**Operations Management**
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**Lecture – 23**
**Factors Influencing Plant Layout**

[FL] friends, welcome to session 23, in our course on Operations Management. We are currently in the 5th week of our discussion on this course on operations and we have discussed the basic aspects of the course, on Operation Management till date. If you remember, just to have a brief revision of what we have covered till today; we have covered the scopes objectives functions of operations management in week 1. Then, in week 2, we have covered product design and development. In week 3, we have covered the sales forecasting aspects. In week 4, we have covered the plant location aspect and in week 5, we are covering the plant layout.

So, if you see we are trying to develop an operation or an industry in which we are going to produce something tangible. So, starting from the fundamental aspects of operations management; we have moved towards what we must produce, although we have limited time to discuss product design and development. It can be studied as a full fledged course of 42 lectures. But we try to cover that we need to focus on developing a new product, why? And what are the basic nuances related to product design and development? That we have covered in 1 sense. Then, we focused on how much products we must make in our session or in our week on sales forecasting. Then, we thought that yes; we have an idea, what we want to produce? We know how much we need to produce?

We focused our attention on where we must produce and produce and you know that we have already covered in week 4, the factors affecting the location of the plant and where like in which state, in which district, in which part of the country, we must set up our operations. So, that we have already studied in our week force, week 4. Now we are in week 5, in which we are covering that once we have decided where we are going to produce our product, where we are going to operate; we are trying to set up our plant in the most effective manner.

We are trying to understand that, what are the strategic types of layouts or what are the basic type of layout which are being followed by industry? If you see, I think all of us travel and go to different hotels and stay in different hotels, most of the good hotels you will see that a layout of the room is more or less consistent. Now, why most of the hotels have similar kind of layout of the bed and the television as well as a table, chair, the washroom, the dressing room; while a specific type of layout is there.

Because the things have been or the parameters have been optimized over a period of years and the optimized results have now become standard. Similarly, the layouts that are followed in industry are more or less standardized, why? Because all optimization related to movement of material, movement of men, inspections, supervision all these things have been optimized that which type of layout is good for which type of industry. We have seen in our course, in this week only we have covered in the very first session the fundamental aspects of layout and what are the important factors governing layout?

And, we have seen that the type of industry, the type of product we are producing, the volume of production all these aspects are very very important related to the selection of a layout. Now, we are trying to understand that what are the various types of layouts? What are the important factors related to the layout? And I have highlighted I have emphasized. Again, I am emphasizing today that layouts of an industry are an important aspect and they are important from the examination point of view; in most of the question papers related to the industrial engineering or operations management, you will definitely find a question related to the layouts or the type of layout.

So, that is important even from the examination point of view. So, we are trying to understand that what are the various types of layouts being followed by the industry and today's session we will try to emphasize; we have already seen briefly that what are the factors influencing the plant layout. Today we will slightly carry forward our discussion and try to highlight each and every point which affects the selection or a type of layout. So factors influencing the plant layout is the topic of our discussion today and we will be winding up the discussion on week 5 emphasizing on all the aspects related to plant layout or factory layout.

So, let us start the discussion for today and today, we will try to cover that what are the important factors related to plant layout? Now one of the most important factor which we

have already covered in our discussion during week 2, is Product related to which we are doing the manufacturing or the Product for which we are doing the manufacturing activity. Now the type of product will also influence the type of layout that we are going to follow; examples are given on your screen.

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So, the Type of product whether it is heavy or light product, big or small product, liquid or solid in nature will affect the type of layout that we are going to select. First example is, For uniform type of products, product layout is suitable. Now, I think it must have been clear to all of you that what is the product type of layout? We also call it as a line type of layout in which we per e the product that is being produced or manufactured follow a specific sequence of operations.

So, product type of layout is usually followed for uniform type of products. Example, I think if it would have been a regular class I would have been more than happy to ask questions from the students that give me at least 3 examples, where this type of products are being produced or where product type of layout is being used. But here I am trying to answer the question that we can use this type of for layout in automobile industry; where, the assembly of car or motorcycle is taking place.

