Principles of Industrial Engineering
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Lecture-13
Plant Location & Layout: Factors Affecting Selection of Site

Hello, I welcome you all in this presentation related with the subject, Principles of Industrial Engineering. And in this presentation primarily we will be talking about the different factors which should be considered for selection of the site so that the plant, whether for manufacturing a product or for services can be located and we can come up accordingly for manufacturing the goods or for providing the services. So there are various factors which play significant role in selection of the site or the location where plant should be developed.

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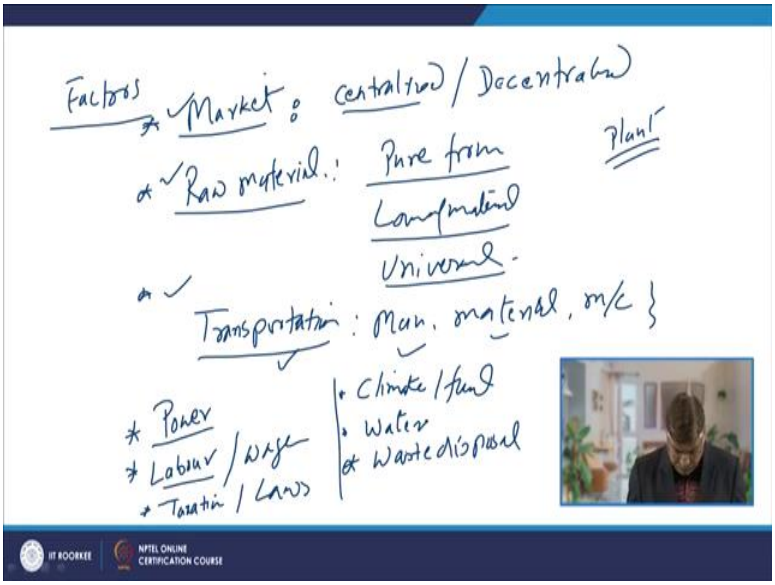

These factors include, so the factors to be considered for selection of the site. The most important one is the kind of the market, where the market is located. About this factor we have talked earlier also. The market can be centralised, means it can be located at one place or it can be the decentralised, it can be scattered over a large area. So as per the kind of the product or the kind of service, having a suitable market, whether the market is located at one location or it is scattered.

So if it is, if the kind of product or the service which is for which the plant is coming up and then which is primarily influenced by the demand which is centralised then the plant should be located close to the market. Otherwise it can be located elsewhere if the demand is

decentralised. Then we have the another factor about which we have talked was the raw material.

So the raw material if it is used as it is, like if it is used in pure form after getting it from the source, then the plant can be located anywhere but if there is a lot of wastage, a lot of extraction and very little quantity of the raw material is finally used in form of final product, then the plant is located, so here there is a loss of material in course of the manufacturing process. In that case the plant is located near the source.

Or if the material is universally available, then like material availability is universal, then it can be located anywhere. The next is next important point which is to be considered is the kind of the transportation. Now transportation or the movement of the resources is very critical. The resource movement maybe there in form of the man or the kind of the material which is to be moved in course of the production of the goods or services or it can be in form of movement of the machines.

So according to the kind of the, the type of the resource which is to be moved, its nature, the volume, the so many options are available for moving the resources from one point to another in course of the production of the goods and services and according to the kind of the most feasible and most cost effective ways of moving the resource, we will be choosing the suitable type.

But this aspect also affects the selection of the site because we have to see, we have the suitable type of the modes of the transport for moving these resources so that the various activities related with the plant can be executed smoothly. Relative importance of these factors and the way by which these should be interpreted that can vary significantly, that can change significantly with the type of industry, the type of product or the type of the plant which is to be developed, whether it is for manufacturing or for providing the services like banks, hospitals, or restaurants etc.

So their significance and interpretations can vary significantly with the kind of the type of the plant which is to be developed. Then we have the other factors. So about these factors we have talked earlier in detail, now we will be talking about the other factors like the power is the another important factor. Then what kind of the labour or the manpower available and what kind of the wages are to be paid to the workers.

