

Operations Management
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Lecture – 16
Facility Planning

[FL] Friends, welcome to session 16 of our course on Operations Management. And we have already covered 3 weeks of discussion on this topic. And if you remember in week 1, we have covered the fundamental aspects of operations management and we have seen that what are the functions and scope of operations management, why do we do the operations management in an organisation and why do we need to study this course at all.

And then we have seen in week 2 the product design and development. We must know that what the company must produce in order to be competitive in the market, when they should make their product obsolete themselves, when they must take a decision regarding coming up with a new product, when they must take a decision related to pushing their product out of the market and coming up with the new and revised or modified product.

So, we have seen product life cycle, we have seen the concept of value engineering design for manufacturing design for assembly rapid prototyping ergonomics all these are the catch words in today's product design and development. Although product design and development cannot be covered in 2 and a half hours of discussion it requires a complete course maybe of 30 hours when you have to address, when we want to study the fundamental or the basic aspects of product development product design and development rather I must say, but we have seen what are the latest tools and techniques used in product design and development. In the third week we have seen that if we know what we have to produce then our next decision is that how much in what quantity we must produce. So, that the product is sold in the market. We do not over produce or we are not found short of production.

So, both ways there is a challenge if we over produce we book our resources our resources are not properly utilised, but we have made the product, but it is not selling in the market on the contrary there is demand in the market people are asking for the

product, but we are not able to produce the product. So, the forecast is very very important from operations management point of view.

So, we know what we have to produce and then we have to see that how much we have to produce. So, the demand forecasting or sales forecasting we have covered in our week 3, we have covered that what do you mean by sales forecasting, what are the qualitative methods at least 2 we have seen, what are the quantitative methods of forecasting we have seen with the help of certain examples.

So, we now till now we know that we have understood that how to design a product maybe the fundamental of product design, then we have said how to we have seen how to calculate that, how much we must produce. Now let us see suppose we have this this information or this data available with us that this is the product this is the quantity in which we are going to sell this product.

The third stage is now we have to produce this product, we have to decide that, where we are going to produce this product, where we are going to manufacture this product where our facility or the manufacturing facility factory enterprise will be located and for that we have to do the facilities planning, we have to decide the plant location as well as its layout.

So, we have to first decide that if ours is a multinational company we have to take a decision that whether we are going to place our manufacturing facility in India or we are going to place it in some other country. We have to see that within India whether our company is going to be located in the northern part of the country or the southern part of the country or eastern part or the western part.

So, we have to take a very conscious decision that where the factory or the organisation or the enterprise has to be located and that requires little bit of judicious decision it requires a very very we can say intelligent decision, because it affects the overall productivity the overall success of any organisation. If you locate your facility in a place where you have certain adverse factors we will see in today's presentation that what are the problem areas or rather to sound little positive we will try to see what are the critical success factors, if we consider these factor we will be able to be productive effective efficient in our operations and our plant will be located at the best possible position, within the country as well as within the state.

So, we will see that what are the factors that are that govern our decision related to plant location. So, we will see what are the important parameters effecting facilities planning and then may be in the subsequent session may be in the next session; we will cover them in detail we will try to understand the Nitty Gritties of these factor, where by taking certain examples.

So, let us start our discussion related to facilities planning and let us have a systematic discussion on this topic. Before starting the definition may be one thing that I must make clear is, that once we have to make a decision related to where we have to place or where we have to establish our factory. Some of the decisions are very common or common sense based decisions. If suppose I ask any engineer where our factory must be prompt will come the reply near to the raw materials, near to the market, where we get some tax benefits, where we get some relaxation in excise.

So, maybe we will see that some of the things are very very common very very common sense based, but we are not able to structure our thought that we are not able to pen down on a piece of paper that which location is better from all other aspects also government policies are there then legal procedures are there. So, there are a number of other factors also which help us to take a decision that where our factory must be located if we want to make use of the advantages that are offered maybe by state policies or maybe in terms of labour or in terms of natural resources or in terms of the civil infrastructure.