So, that can be 1 example; where, uniform type of product, all cars produced are of same type. They are of same color or they can be of different color also, but the type of car that is being produced will remain same or uniform. Similarly, we can take an example of a

line type of layout in FMCG goods also. Suppose, biscuits are being produced and 1 dedicated line is for a specific brand and sorry, a specific type of biscuit. So, there will be sequence that will be followed and a complete sequence will give you a final product. So, that can be another example of a product type of layout where, same product is being produced.

Then, the next example is for customized product. Customized product means that it is the product is customized to the needs requirements, specifications of the customer which means that as the customer is changing, your product design is getting modified and for a variety of product designs, our uniform or may be a line type of layout may not be suitable. Therefore, we will go for a process or a functional type of layout where, you remember that there are different departments different sections.

For example, we have seen there can be a drilling section; there can be a milling section; there can be a grinding section having grinding machines may be 8 to 10 type of grinding machines, within grinding also there can be different types of grinders like bench grinder, there can be a cylindrical grinding machine, there can be center less grinding machine; different types of grinding machines can be there. But that will be within the grinding section only. So, that type of layout can be used, where you have a frequent design changes in the product or the customized products are being produced.

For very bulky products, we can go for fixed position type of layout. As we have seen in an example, where a Aircraft was being manufactured. So, when you want to manufacture a bulky big aircraft or a very big ship, in that case we will use a fixed position type of layout. Where, the product will remain at its position, but the machine and men will move to that product to perform the specific operations in order to ensure the complete assembly of the product.

So, these are the important topics related to the product or important factors related to the product that will influence the selection of our layout. Similarly, the sales and demand also influence the plant layout. Moreover, the volume and quality of product are important factors to how that suppose, the quality criteria; quality is an important criteria. We have to see that whether we are going to go for an online quality control or we are going to do the quality control after the product has been produced or we are going to check the quality during the line at 3 specific locations.

So, depending upon the quality that we want to ensure or the quality control policy that the company wants to frame; they will decide that what type of layout should be used by the industry. Because these qualities control personnel, quality control equipment also has to be integrated within the layout only. Some companies may have a policy that first they will make the product and then, the product will go to a specific quality control section; where, the quality personnel will ensure that whether the product being manufactured is meeting the specifications or not. So, that can have a different; maybe thought related to the layout because you have a separate section of quality control.

But in some cases the quality personnel may be deputed on the line itself in order to ensure the intermittent or inter level maybe during the line. They will be checking whether the product is meeting the specifications or not and depending on that the layout will be influenced. The volume of production also; in case of a aircraft, the volume of production may not be that much. Because the product will be produced as per order and the delivery dates will be negotiated and decided dependent upon or depending upon the production facility of the company.

So, the production may not be too large in number. So, therefore, we may easily go for fixed position type of layout; whereas, in case of cars or motorcycle that demand may be large. So, volume of production required is also large and line type of layout where every minute every 5 minutes we are producing one vehicle that type of layout will be more suitable; because it is mass or continuous type of manufacturing that is desirable in case of automobile industry; where, the demand is large. And therefore, the s at the layout which can sustain, which can produce that kind of products to satisfy that demand will be more suitable in a automobile industry. So, the volume, the quality, the sales, the demand all these parameters and all these parameters are related to the product.

So, product that we are producing is the first influencing factor, influencing our decision regarding the selection of a particular type of layout. So, first thing you should remember regarding the plant layout is plant layout starts with p and product also starts with p.

So, p and p we should remember that for plant layout product is one of the foremost parameters that must be considered and related to the product, volume of production, demand in the market, quality of the product that we want to ensure size of the product whether it is large, medium; variety of products that we are producing all these are other

parameters may be secondary parameters product overall may be primary and then related parameters are secondary. All these parameters will affect our decision related to the selection of the layout. But this is not the only parameter; there will be a series of parameters or factors which will influence our decision.

