Operations Management
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Lecture – 21
Facility Layout and Planning-I

[FL] Friends; welcome to session 21, in our course on Operations Management. So, today, we are going to start the discussion related to the plant layout. Basically, we have already discussed in week 4, the theory as well as the topics related to selection of a location for setting up our plant or our factory.

So, today, we are going to start our discussion with the theory and practice related to the selection of a layout. So, week 4 was related to plant location, factors influencing plant location as well as the theory behind plant location and the selection of a plant location. So, basically these two weeks 4 and 5 will help us to select a location as well as to select a type of layout that we are going to follow in the in our pursuit of launching a new product in the market.

So, we have already decided that what is going to be the product? What is going to be or how much is going to be the quantity that we are going to produce? Then, in week 4, we have seen that where we are going to produce or what is going to be the location where we are going to set up our plant? And now on we will see; what will be there inside the plant or how the plant layout will be designed? So, our focus now on will be on plant layout and if you remember in week 1, we have seen that what are the overall objectives of operations management?

We have also seen that what are the scopes and functions of operations management? So, basically we were able to understand that Operations Management is related to complete conversion or we can say that complete management of the operations related to procurement of the raw material to the final dispatch of the product into the market. So, we have discussed the fundamental aspects in week 1 and thereafter we discussed carry forward this discussion in week 2, 3 and 4.

We have then, discussed in the 2nd week, the product design and development in which we have seen the basic aspects of product design, we have seen product lifecycle, we

have seen the concept of value engineering, we have see sorry seen the concept of design for x that is designed for manufacturing and assembly, we have seen ergonomics the concept of ergonomics and how it helps us to design a good product and finally, we have seen how to prototype the product quickly or what do we understand where rapid prototyping or what is the concept of rapid prototyping?

So, we have seen what is operations management? Product plan is one of the important aspects of Operations Management that we have seen in the very first week and then we focused our attention on developing a product or designing a product. Thereafter, once we know that what is the product that we want to make we as a company as an organization, what is our product line going to be or what type of products we are going to launch maybe in the next 5 years or 10 years? So, once we know what has to be produced, we need to find out that how much is the quantity or how much is the volume of production that is required?

We have decided that a particular product we are going to make; now, in what quantity we must make? Because there can be 2 extreme cases. We may make it in bulk; we may follow mass manufacturing system or mass production system or a continuous production system. But there is no market in the or there is no demand in the market. On the contrary, we are very conservative; we make very few products only, but there is a huge demand in the market. So, the 2 extremes are there in both cases we are going to lose; in one cases, we have blocked all our financial resources and we have used those resources for making the product which is now not selling in the market.

On the contrary, we on the other side, if we see that we have the technology, we have the product technology available, but we are not producing it and there is a huge demand in the market. So, in both cases, if we are making less products, demand more; we are at loss. We are making large number of products, blocking our financial and another resources; there is no demand in the market then also loss. So, therefore, it is important to understand the need of demand forecast. We need to make a demand forecast that what is going to be the sales? What are the expected sales? What is the expected demand in the market?

Once, we know that demand; we can use different methods for making this forecast. Once we know the demand; now, we have to plan our operations, now we have to

manufacture the product. One of the important points, when we are starting to produce a new product is the type of the factory that we are going to use, the layout that we are going to follow; every particular building or a complex has got a layout. You enter the premises of any organization, you will see a layout.

So, basically what do you mean by a layout? It's the relative location of the various facilities in the premises. So, that is the basic concept of a layout or we can say it is a Birds-eye view of the organization that where which facility is located; where is the maybe carpentry shop, where is the foundry, where is the machining shop or if we talk of a hospital, it will again have a layout. So, for a hospital, where is the, we can say ICU, where is the X-RAY lab, where is the doctors chambers.

So, all these are we can say location of these facilities within the boundary, is what we call as the layout. So, once we know that what is the product we want to make; we are we are also decided we have calculated using the qualitative and quantitative methods of forecasting that what is the quantity we are going to produce?

Then, the next stage is the layout or the industry that we are going to use to make that product of facilities that we are going to use to make that product and there is a good presentation if you search the internet, you will find a number of very good presentations on this topic and fortunately, we were able to find 1 such presentation by Sanket Bhambal which is given the source or the link is given the website is slide share dot net.