Then next factor is the kind of the taxation policy of the land or of the state which is there. So the taxation and the laws for the working hour, in terms of the working hours, in terms of the minimum wages. So all these factors I will be elaborating. Apart from the power, labour and wages, taxes and there is climate, what kind of weather and what kind of the fuel is to be used. What about the water requirement for the organisation and how the utilised water will be disposed off? So waste disposal. So these are the other factors that also we need to consider. So we will be elevating these factors in detail and their significance.

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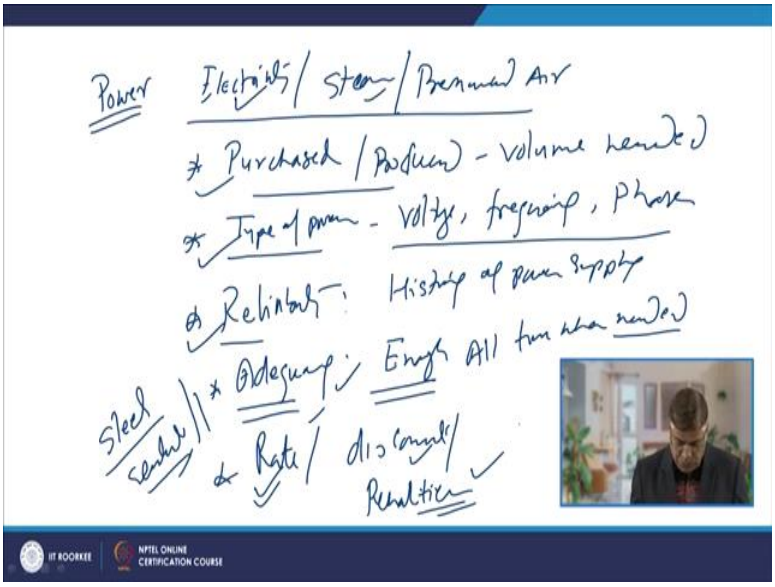

So as far as the power is concerned now, the power there, the power means the which type of the power. It is simple electricity which is to be utilised or the power is needed in form of generation, in form of the steam which is to be used for smooth working and smooth operations of the plant or it may be in form of like the pressurised, pressurised air is to be used.

So as per the kind of the, so what we have to see really, whether the power is to be purchased or it is to be produced. Now, this decision will be based on the kind of the volume which is needed. Obviously, if the requirement is very limited, then we will be going for purchasing and if the volume or the kind of the power requirement is very high and it is not available so easily at the cheaper rates and the regularity is very limited, then it is all, it is good to consider the possibility for producing the power.

Like in some of the plants, lot of steam is required for a smooth functioning of the organisation. So the plant, it may be required to install the steam generating plant so that it

can be made available. So that will also be affecting the cost related to the particular location. So, if it is in the heart of the city, then it may not be possible to install so many things which otherwise could have been done if the plant is located at a remote area or rural areas.

So that is one, we have to take decision about whether the power is to be purchased or it is to be produced. Then what is that type of power which is available that whether it will satisfy our requirement in terms of the voltage available, the kind of the frequency at which it is available or the kind of the phases in which it is available as far as the current is concerned. So voltage, frequency and the phases, the requirement should be very satisfied in terms of these factors.

Then how about the reliability of the power? So that will be based on the history of the power supply, what kind of the stoppages and the failures in power supply were there and how will it affect the continuity of the operations of the organisation? Like some of the plants where 24 hours power is mandatory. Otherwise plant of various, the smooth functioning of the plant will be very adversely affected.

Say in steel making plants or the cement plants where it is very crucial to have the continuous power supply. Otherwise entire operations and the so many losses will be happening to the plant in terms of the like heated up and solidified metals in course of the production. So the reliability of the power supply is another important thing. Then, how about the adequacy? Whatever the power available, will that be sufficient?

So it is enough, enough power is available because sometimes the power is not available in the required quantity as and when it is required. For example, in under the peak load conditions power may not be available in the quantity which is needed as compared to the other times. So adequacy of the power, whether enough power is available all the time when needed or it is not available under the peak load condition.