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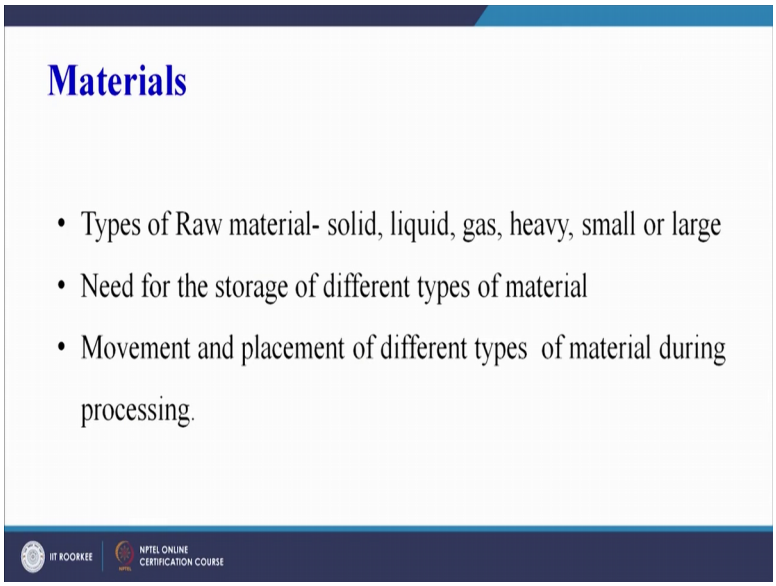


So, let us take the other parameters also. The other factor is Materials. The types of Raw Material whether it is solid, liquid, gas, heavy, small or large. So, depending upon the type of material, we are handling; we have to select our layout. For example, that we are having large sheets of metal that we have to handle. So, definitely we will require a layout where, we can have a place to handle all these big sheets. We may require to cut them using may be a plasma arc welding process.

So, there we are plasma our cutting process. So, there we require that this machine wherever we are locating these mesh this machine, there should be an appropriate place where we can keep these big sheets. So, the size, the shape, the form may be whether it is solid liquid or gas. So, all these will influence the selection of our layout. Need for storage of different types of materials.

As I have already told big materials may require different types of storage space; small materials, very small materials may also require different types of storage space. There may be materials as I know; we have done a course on processing of polymers and polymer composites also. There are prepregs which have to be specifically stored at

minus 18 or minus 20 or minus 30 degree centigrade. Now the place where they are stored and the place where they are being used; there should be minimum distance between these 2 places and this will also affect the selection of our layout that what type of layout we must follow.

Because as soon as we take this material out of that temperature where we are maintaining it, it will start the process of polymerization and we want to use it as quickly as possible. And we have to place it on our mold. So, that is 1 specific requirement and 1 example I am sharing with you that the need for storage of the different types of material will also influence our decision related to the layout.

The movement and placement of different types of materials during processing; so, maybe that is also important the working process and the other parameters related to the movement of the materials will also influence the selection of our layout movement and placement of different types of materials during processing. For example, let us take an extreme case, there is no movement of the material as in case of very bulky and large sized product.

So, definitely we will say this is large size product movement is difficult. So, let us go for a fixed position type of layout only. And in line type of layout the movement is linear, sequential operations are being performed; we will say the movement is in 1 direction only. The raw material is entering the company or the factory from one end and the product is coming out from the other end. So, there is a sequential operation. So, let us have a line or a product type of layout.

So, the movement of material is also very very important. Then, maybe the tertiary parameters like manpower.

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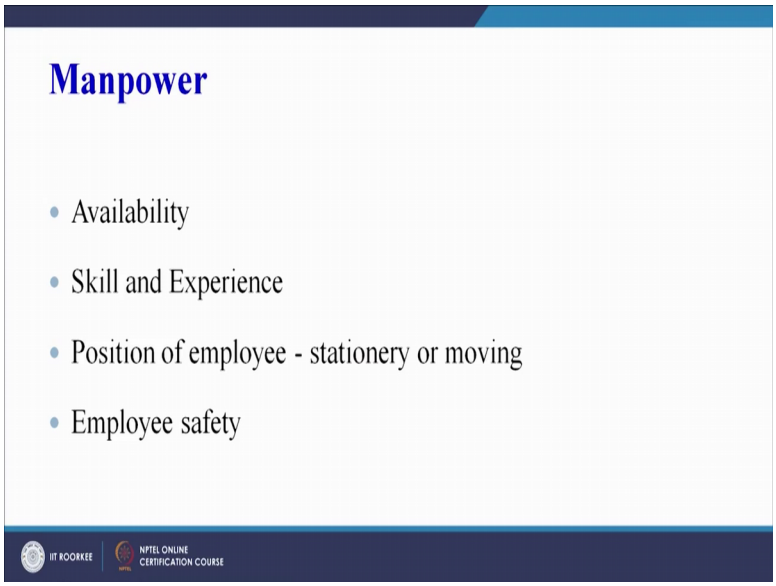