So, we could get this very good presentation by this gentleman and this presentation we are going to follow maybe, many slides of this presentation we will follow in order to understand the aspect of layout. Different books you will find, different types of examples related to the factory layout. So, the title for us today is to understand that we know what we want to produce, we know how much we want to produce; then, we have to decide how to produce.

To how to produce we have to manage the operations there also. So, we will see that what is the facility layout? What do we mean by facility layout? What are the different types of layout? And some of you may be wondering that facility layout and planning one is given. So, we will discuss the complete aspect of facility layout and planning in 2 sessions. Session 1, we will see the introduction, the definition, the factors influencing the factory layout and few types of factory layouts which are generally used in the

industry. Then, we will focus our attention on the other types of layout, for the latest type of layout that are being followed in the industry.

So, with this background that is the, what is the importance of week 4 in our discussion. We are now focusing on actually producing the product, we have already decided what to produce in product design and development we have decided how much to produce in sales forecasting. Now we are focusing on how to produce is, produce it.

And how to produce it, we are going to understand what is going to be the layout of the company, what are going to be the material management plans and policies? What are going to be the aggregate production plan for manufacturing? How we are going to manage the materials like materials requirement planning? All this means that is actual actionable output that is actual production of the products or the parts or the components or equipment that is what is now, now onward our focus going to be.

So, let us start the discussion and try to understand that what do we mean by Facility Layout?

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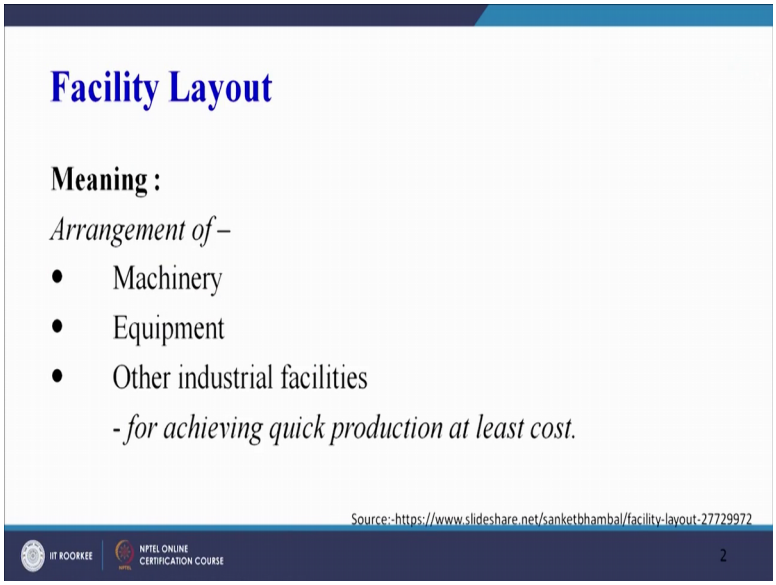

So, just a very simple definition you can see, Arrangement of -Machines, Equipment and Other facilities -for achieving quick production at least cost. So, you see 2 criteria are already outlined here. What is the meaning arrangement of? That is the location of

various machines equipments and facilities within the organization. What is the target? The target is 2 important criteria that is quick production.

So, quick is the catch word here, quick means we have to make efficient and effective use of our time because the lead times have to be less; we need to produce our product or parts as quickly as possible without compromising the quality and performance of the product. So, quick production is one objective, we have to ensure that.

Second is at least cost. So, the cost should also be manageable or competitive we must be able to compete with the customers based on the cost of the product. So, 2 things we have to ensure. So, the layout must be such that it is it will ensure quick production as well as a cost effective production. So, 2 factors for a ideal layout can be very easily specified from this slide that is time and cost. So, we have to focus on the time required for production and the cost involved in production.

So, we must ensure the location of our facilities within the organization in such a way that we are able to save time and we are able to save cost there other factors also. These are not the only 2 factors which are going to be important. There are other factors which we are going to take into account that we will discuss maybe in the subsequent slides. Now, what are the objectives of a good layout?

