the other two factors like, the thinking about the community is not about the general territory, but really important for the specific site.

And then kind of the waste disposal, disposal of the waste, how it will be done. So for general territory, it may not be that important, but for the specific site location, it is important where and how the wastes and emitting gases will be released. So it is important to consider for both, for the specific site selection.

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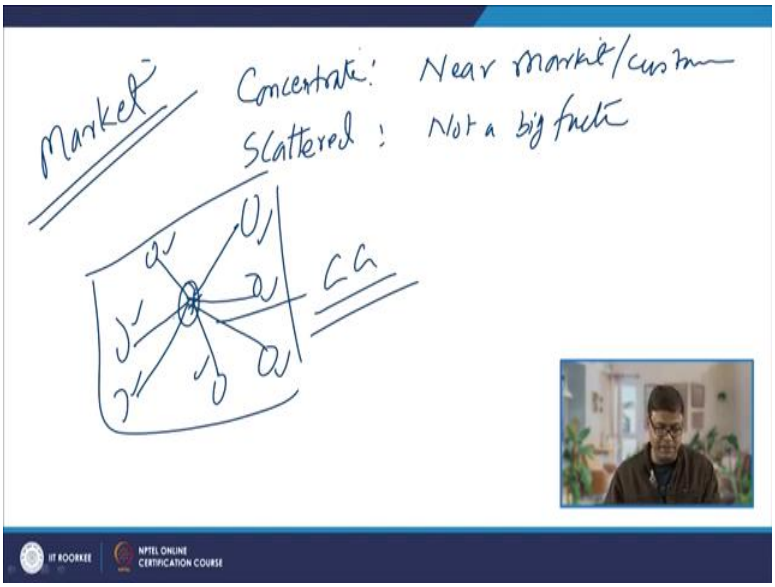

Now, coming to the details of these factors, what is the meaning of this? So the market, the big factor in selection of the plant, the kind of product which is being manufactured by a particular plant, so where it will be consumed, where those customers and users of the product are located, that is important. So in this connection, there are two aspects that has to be seen.

One is yes, so there are two aspects, what is the nature of the market? Like whether the market is concentrated or it is scattered, widely scattered. So according to the kind of the market nature, if the market for a particular product for which the plant is to be located, if it is concentrated then the plant is located near the market. So if the demand for a product is localised in a particular area, then plants should be located near the market or wherever the demand exists near the customers.

And if the demand is scattered, means market is scattered, then it is not a big factor in the selection of the plant location. If the demand is scattered in this manner, like there are different zones where the demand exist for the products or to the services which are being offered by the organisation, industry or a particular company, then normally the CG method is found to be useful.

It helps to identify the location where a plant should be located so that it can serve the demand to all the points effectively. So this is called centre of the gravity method which helps in identifying the locating a plant or an organisation or an outlet or a particular company which is either manufacturing the goods or providing the services to the customer. So it is located in such a way that it is able to effectively serve to the all customers which are scattered all around. So the CG method can be used for, centre of gravity method can be used for locating the plant in this situation.

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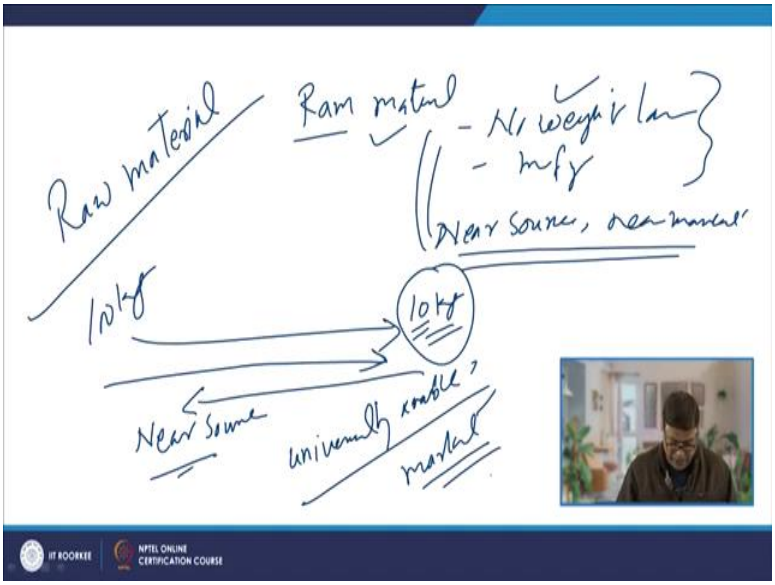

Then the another factor is the raw material. Like in the manufacturing of the goods and services, sometimes the raw material is used as it is with the final product. So if that is the

case, there is no weight loss in processing or manufacturing of the products, raw material is used as it is. In that case, the plant can be located either near the source of the raw material or near the market or anywhere in between.