The Availability of the workforce, Skills and Experience of the workforce Position of an employee whether the employee is stationery or the employees moving, Employee safety. So, all these are also parameters which will help us to take our decision related to the selection of the layout. Then the factory building; the building that we are going to erect or that we are going to construct for manufacturing facility is going to influence the type of our layout. The nature and size of the building determines the floor space available for the layout.

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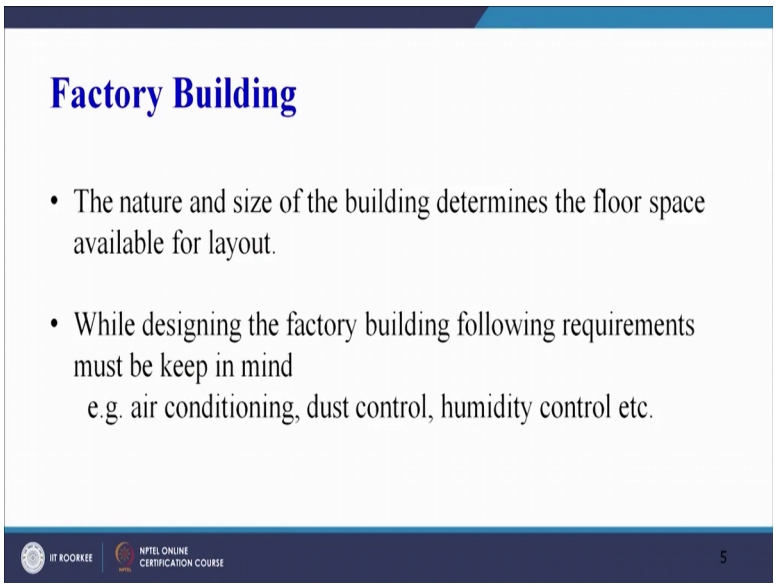

So, depending upon the floor space available, we will try to ensure the maximum utilization of space. So, that we are able to effectively and efficiently convert the raw materials into the final product. So, in building whatever space is available, the type of building we have whether let us take an example that we have a single floor building only; maybe it is a ground floor only. So, we have to see that where which facility must be located? What type of layout we must follow? Whether we should go for a compartmentalized or section wise type of layout or let us bring the raw material and let let us have a sequence of operations and let us push out the final product from the other end.

So, depending upon the building and the space required or the space available sorry, we will select our layout. Suppose, we have double storey, triple storey building we will try to use the elevation also, the floors also and we will see that what we can do on the ground floor; may be the heavy equipment can be placed on the ground floor and the office space can be on the first floor or the quality control department can be on the first floor and the offices can be on the second floor.

Now depending upon the type of building, we will see that we will decide that what type of layout we are going to use. And we will see in our subsequent session on flow of material or material flow lines and there we will see that we can have a flow on the may be ground floor only and we can have vertical flow also; may be we can classify it as horizontal flow lines; may be on 1 floor only.

The material is moving and getting converted into find the product and moving out and we can a vertical flow also where the material is moving across different floors of the building. And then it is finally, getting converted into the final product and going out. So, the type of building will also influence our decision related to the type of layout that are going to follow.

So, while designing the factory building, following requirements must be kept in mind like the air conditioning, dust control, humidity control and these are may be very textual or theoretical type of guidelines. In the current scenario people are focusing on or the scientists, engineers are focusing on green buildings, natural ventilation, use of solar energy, use of the draft of air, making windmills, using windmills, using natural energy. So when you are trying to develop a factory building or trying to develop a building for

creating a manufacturing facility, these are not the only parameters in the current scenario in 2017 we have to focus on. So, many other things like the catchword can be green buildings using the energy.