So, there are number of parameters that add to our common sense which usually we use while making a decision related to the plant location. So, some of you may be wondering that it is easy to a take a decision I totally agree with all of you, that this is a common sense base decision, but still if we have a structured opinion on this decision I think it will add to it will not reduce or take away anything from our common sense, but you will further reinforce that decision that we are going to take. So, let us try to understand in a very systematic manner that what are the important maybe aspects related to the facilities planning.

Now, you can see facilities planning encompass 2 things; as I have given a very maybe a long I must say introduction today. We already know that what we want to produce we know in what quantity we have to produce. Now we have to take 2 more decisions that in which part of the globe, which part of the world our location or our plant must be

located. And once we decide that which we have this much of square hectare or maybe whatever units all of you may like to have we have this piece of land available with us in this state and in this country within that land; however, location or; however, facilities our infrastructure must be located strategically in order to ensure productive efficient and effective production.

So, 2 important decisions are there one is where this piece of land must be that is country state within state may be district and within district there will be a specific location. So, may be from we can say global point of view first you have identify the country, then you have identify the state, then you have identify the land where we are going to start our production that is plant location second is plant layout that within that piece of land again I am reiterating. So, that it becomes clear to all of you.

So, within that piece of land how our various facilities will be placed how our various facility will be located for example, if we take an example of any I I T there can be academic area at one place, where all the classes are engaged there can be a hostel area, where all the hostels are there in the students stay there during their off arts and then there can be a residential complex where the staff members stay there can be a sports arena where the students and staff go and play. So, there are specific addresses specific locations within this piece of land where the various facilities are placed.

So, that basically is layout and if you enter an or organization or an educational institute you will see that layout is shown, it can be a 3 dimensional modelled layout or it can be or scale down model usually we call it an technical terms or it can be a 2 dimensions depiction of the various facilities that we call as a layout of the organization.

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Facility Planning

- Plant Location
- Plant Layout

Source - Google image

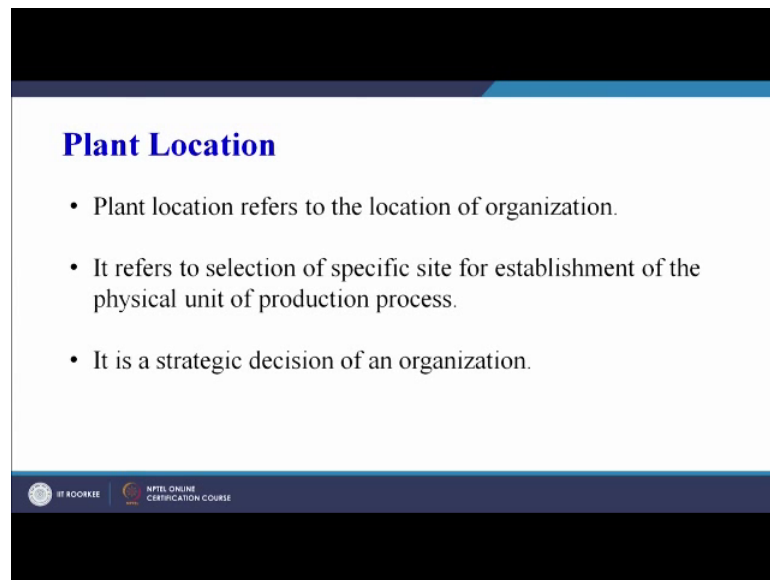
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The slide features a title 'Facility Planning' in bold blue text. Below it are two bullet points: 'Plant Location' and 'Plant Layout'. To the right of these points is a collage of images: a world map, a green field, a factory, a power plant, and a group of people. Below the collage are two larger images: a power plant and a factory. At the bottom, there is a footer with logos for 'IT ROORKEE' and 'NPTEL ONLINE CERTIFICATION COURSE', and the number '2'.

So, we will study both of these our first focus is the plant location that how or what are the critical factors which will help us to identify a piece of land, where we want to start our production. Once we identify that land our next stage will be how to place our facilities within that land. So, that optimal utilization of the floor area is ensured or optimal utilization of the land is ensured.

So, let us now first try to understand plant location plant location as I was already explained I am just reading it for you just to reinforce this concept in your thought process, plant location refers to the location of an organisation or we can say it is the address of an organisation.

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Plant Location

- Plant location refers to the location of organization.
- It refers to selection of specific site for establishment of the physical unit of production process.
- It is a strategic decision of an organization.