So under those conditions or the time when the power is not available, we may consider to produce it and to supply, to deal with those situations effectively. So adequacy of the power will also be playing an important role in choosing a particular site for locating the plant. Then the other factors like at what rate power is available and what kind of the discounts will be available if it is procured or consumed, be on a certain quantity.

And what if it is consumed more? Then what kind of the penalties will be imposed? So these are the factors with regard to the power which need to be considered related with a site while

considering a site for selection of a plant. Like what kind of power we need, whether it is only electricity or the steam, then whether it is to be purchased or procured, the type of power which is available or what is the reliability of the power supply.

Whether it is required, available in the sufficient quantity or it is available in a very localised manner, not available during the peak conditions, at what rate it is available, if there is any discount policy or if there is any penalty policy for the consumption of the power beyond the limit. So those factors must be taken into account while choosing the site for locating the plant.

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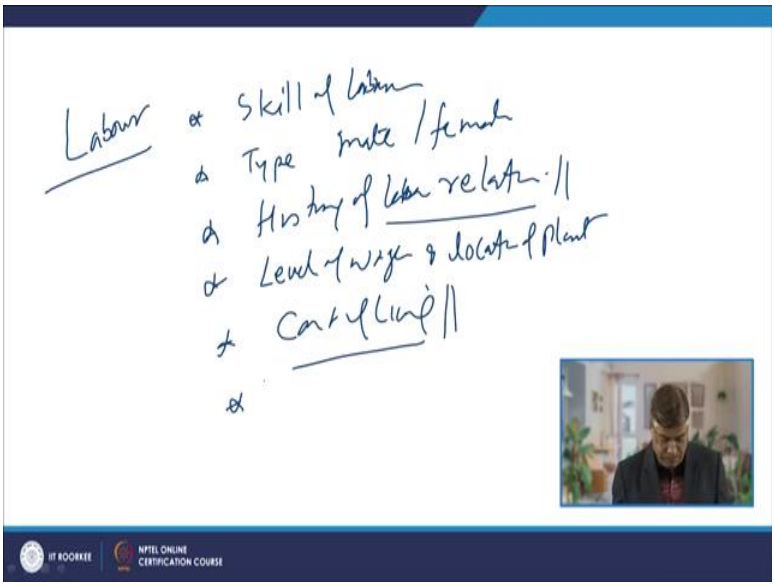

Then coming to the labour, there are like what is the kind of the skill of the labour which is needed and then whether that, so we have to see that if the if the less skilled or unskilled worker is needed we will locate the plant in the rural areas, if skilled workers are needed then plant is to be located in the semi-urban or in the urban areas. About that we have already talked earlier.

Then the type of the labour, like the male or the female labour is required. Then, what about the history of the labour relationship? Labour relationship. This very important to see if the labour in a particular state or the country or in a particular region has been very supportive to the organisation or there has been unrest related to the labours due to the various reasons. So those factors need to be considered.

The labour relationship and then we have what kind of the wages are to be paid, level of the wages to be paid because these things will directly be affecting the total cost of per unit item

which will be produced at a particular site and that in turn will be affecting the competitiveness of the organisation to sell the product as compared to that of the competitors' product or what will be the level of the competition which a company will be able to give to the competitors' product based on the pricing given while the quality, the product quality or the service quality is same.

So the level of the wages, that will although depend upon the location significantly, location of the plant. Like in a city the level of wages will be higher as compared to the, in case of the countryside or in the rural areas. And what about the kind of the cost of living?

These wages will be based on to some extent the kind of cost of living because, if the workers are paid less than that is needed for survival in a particular location, then their moral will be down, they will not be able to contribute effectively. So it has to be considered when deciding the wages so that whatever payments are made to the workers they are able to live a reasonably good life so that they can contribute to the organisation.