Then, there can be the utilization of the waste water that we are doing can be recycled, recycling of waste water, recycling of the solid waste generated, recycling or the proper waste disposal are important parameters that have to be considered when we are developing a factory building. So, that is maybe a additional information not available in the textbooks, but as engineers we must be very very sensitive towards our planet and the technology that we develop, we need to keep a focus on the planet that how it is going to affect the environment.

Because we have to leave this, leave this planet for our children, for our grandchildren. So that, they can have a happy life, whenever we are talking of doing some developing some location, developing some factory location or some factory layout or a factory building; we must also consider that how this is going to affect the environment. Whether it is going to have a positive impact on the environment or whether it is going to have a negative impact on the environment. So, that type of analysis; there are experts who carry this type of analysis and rate the buildings accordingly.

So, whenever we are talking of a factory building, a factory layout; we must also consider its influence on the environment. That is also important to for all of us to understand. Then the Location is also important; Topography, because sometimes you may not have a flat land space available with you there may be a topological changes. So, we need to see that how the layout should be designed that that topology is well taken care of and taken advantage of for example, you may have a specific topology where gravity can be made use of for material handling that can be taken advantage of Shape and Size of the plant will also influence Climatic conditions.

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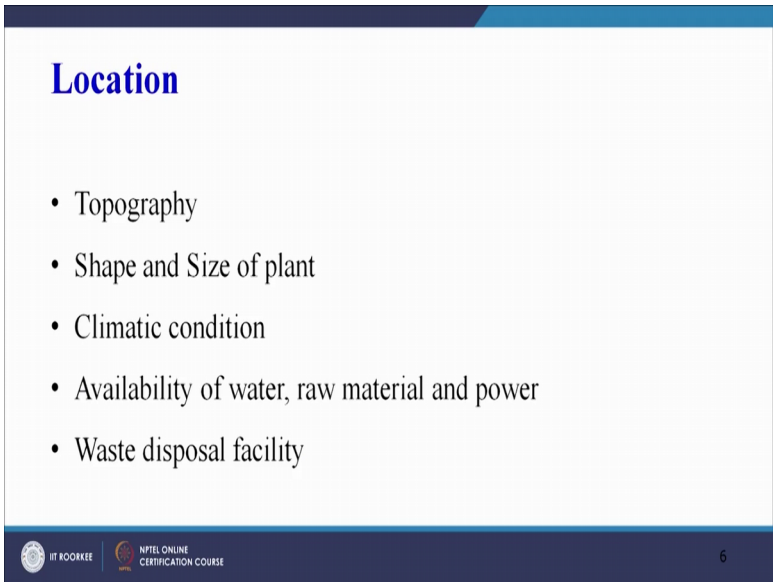


For example, we are setting up a plant in the hills where you need not have any requirement of air conditioning.

So, there also we need not have a air conditioning plant and it will affect the type of layout that we are using for manufacturing type of a product or a particular product. Availability of water, raw material, power will also influence our decision related to the location within the premises and Waste disposal facility is also very very important. Suppose, we need to have a ESP for cooling or for purifying the air, to reduce the air pollution. So, that is one thing; we may have a effluent treatment plant.

Suppose, we want to put alongside our factory that will influence our layout that we need to push out the used water in a direction where, we have our effluent treatment plant. So, similarly, we have to plan our layout in such a way there are the effluents are treated properly before being disposed into the; maybe a river or a drain whatever is being used by the industry for its effluent treatment. Because once it is treated you can just relieve it because there are guidelines that what type of effluent you can lead, leave in that drain or into a river. So, there are guidelines if you are able to treat your effluent to that level, you can release it in the drain.

How it will influence? As I have already explained wherever you set your treatment plant your inside layout will have to be modified accordingly. So, that the output goes or the waste goes towards the plant. So, definitely it will influence the layout in a specific or a

particular manner. So, waste disposal facility, availability of water, air, raw material and power that will also and influence your decision that how the layout has to be planned.