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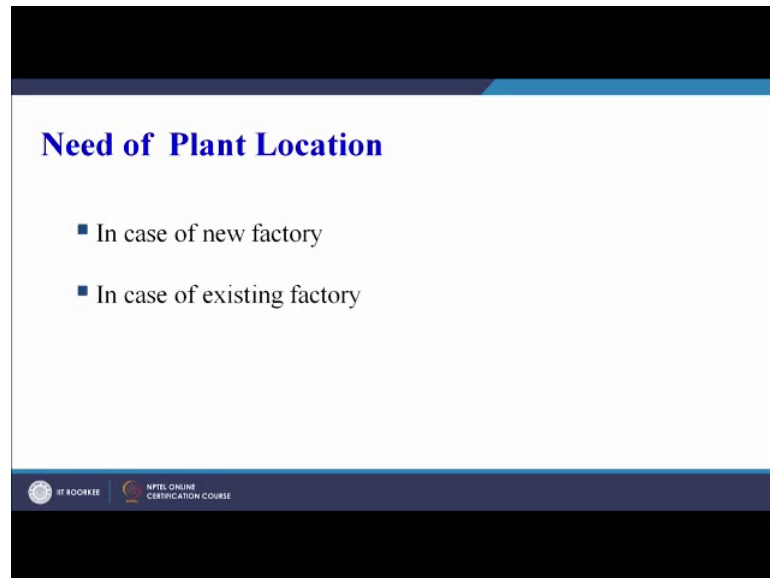
It refers to the selection of specific site as I have been using the word specific location it refer to selection of a specific site for a establishment of the physical unit of production processes. So, we usually call it in general terms as a factory that this is the address of the factory we have to decide that where our factory is going to be located or where our production process or production facility is going to be located. It is just strategic decision of an organisation. So, I think all of you will agree with me that this is a very important decision, because it influences the overall productivity of an organisation.

Suppose we locate our facility at a place where we do not get skilled labour who can work for us, we may not be able to produce effectively and efficiently. We locate our facility or factory at a location where we are not able to get the raw material easily and constantly, consistently, then also our productivity or our production will be affected.

So, we can take number of examples where the things have gone wrong, because of the wrong selection of the plant facility. So, it is important that we give due weight age to this decision that where the plant should be located and therefore, it is at the strategic decision level that is usually we know that the highest level of decision making is the strategic decision making followed by the corporate decision making, then followed by the operational decision making. So, location of the plant is a most important decision and therefore, it is taken at the highest level of the organization.

Now, need of plant location the whatever examples I have taken from the point of view that we are going to establish a new factory.

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Need of Plant Location

- In case of new factory
- In case of existing factory

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Then in case of an existing factory also sometimes we need to relocate to a new position because of the government policies or maybe, because of certain benefits that we derive out of changing our location from one place to another place. So, need of plant location can be if we want to start from scratch a new factory has to be located or the relocation of an already existing factory.

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Need of Plant Location

For existing facility

- Change in availability of resources
- Shift of demand
- To expand new target market
- Development of new technology
- Socio Political and legal changes

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Now, why there is a need of plant location means for an existing facility now suppose we already have an existing facilities, because in a last slide I think it was slightly may be difficult to understand that already if we have established a factory. We must have taken care of all these factors before establishing the factory and then why do we need to change from an existing factory to a new factory.

So, this is these are the points those that explain that that for existing facility we can change from one place to another because of the change in availability of resources. We may have chosen the earlier location because of the proximity to the resources or specific resources.

Now those resources may have dried up or the resources may have been completely utilised. So, you need to take a decision regarding shifting of your plant location or the shift of demand, we may have located a particular industry in a specific area because it was close to the market, it was close to the demand, where the demand is generated, but now the demand has diminished or it has stopped. So, you need to change or there is a shift in demand there is more demand of our product in some other area.

So, we think that why not to shift our manufacturing based to that particular area only, then to expand new target market. So, that is also very important that if we want to develop a new product market we may have this facility here, but we may start or may think of creating a new facility at a different place or extension of this facility at a different place, where we want to develop our target market development of a new technology may also lead to shift in the existing facility and the socio political and legal change is which are beyond our control sometimes may force the organisation or the administration of the organisation, to shift it is base from one location to the other location.