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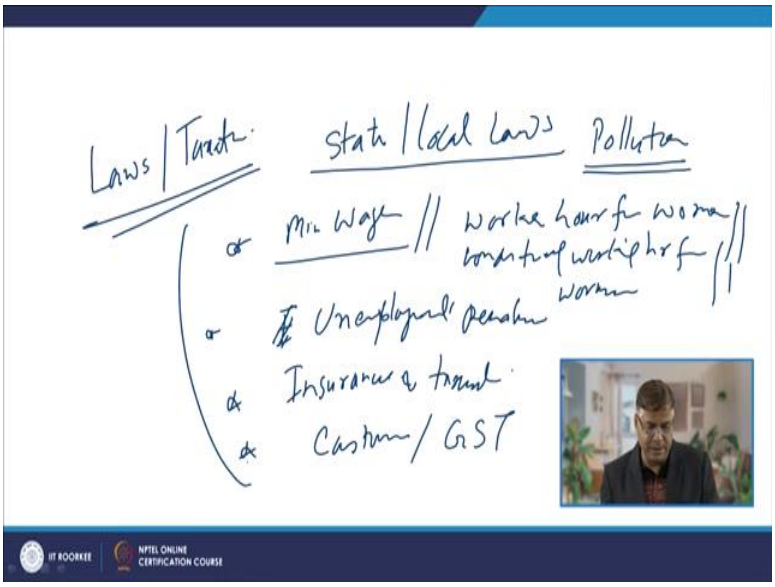

Then next point is about the laws and taxation. These are very big factors as far as the locating a new plant in a particular state or the country is concerned. Many states give the benefits in terms of the taxes and when a new industry is developed or it is established, then they will say, the states will say that okay, well for 4 or 5 years, there will not be any taxation of whatever goods or services they produce and whatever benefits they earn from the industry.

So many industries are located in such states and such areas where tax benefits are given by the respective governments. That becomes very important factor because reduced taxes help them to give the, to provide the goods and services to the customers at the lower price and that in turn gives them an edge or competitiveness over the competitors. And that is why the laws and taxation factors are really important.

So they will have to see what kind of the state and local laws are there. These state and local laws are important in terms of the kind of the pollution, what they can dispose of with regard to the waste and that what kind of the gases which will be released in course of the manufacturing or in course of the development of the services. So what about the pollution laws and the waste disposal policy related to the particular law?

Then what are the minimum wages? Like in each state, there will be minimum wage requirement which is to be paid. So they will have to see that if this the company will be able to afford those minimum wages or not. Then what are the working hours for especially women? So working conditions basically, conditions of working hours for women. These may vary significantly from state to state and this has to be kept in mind as per the kind of the labour which is to be hired and what are the conditions to be fulfilled for hiring the labour of the different types.

What will be the minimum wages to be paid to the workers and what will be, if the penalty, if the workers are fired from the job, so like unemployment penalties which are to be paid if the things do not work out properly? What about the insurance and other taxation policies? What will like, there will be customs, there will be that nowadays it is like the GST. So those taxation policies need to be considered to see what will be the total cost at which they will be able to make the product available to their customers considering these laws and taxation related things.

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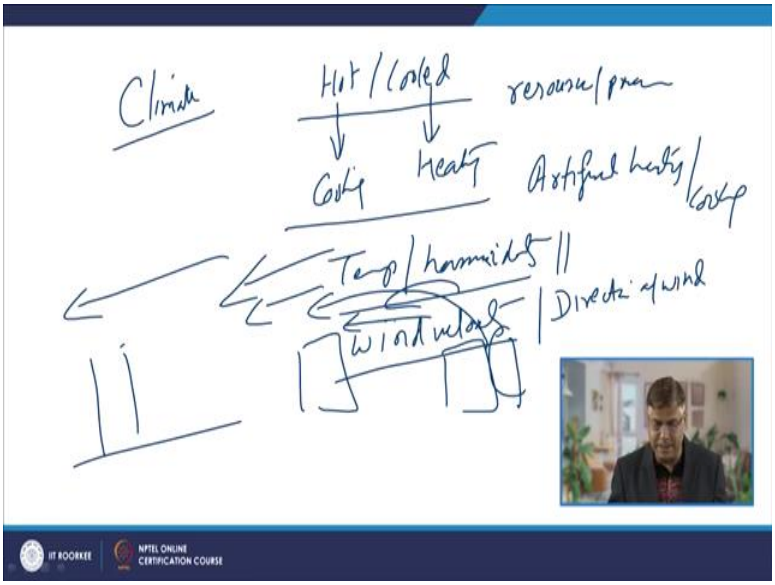