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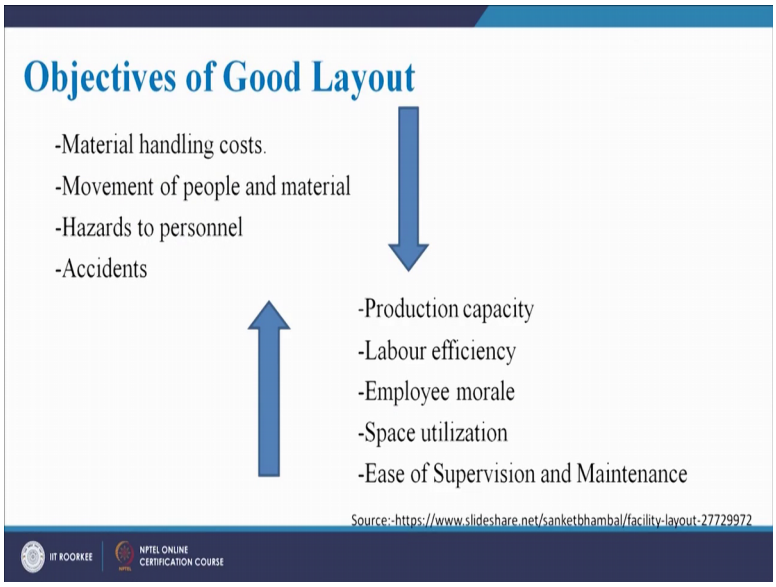

You can see 2 arrows here. Now the top arrow is pointing downwards which means that these 4 factors we need to reduce, when we are designing a layout or a good layout should focus on minimizing these 4 factors that are given here.

It must minimize the material handling costs. So, it is important that the handling cost should be less. So, that a layout can be such that the travel of the materials can be minimized; the material handling cost may be if you are using manual method of material handling it may be a costly affair, but if you change it with the automatic handling system, you may save some money.

Although, the initial cost will be high, but the lifetime cost may be cheaper as compared to the manual handling system. So, first thing that a ideal a layout or a good layout must address is the material handling cost and try to reduce the material handling cost and second is it should minimize the movement of material and people, minimum movement of materials and people must be ensured.

If we can ensure that it will automatically reduce the risk of hazards to the personnel working in the organization and which will subsequently lead to reduction in the number of accidents happening in the organization. So, 4 things we need to minimize by designing a good layout. Now, what are these 4 things? The material handling costs, the movement of people and material hazards as well as the accidents, but a good layout must increase something.

Now, what it must increase? It must improve the production capability or the production capacity. It should improve the labour efficiency, if the labour is working in a safe environment. They have to move maybe to the minimum, they will definitely become efficient; unnecessary redundant movements can be reduced by the ideal design of a layout. Then, employee morale will be high, space utilization will be better and ease of supervision and maintenance will be ensured.

So, when we design a layout we should design it with certain objectives and the objectives are clearly mentioned in this slide that what should be our focus? What should be our objective, when we are designing a layout for a specific organization? There are other factors also which we will see, but these are the objectives. We must ensure safe working environment, we must ensure a cheap or maybe a cost effective layout. We must

ensure accident free layout. We must ensure a layout which is highly productive, which is highly efficient, which is highly effective.

We must ensure the proper utilization of the space, we must ensure that the layout is such that the working professionals or the working personnel feel happy while, working in that environment. Their morale is high. They feel satisfied by working in the particular type of a layout because if we have, if we give a worker a very cramped space and he has to stand in a very cramped corner and do his work; he may after some time start losing focus and start losing interest in the job that he is doing.

So, we have to ensure a ideal layout where the machines are properly placed, the space is properly utilized. People feel happy and comfortable working in that arrangement of machines and equipment and the overall system productivity is enhanced.

So, we have to ensure, we have to reduce certain things as objective and we have to improve other things in order to design a good layout. Now, what are the factors that will affect a good layout? We can see what type of material we are handling.