So, these are the may be factors or maybe say we can say the forcing factors, which may influence an organisation to take a strategic decision of shifting the location from one place to another place. Now these are the location decisions you can see the country decision.

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The slide is titled "Location decisions" and is divided into two main sections. On the left, under the heading "Country Decision", there is a map of North America (USA, Canada, and Mexico) highlighted in red. On the right, under the heading "Critical Success Factors", there is a numbered list of six factors. At the bottom of the slide, there are logos for "IIT ROORKEE" and "NPTEL ONLINE CERTIFICATION COURSE", along with the number "6" in the bottom right corner.

Location decisions

Country Decision



Critical Success Factors

1. Political risks, government rules, attitudes, incentives
2. Cultural and economic issues
3. Location of markets
4. Labor availability, attitudes, productivity, costs
5. Availability of supplies, communications, energy
6. Exchange rates and currency risks

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We have to first decide suppose I have already taken an example that ours is a suppose multinational company. So, the multinational company can decide any country where they can start their operations. So, first decision is the country decision that where in which part of the globe the factory or the plant should be located. There are some critical success factor which we must consider before we taking this strategic decision, first is political risks government rules, attitudes and incentives as our focus as the focus of the current government is make in India.

So, the point can be that we are inviting the global leaders in manufacturing to set up their plant locations in India, how we are attracting them by maybe giving them certain incentives certain amendment in the government policies and rules, which will help these foreign big foreign players big market leaders to come and set up their locations or set up their factories in India.

So, political risks government rules attitudes and incentives are important in this decision of locating a plant in a specific country cultural and economic issues location of markets. Now suppose maybe there is a beverage company and we have the biggest market in India. So, they may take this decision or conscious decision that we must be close to our market. So, if India is the biggest market for this multinational company they would definitely like to set up it is manufacturing facilities in India only.

So, because of the large segment of the market. So, location of markets labour availability attitudes of the labour and then the productivity of the labour the cost involved, because wages and cost is an important criteria because each country may set up certain minimum wages for its workers. So, skilled workers may have different minimum wages unskilled labour may have different minimum wages. So, with those wages what would be the cost of the product that sometimes maybe is an important parameter for the administrators or the organizers of the organisation to take a decision that, where our location must be located, when they are taking a decision globally and they want to decide or pin point their point pin point their focus on a specific country.

So, labour availability attitude productivity cost these are parameters related to labour then availability of supplies communications, energy that is also very very important. Maybe some of the countries maybe totally dependent on nuclear energy some of the countries maybe totally dependent on coal somewhere it may be a petroleum based power generation. So, may be different sources of power generation are there. So, every organisation or factory would require energy.

So, they will take a decision that wherever we are getting energy what is the cost of energy that is also an important decision exchange rates and currency risks. So, maybe there can be a country where the economy is not that stable there are chances that the currency fluctuates or the global level of the currency fluctuate too often. So, they will take a decision that there is an issue we must not venture into this particular country.

So, whenever decision has to be taken related to the country where the company wants to set up their plant they will take into account all these parameters. To just to revise this political risks government rules and regulation, cultural and cultural and economic issues, location of markets, labour availability, attitudes, productivity of the labour costs of labour, then availability of supplies, communication, energy, exchange rates and currency risks. These are some of the parameters which will influence the decision of any organisation to select a plant location in a specific country.

Similarly, if it is decided that we are going to focus on country x next will be that within country x where in which particular state in which particular region our plant should be located. So, next will be the region and the community decision.

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Location decisions

Region/ Community Decision

Critical Success Factors

1. Corporate desires
2. Attractiveness of region
3. Labor availability, costs, attitudes towards unions
4. Costs and availability of utilities
5. Environmental regulations
6. Government incentives and fiscal policies
7. Proximity to raw materials and customers
8. Land/construction costs

The slide features a map of the Midwest United States, highlighting the states of Minnesota (MN), Wisconsin (WI), Michigan (MI), Illinois (IL), Indiana (IN), and Ohio (OH). Each state is marked with a black dot. The slide also includes logos for IIT ROORKEE and NPTEL ONLINE CERTIFICATION COURSE at the bottom.