Then, we have the climate, whether it is very hot or it is very cold, in both the cases it will be required to use the additional resources, additional resources or power for maintaining the suitable or comfortable working conditions. Like if it is hot then cooling is to be provided and if it is a very cool, then heating is to be provided. So for this artificial heating and cooling arrangements need to be made and that will be costing extra.

So this will be increasing the cost of the product as well as the fixed cost will also be increasing. At the same time we will have to also see the kind of the, the temperature and humidity conditions which will be there. Sometimes very specific community requirements are there for a particular kind of industry. Like in textile industry high humidity or humidity is maintained in particular range for a smooth production of the goods.

So humidity in that way will help in taking suitable decision if locating a plant of particular type in particular location will be beneficial or not. So then there is about the wind velocity. This is important especially, like whatever waste gases are generated in plants, they are released through the chimneys. So if the velocity is good then these, the waste gases and the gas emissions being released through the chimney will be able to get dispersed over a wider area if the wind velocity is good.

So that is one. If that is not there, then it will try to get settled down all around near the industry only. And another point is about the direction of the wind, direction of wind. So especially if here is the industry having the chimney and if this is the city, then the wind

direction, mostly the direction of the wind flow should be opposite to the direction of the city so that the pollution effect of the pollution in the city is maintained.

So accordingly if this the direction of the wind in a particular zone, then the industry will not be located this side because it will be causing the flow of these, all these gases or the gases which are being released by the organisation towards the city. So the wind velocity or wind direction of the wind flow should be in direction opposite to that of the city so that the pollution effect, effect of the pollution due to the flow of the winds toward the city is minimised.

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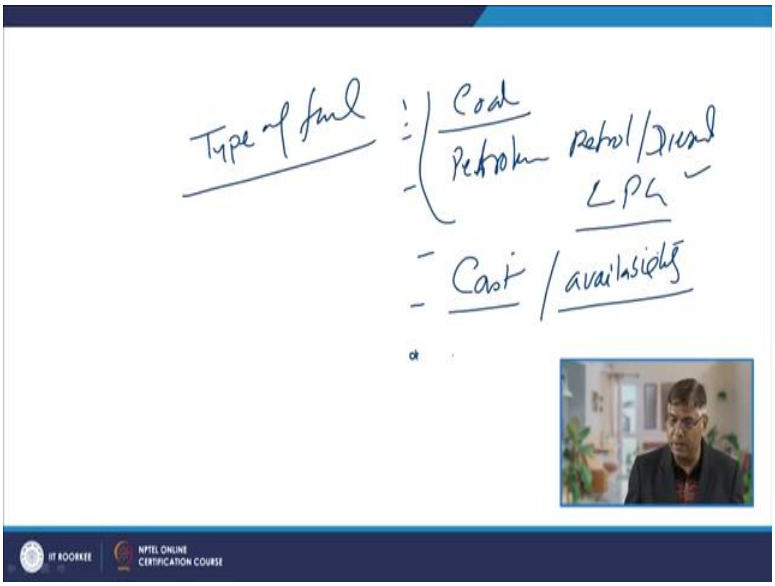

Then we have to see like, what type of the fuel will be consumed. Like some of the industries need like coal. Then they will be using the petroleum products like petrol or diesel or the liquid petroleum gases like LPG or other natural gases. So as per the or it uses like in thermal power plants it will be called or the diesel or liquid petroleum gas or like in hydro power plants the water is used.

So as per the case, so as per the kind of the fuel which is to be used for a smooth, either for generation of the power or a smooth functioning of the organisation, we need to see at what costs the fuel is available and how about the availability in the required quantity, availability in the required quantity of the fuel and the reliability of supply of the fuel. Because it is important that whatever fuel is consumed that is available at the lower cost and continuous regular supply is available so that the industry or organisation can work smoothly and efficiently.