Now some of you may be wondering that there are so many parameters, how we will be able to incorporate each and every parameter in the selection of a layout? I understand that yes, it is a challenging task; but in the very beginning of todays session if you have tried to read between the lines, I have emphasized that researchers, scientist industrialists, businessmen, business wizards have already standardized few types of layout. They have optimized the types of layouts based on all these factors that we are considering today. So, now, what we have to do we have to choose from among these 4 or 5 specific types of layout which have already been optimized and see that minor tweaking required in these layouts which will specifically customize these layouts to our requirement.

I think, I have been able to make myself absolutely clear that we have a standard types of layouts which are available in the textbook. We have these factors which must be taken into account while selecting a layout. Then, out of these 4 or 5 based on these parameters, we can select 1 or 2 which can be best suited to our requirement. And then as per our requirement, we can do the final customization of these standard layouts. So, location is also an important parameter policies of management is also important.

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So, the policies of management related to Volume of production, Size of the plant. Company maybe a medium or small scale industry. So, they know that, what is our capability? What is our strength? What type of production we are doing? So, they will that will decide on the size of the plant. Sales and marketing policies, Purchasing policies; Facilities to the employees, they want to create. Future targets, future expansion. So, all these parameters related to the decisions or strategic policies of the management will also influence the type of layout. For example, the last point I want to emphasize that is the future targets.

Now the company feels that they are into an initial market and maybe in the next 10 years, their volume of production is going to be 3-fold or 4-fold. Definitely they will require expansion. So, they need to see that what type of layout they must follow; whether they should keep some space in the same plant for future expansion or they should expand maybe in other areas or other zones of the country. So, all these policies of the management will influence the type of layout that we are going to have. Similarly, the facilities they want to create for their employees.

Suppose, they want to have a residential campus only; all employees have to stay in the premises on the of the organization. Then, specifically they have to create the living facility, the buildings for insuring the flats and houses for the employees, the recreational facilities for the employees. So, once that is decided by the organization. They have to decide the layout of the organization in that manner only; that yes, within the layout facilities for residences also have to be created. So, every parameter has to be taken into account if we want to create a good layout a good working condition as well as a good living condition for the employees of the organization so.

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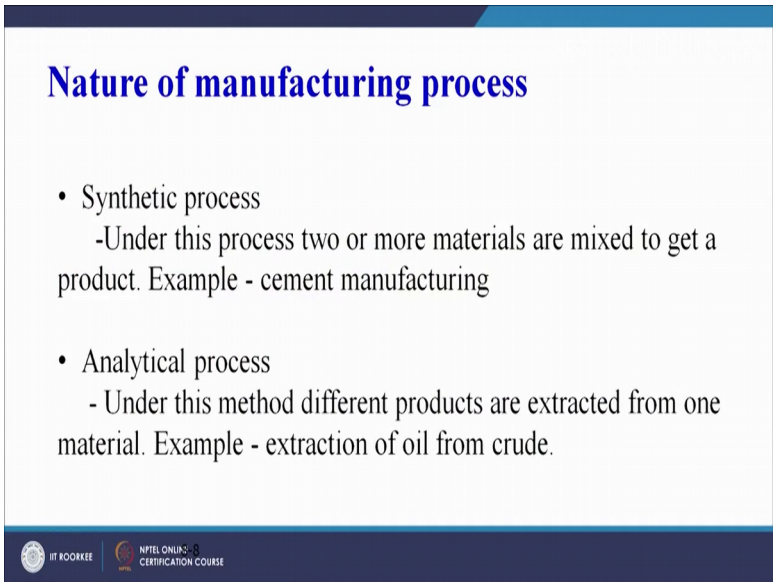


Lastly, we can see that the Nature of manufacturing process will also affect selection of the layout. Very quickly, we can see we can classify the manufacturing processes; I am a mechanical engineer at least we have 2 3 4 classifications possible for the manufacturing processes. But today, we will try to classify the manufacturing processes based on the type of layout that can be used for processing.

For example, the first one, Synthetic process- Under this process two or more materials are mixed to get a product. Example is also given- cement manufacturing. Analytical process- Under these method different products are extracted from one material for example, extraction of oil from crude. So, we have Synthetic process, we have Analytical process; we have Conditioning process.