So this is not a big factor when plant can be located anywhere when the raw material is used as it is without weight loss. But sometimes raw material is taken from the source of the 100 kg and in process it is reduced to significantly and effectively the 10 kg is effectively used. So in order to avoid such kind of the wastage in transportation ride, we need to invest a lot in transporting the 100 kg and then it will be processed and effectively it will be used 10 kg only.

So in this situation when there is a huge loss of the material in course of loss of the material or huge reduction in the weight when the product actually comes out in the final form. In that case the plant is located near the source. So this is the second case. One case is when there is no weight loss, there is no reduction and the raw material is used as it is. Second case is where there is huge reduction in weight during the processing.

So in that case the plant is located near the source. And third case, when the raw material is universally available and it is used in any of the forms in which it is available, universally available material. So in that case the plant can be located anywhere, there is no limitation. So basically when we have the flexibility of locating the plant anywhere, basically it is located close to the market so that the transportation cost to the market and access to the customers can be enhanced effectively.

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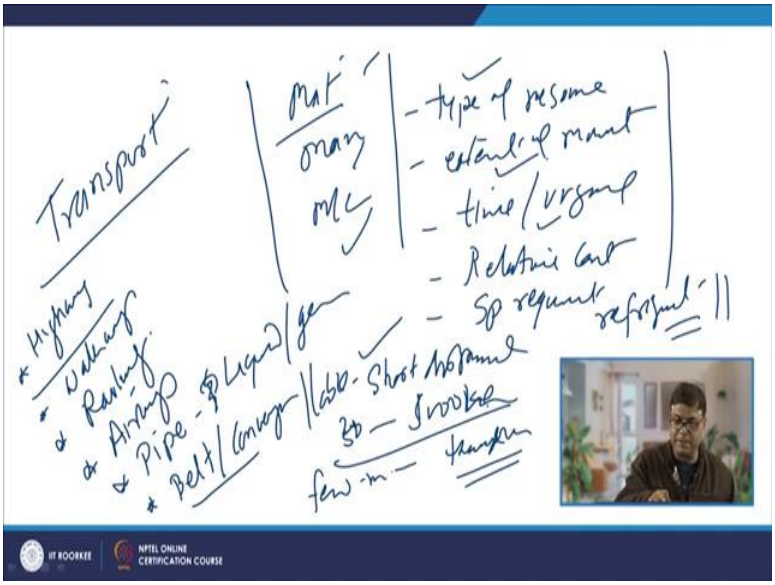

Another big factor in taking the decision about the location where a plant should be located is the transportation. It is required to move the material, man, machines during the processing, during the manufacturing. So depending upon the kind of the movement which is needed extent, so basically it is the kind of the type of the movement. We can say what is to be moved. Type of the resource to be moved.

It is man, material or machine. Then extent of movement, what is the quantity? It is just 10 or 10,000 or 10 lakhs, like that. So the extent of the movement, it is a random or continuous. Then the second is, no, third is the kind of the timeline which is available for the movements. So time or the kind of urgency available for the movement. And then what are the various options available?

So out of those various options available, what is the relative cost of moving the resources? Man, material or the machine. And then there is a possible that transportation, the way by which it should be transported, there may be special requirement like perishable goods need the special environment like a refrigerator or chilled plants.

Milk is transported in the chilled system so that the quality is maintained and there is no degradation in quality. So depending upon the type of the resource to be moved, extent of the movement which is to be done, the extent of movement maybe in numbers, maybe kgs, volumes, litres and then the kind of urgency and the speed at which the things are to be moved, relative cost, et cetera.

So accordingly, we have various options to move the things, move the resources. These may be in form of like, use of highways, use of trucks, big or small, the use of ships, so water ways, use of railways. Then, if there is urgency then and the fast movement is needed, then airways. So these are the four different ways through which the movement of resources can be done.

Then there are other types of the modes which are used for moving the resources like the pipes, the resources like material is used in form of petroleum or you can say the liquid or the gases are to be moved. Then there are base, conveyors, cables, these are used for short distance movement, like maybe 200, starting from likes a few metres to few kilometres also, like 5000 metre, 50 metre to 5000 metres.

So starting from few metres to few thousand metres, this kind of the systems can be used, like cables are used a few kilometres as well, conveyors and belts are used for a few metres, like

50 metre, 100 metre, like that. In cement plants, we can see 100, 200 metres belt conveyors, belts and conveyors are used. So the highways, airways, railways and these waterways can be used for all types of the goods and services. The airways primarily preferred for a fast movement of the resources from one location to another.

Now I will summarise this presentation. In this presentation basically I talked about what is the, what are the conditions under which it is required to locate a new plant, what are the general, what is the scope of the plant location? What are the factors that we should consider for locating a plant, whether the plant location problem is to be seen at the general territory level or specific site location level? I shall explain the details of the other factors in the subsequent presentation. Thank you for your attention.