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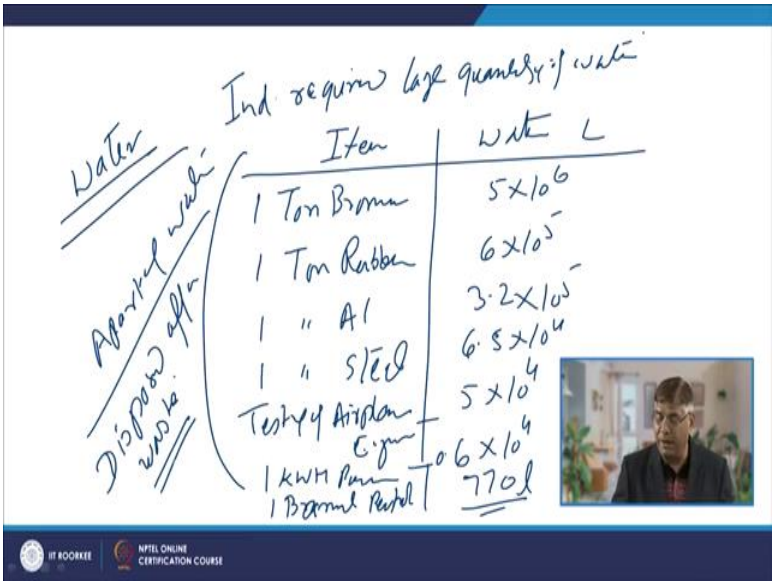

Then there is the water requirement. Water requirements, various industries require the different amount of the water, but in generally the water is, many industries require very large quantity of the water, require very large quantity of water. So, they will have to see that this, that quantity is available, quantity of water is available. So, availability of the water for those industries become crucial.

They will have to see that the required quantity of the water is available. So accordingly the plant will be located near the source of water. For example, like for producing the different items what quantity of the water that will be needed. Here water quantity needed and item to be produced. Say for producing the 1 tonne bromine, we need very large quantity of the water. 5 million litres of the water is needed.

Then for producing the 1 tonne of the rubber it is required to use the 6 into 10 to the power 5 litres of the water. Then for producing 1 tonne of the aluminium, we need 3 into 10 to the power 5 litres of the water. Then for producing the 1 tonne of the steel, we need 6 in 10 to the power 4 litres of the water. For producing for testing of air plane engine, the quantity of the water is like 5 into 10 to the power 4, 50,000 litres and then for producing the 1 kilowatt power, it is required to use the 6.6 in to 10 to the power 4 litres of water.

And then for refining the 1 barrel of petroleum we need the 770 litres of the water. So if we see the quantity of the water that is needed in production of the various types of the good is very huge. Whatever water is used, a part of that, of part of water will be disposed off as

waste. So and this disposed off water will have very harmful chemicals, odorness and undesirable consequence.

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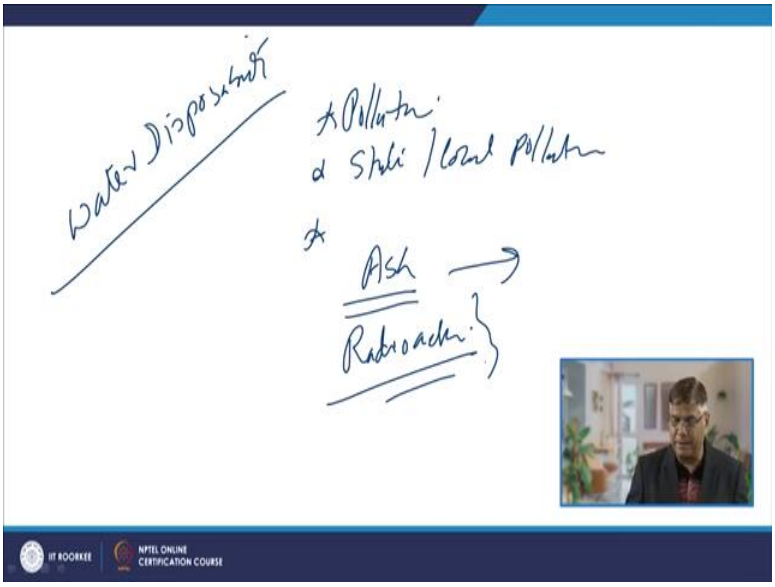