First is the country decision we have seen certain parameters the next is the region or the community decision here may be what are the important parameters the corporate desires may be sometimes a after the strategic decision is taken that it will be country x. Now within x it maybe sometimes a corporate may feel that all over maybe competitors are located in a specific region, why not to go to that region only because it will help us leverage on the expertise or maybe the vendors that the that have been developed by these existing corporate houses there.

So, maybe one is the corporate desire second is attractiveness of the region may be as I have already told there can be different factors of defining the attractiveness, but one of the reason regions can one of the reasons can be that already that is an established region for a specific industry. For example, for I T and computer based industry there can be a particular region in a particular country, which is well known for automakers or automobile industry there can be a specific reason in a specific country which is well known. So, maybe a company may take a decision that this region is known for maybe auto making. So, why not to establish our plant or manufacturing facility, where it is well established, because maybe we are taking the advantage of the work related to plant location which has been done by our competitors or by of the people who are already in that market. They may have also taken into account all these factors and therefore, only they must have established their plant at that location it may be near to the ancillary units

which are feeding them the sub-assemblies which are being find the assembled into the into an automobile.

So, that is another decision that is attractiveness I have only highlighted one aspect there can be another aspects of attractiveness it maybe climatically suitable in order to justify it attractiveness it may be house to a skilled people those who have migrated to that place although intelligent people corporate people are staying in that region. So, that can also be a reason of finding attractiveness in that location there can be different parameters of attractiveness. So, corporate desires attractiveness of the reason labour availability the cost of labour attitude towards unions.

So, that is also very very important related to the employee unions that what is the attitude of the employee unions in the specific region, then cost and availability of the utilities utilities can include maybe electricity charges, environmental regulations are also important may be different states may have different regulations related to the environment or the usage of environmental resources, government incentives and fiscal policies, proximity to raw materials and customers, which I have already highlighted then land and construction cost. Maybe suppose you want to set up a plant may be in the hilly terrain you will have to add the cost of construction there it is not that easy to procure the land and do the construction activity in Hilly regions. So, therefore, the land and construction cost will also add to the overall investment that the company is planning to do in setting up a plant location.

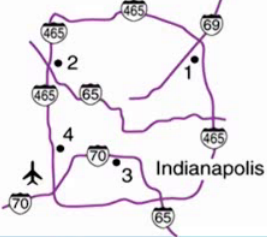
So, by now we have seen that what are the critical success factors or critical factor that must be considered, when we are selecting a specific country for setting up a for setting up of our plant. Within the country then we have to decide the state and for selecting a particular state again there are factors maybe some of them are similar in nature.

So, those factors again we will consider and we will decide on a particular state that within country x my state will be x 1. So, I have now finalize the state based on these factors where the factory will be located then there are site decision.

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Location decisions

Site Decision



Critical Success Factors

1. Site size and cost
2. Air, rail, highway, and waterway systems
3. Zoning restrictions
4. Nearness of services/ supplies needed
5. Environmental impact issues

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Next is within that district or within that state where our site will be located. Now here the critical success factors are site size and cost, air railway or maybe waterways systems that are available for transportation zoning restrictions are there; nearness of services and supplies needed environmental impact issues.

So, for the site when we have identified a particular site we will see that whether air transport is available rail line nearness to rail line if waterways can be used for transportation, then what is a land use policy of that region then we have to decide on the environmental impact issues also maybe cutting of trees may not be allowed in a specific region. So, we cannot select the site close by that region because we made later on think of expansion of the facility and if that is the policy that cutting of trees is not allowed you cannot expand in x and y domain.