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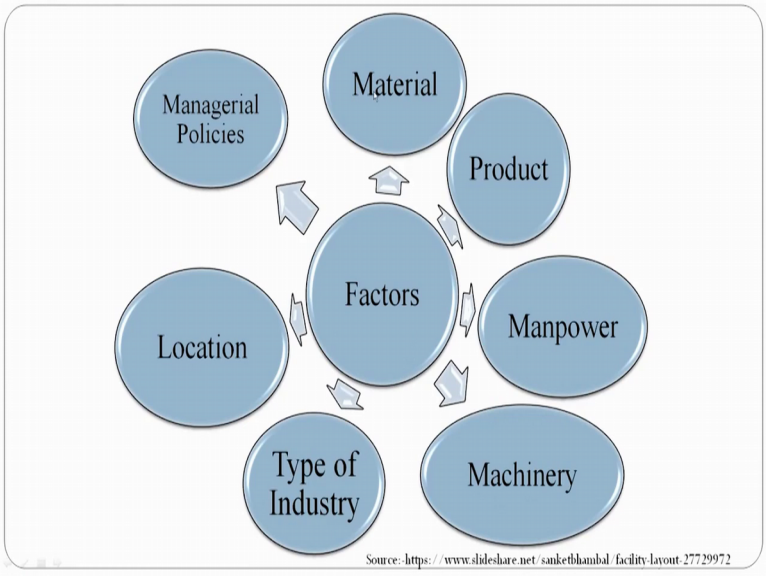

What type of product, we are producing? What is the manpower requirement? How many of them are skilled, how many of them are unskilled? So, that may also help us to decide on our layout.

Sometimes, you will see in a specific layout the works manager will be sitting on the first floor and from there through the glass windows he or she can observe the workers working on the ground floor. So, at from a height the works manager can always keep a control, always keep a probing eye on the work being conducted on the shop floor.

So, that is also one we can say additional criteria for deciding the type of a layout, the type of people involved, the manpower involved; then, the equipment involved. If heavy gantry planes or heavy gantry robots or heavy gantry cranes are being used; accordingly, we have to see that how the layout should be, what will be the movement of the cranes?

Whether we should have certain machines below these heavy cranes or not? So, that will also. So, equipment, machine, manpower, the type of product we are producing. If we are manufacturing a aircraft, we will have a completely different type of layout. If we are manufacturing suppose, a automobile that is a motorcycle, we will have a different type of layout. Location also is very very important type of industry is important.

For example, if we are talking of a hydroelectric power project where, water is being used for creating or generating the power, we will have a different type of layout. Whereas, in case of coal fired or coal based hydro sorry coal based power generation units we will have a different type of layout. So, type of industry if it is a continuously producing product; then, different type of layout. If it job shop type maybe once in awhile a company is getting the order of a specific design, if it will have different type of layout.

So, type of industry, machines, manpower, product material, managerial policies and location will definitely dictate or will definitely be a backbone based on which the layout of a company will be decided. Once again, I am reading you this is important that what are the factors that are considered while designing a layout.

So, we have to decide on the type of material handling, the type of product we are producing that number and skill set of people involved in manufacturing activity; machines, the types of machines used. Type of industry location and managerial policy. So, all these and these are not the all, all the factors that we have covered. There can be some other factors beyond these factors which will also govern the process of selecting a particular type of layout for a particular type of industry.

So, but these are the general parameters or factors which affect the type of a layout being followed in a industry. Now, what are the principles of ideal layout? So, objectives and principles we can say are may be complimentary.

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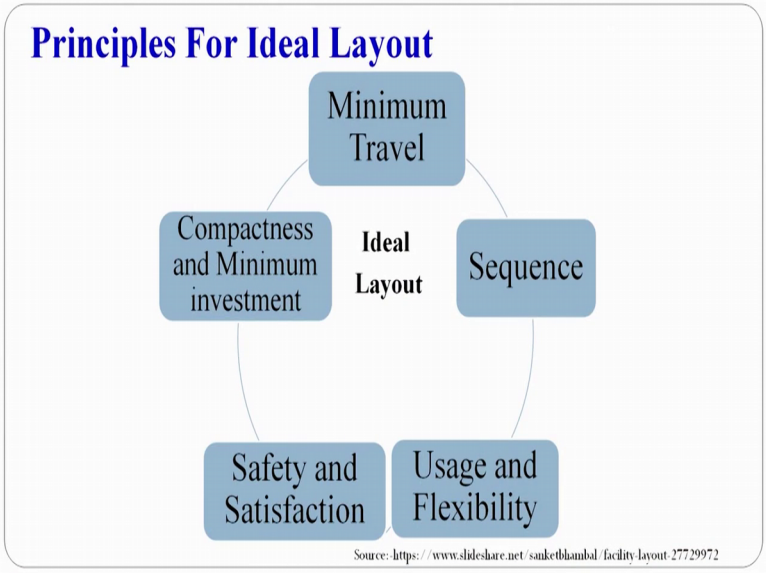