So that water disposability becomes very crucial from the pollution point of view and therefore, the state or local pollution laws must be looked into to see that if they allow the proper disposal of such kind of the waste water and likewise many industries as far as the waste disposal is concerned, many industries generate, a lot of, in thermal power plants like a lot of ash is generated, that has to be disposed off.

Because the quantity of these kind of the waste is very high. Unless there is a proper procedure and proper policy to dispose of these, these will be creating a lot of problems. Like in nuclear power plants, the waste is there in form of the radioactive material. So proper policy and procedure has to be adapted for proper disposal of such kind of the wastes. Otherwise these will be causing the lot of harmful effects on the human being. So these were the factors that we will have to look into. Those must be considered.

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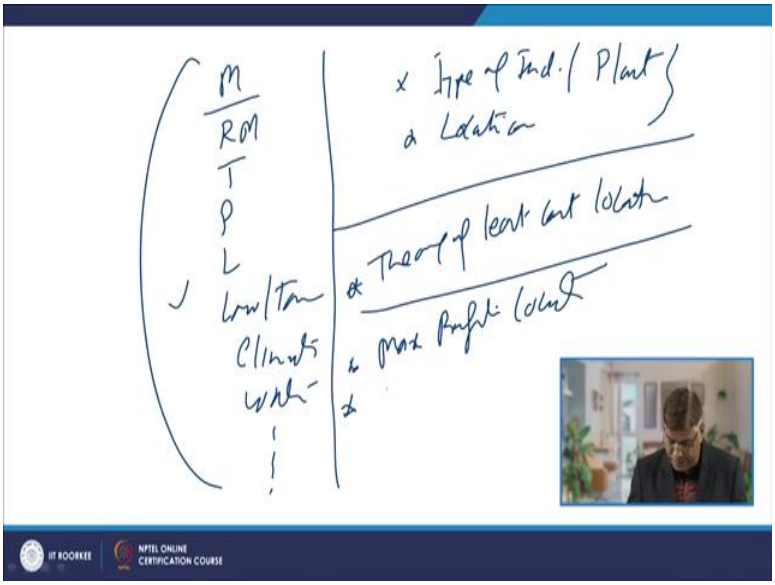

Now, as far as the various factors which were there that we have seen. Like it was market, then the raw material, then there was a transport requirement, then there was the kind of power requirement, then labour, then the laws and taxes and then the climate, the water requirement and likewise as per the kind of the industry and organisation there can be different factors.

So now, these are the different factors. The importance of these factors may change significantly with the type of the industry or the type of the plant, which is to be developed. It will also vary, the relative importance of these factors can also change significantly with the location. Like which country it is, which state it is or which particular locality or the site it is. So location, relative importance of these factors can also change with the location and that is why every site has to be considered for the selection in the light of these factors.

So now, few principles have been developed for selecting the site wherein all these factors will be considered to see which site will be good. Few principles are like this. Like the theory of the least cost location. Means the one site out of the so many options the site which will be able to offer the products at the minimum possible cost, minimum total cost of the per unit item that is selected. Then there is the site.

So in this case we consider that there is no, the demand is not affected because of the site selection. Then we will have to see that maximum profit location, the site which will be offering the maximum profit in terms of the, like increased business and the increased volume of the profit. Well in this case it is assumed that the cost of producing the unit will be

minimum and this will not be affecting the demand of the product or of the service wherever it is located.

Then there is interdependence theory of the location which is based on the ability to control the target or the market in such a way that most of the area is served and facilitated by the products and the services of the organisation. So in the coming presentations I will be talking about the different methods which are used for selection of the site. Now, we will summarise this presentation. In this presentation, mystically I have talked about the different factors which should be considered for selection of the site. Thank you for your attention.