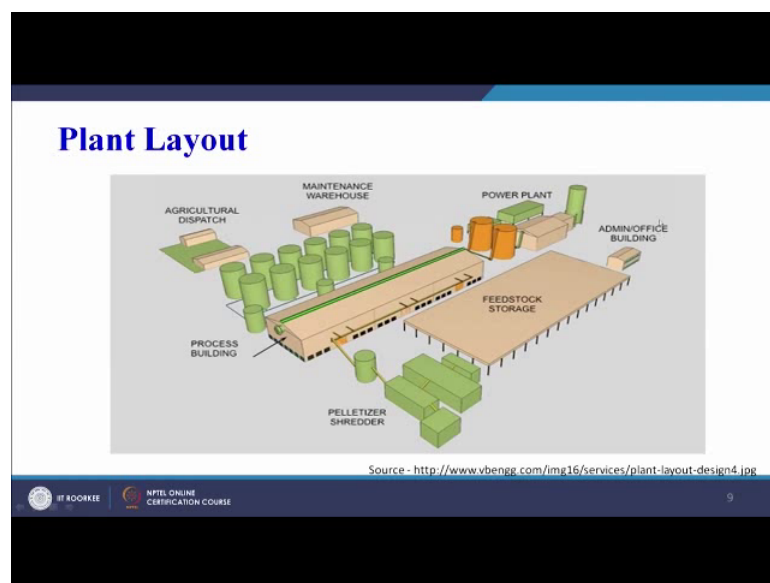
So, that can be one decision that we cannot select this site because tomorrow if we have to expand we have hilly region around we have jungles around where we cannot cut the trees. So, we will not select that site because of the policy that cutting of trees is not allowed just I am trying to give an example. So, we are trying to see that once we have identified the country we have to identify a state within the state we have to identify the site where our location would be there or wherever plant location would be finalized.

Then coming onto the second part as I was already told that once we know that where our location will be, the next is we have identified the site within this site where we are

going to put our maybe manufacturing plant where our employees will stay where will be the recreation facilities for the employees all these decisions will be coming under the broad umbrella of plant layout.

So, first thing is plant location country state region then the within that site we have to identify the layout as given on your screen you can see there is administrative office building, there is a pelletizer shredder process building this large building is the process building.

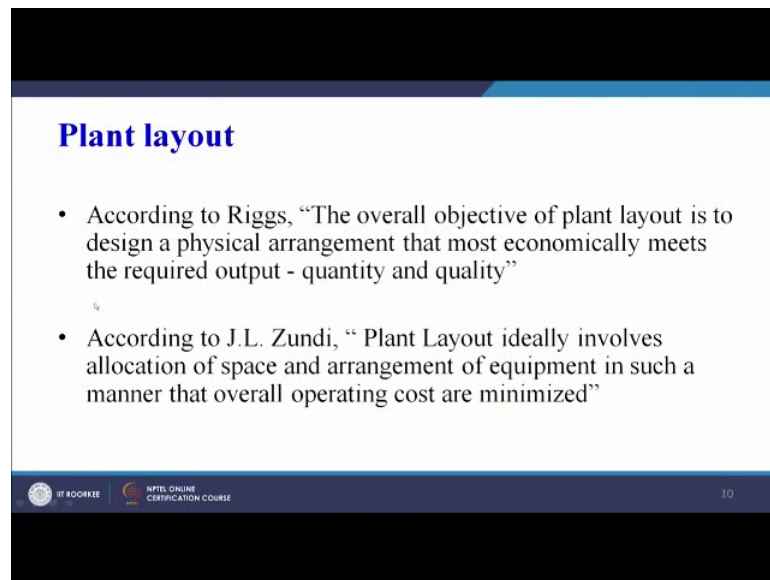
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Then there is a power plant is also inside the site where the power is being produced, then there is a maintenance warehouse there is a agricultural dispatch. So, we have different area year marked for different facilities within the site.

So, plant location has helped me to identify a site where I am going to place my manufacturing facility. Once the site is finalized within the site where which facility will be created will come under the plant layout. So, there are 2 definitions according to Riggs.

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Plant layout

- According to Riggs, “The overall objective of plant layout is to design a physical arrangement that most economically meets the required output - quantity and quality”
- According to J.L. Zundi, “ Plant Layout ideally involves allocation of space and arrangement of equipment in such a manner that overall operating cost are minimized”