Under this process, the original raw material is given the shape of different products and nothing is added to it. For example, jute is an important example. So, we are not adding anything, we are not maybe removing much from the jute, but we are giving or we doing something with the jute and making it into a tangible or a useable product. Similarly, Extractive process; this method involves the extraction of a product from the original material by application of heat or pressure.

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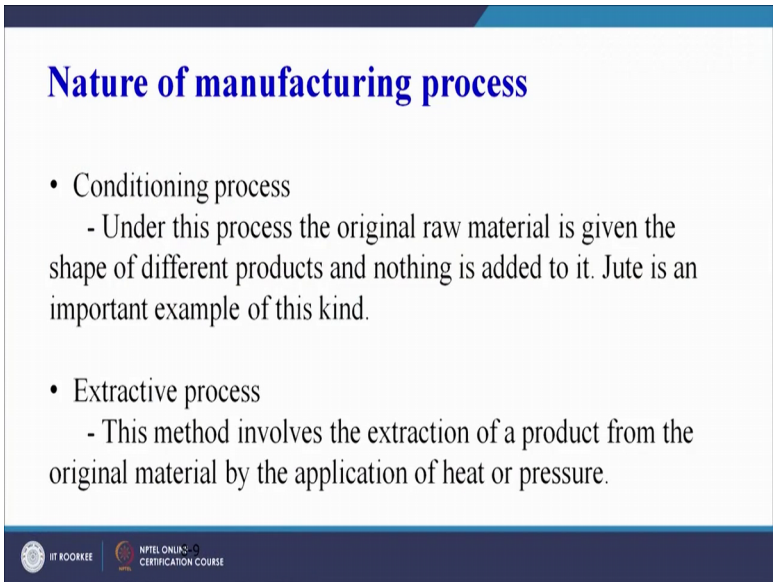


So, you can see synthetic process in the previous slide; Analytical process; then, Conditioning process; then, extractive process. So, all these 4 types of processes, we maybe focus on a specific type of layout only.

So, they will also influence that which type of layout is suitable for a specific type of process. Finally, we come to an important point which we have already covered if you remember; we have seen the type of production systems in our very first week, in our fundamental week related to Operations Management; in our introductory week related to the Operations Management. So, in very first week, we have seen the type of production system actually every week is interrelated interviewed with the other week.

So, the complete course will give you a thought process that suppose we want to produce something, what are the different things that should be covered that we should keep in mind. So, that we are able to bring good name to the organization as well as good profit for the organization. These 3 things we have already covered. Plant layout is generally determined by taking into consideration; the quantum of products to be produced and this we have already related very quickly within a minute or 2; I will try to relate the 2 things.

In job shop type of production all of you know it is intermittent type of production, design changes are very frequent. So, we would like to go for a process or functional type of layout. In batch production also we would like to go for process or batch type of

process or functional type of layout. In mass production we would like to go for a product or a line type of layout.

So, the type of production that's we are following or the type of product production system that we are following will also influence the plant layout or the selection of the plant layout. In job shop and batch type of production, the product changes the customized products are produced; when the product changes frequent we would like to make it in different sections and the there can be a material flow line which we will cover in the next session.

So, depending upon the requirement or the operations to be done on the product it will go to the specific departments and final product will be produced. But in mass production, we will have a product or a line type of layout in which the raw material will enter from one end of the organization. All operations will be performed in a sequence and the final product will come out either from the same direction or from the opposite direction depending upon the material flow lines or the material flow system that we are following. So, we can see that the volume of production is also an important aspect related to the selection of a layout.

So, with this we come to the end of today's session and we have seen today that what are the various factors governing the factory layout or the plant layout and how these factors influence our decision related to the selection of the layout. Also you will appreciate that there are a number of parameters which influence our selection and we have to judiciously take into account these parameters for selecting a layout which will give us improved productivity as well as efficient and effective manufacturing. So, in this week, we have today finished 3rd session of our course. In the first 2 sessions, we have seen the introductory aspects of the factory layout or the plant layout.

We have seen the different types of layouts and today, I think we have been able to properly appreciate the factors that are used for selection of a layout. Also we have tried to emphasize with examples that these parameters are really important in our decision related to the selection of a layout for a particular manufacturing facility.

Thank you.