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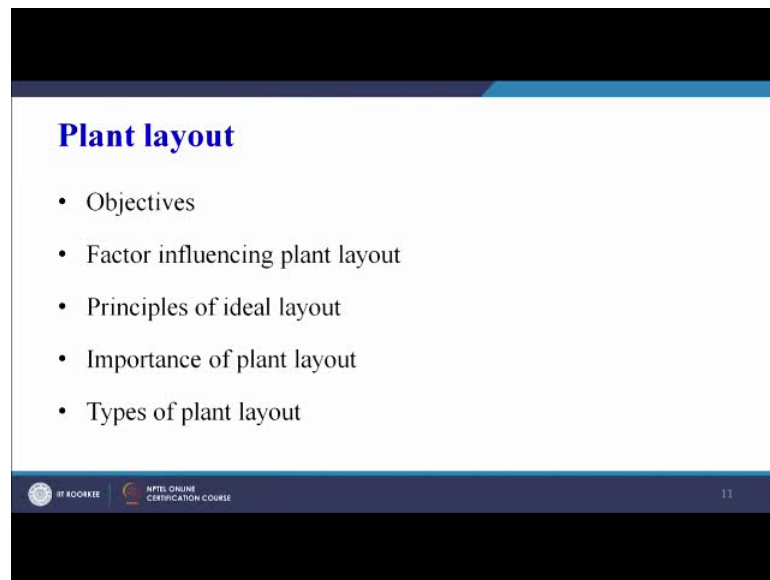
The definition given is very very simple and very very informative the overall objective of plant layout is to design a physical arrangement that most economically meets the required output in terms of quantity and quality.

So, basically we have we need to understand that our facility within the site must be. So, located that we are able to achieve our main operations management objectives that is we must be able to produce the desired quantity of material in desired quality and offer our customers the best product that is available in the market.

According to Zundi Plant Layout ideally involves allocation of space and arrangement of equipment in such a manner that overall operating cost are minimised. So, we have to decide the location of the various facilities within the site. So, that our overall operating costs are minimised. So, 2 definitions give different maybe objective first is right quantity right quality we must be able to produce by locating our facilities judiciously the second says; we must physically arrange our facilities in such a way that the overall operating costs are minimised.

So, plant layout basically we will have one complete discussion maybe a week's discussion 5 sessions of half an hour each on plant layout.

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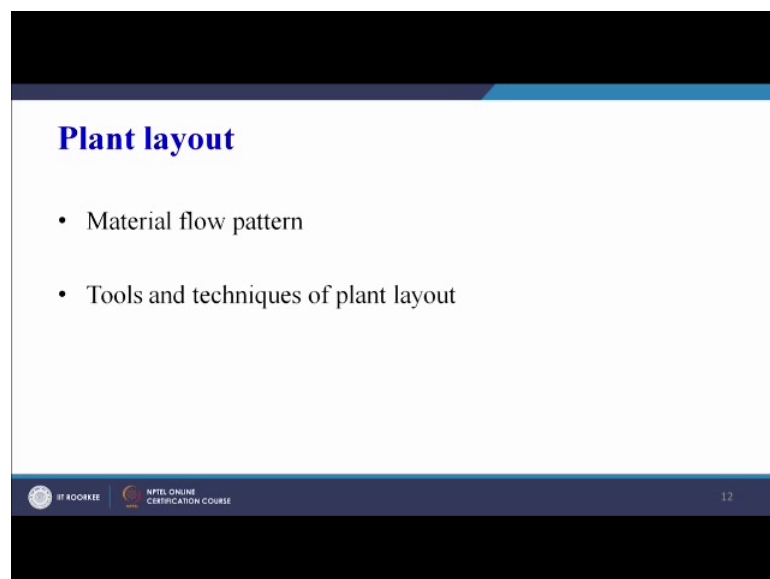
Plant layout

- Objectives
- Factor influencing plant layout
- Principles of ideal layout
- Importance of plant layout
- Types of plant layout

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In which we will discuss the objectives of plant layout factors influencing plant layout what is an ideal layout, we will try to study the importance of plant layout as well as the types of plant layout.

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Plant layout

- Material flow pattern
- Tools and techniques of plant layout

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So, this is basically we are going to study and finally, we will see the material flow pattern within the plant layout and tools and techniques that are adopted for designing a good plant layout.

So, 2 things are important from facilities location point of view the plant location and the plant layout. So, plant location we will further discuss in this week today is the first session that is session number 16 in week number 4 in our course on operations management.

So, we have only highlighted the importance of plant location and plant layout. So, in this week we will have 4 more sessions dedicated to plant location only and in the next week our focus will be on plant layout.

Thank you.