So, principles for ideal layout are that we have to decide on the Sequence of operations. We have to decide on the Uses and Flexibility of the space as well as the equipment. Then, Safety and Satisfaction of the employees, compactness and Minimum investment. So, in ideal layout, we have to focus on these 5 important points. We have to focus on travel that there as we have seen in the objectives that we have to minimize the travel of men and equipment as well as machines.

So, minimize the travel, we have to optimize the sequence of operations being conducted for converting the raw material into the final product. We have to ensure proper usage and flexibility of the machines, so that we can adopt to their design changes very quickly. Then, safety and satisfaction of the employees on the behavioral part, we have to ensure that as well as on the technological part also because safety is directly related to technology and then, we have to ensure compactness and the minimum investment

So, ideal layout, we will try to achieve the ideal layout if we are able to optimize all these important parameters, the working environment is very safe. There is no danger to the working equipment as well as the working personnel. They are satisfied; then, the usage is optimal, maximum utilization of the space we are doing both in the x y and z

coordinates; all the space is properly utilized. The machines equipment the all other production line is flexible. 0054he sequence of operations have been optimized.

So, if we are able to optimize all these parameters or all these factors as depicted in the slide; we can very easily say that the layout that we are following is the ideal or the best layout for this particular type of industry.

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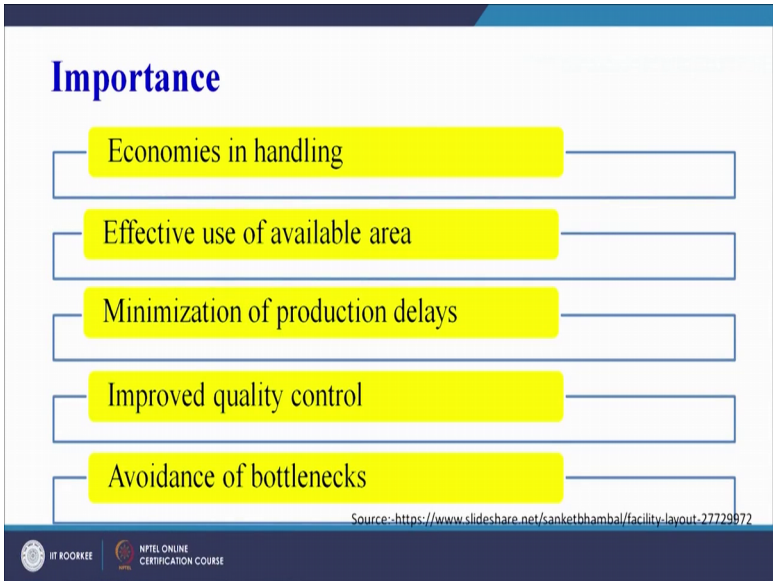

Now, importance that is really important we have seen we have to cover. So, many factors in for making ideal layout; these are the important things that must be satisfied.

Why? Why should we focus so much on the layout? We can put all the machines may be in a single line and start manufacturing. What can be the problem? There can be certain problems. Therefore, it is important that we give, we give a piece of our mind to the design of a layout also because the optimal layout or optimal design of a layout will not only help us in minimizing the travel or minimizing the effort on part of the workers.

But it will save certain accidents which may prove to be costly for the organization as well as it will help us in improving the morale of the workers. It will help us to minimize the cost of our product, it will help us to be more productive in our operations; it will help us to be more efficient and effective in our operations.

So, basically a good layout is what is desired by each and every organization and therefore, it is really important. Now, if we are able to design a good layout then it will

help us, it the importance will help us to economize or it will achieve, help us to achieve the economies in handling.

It will help us in the effective use of our available area. It will help us in minimizing the production delays; it will help us to exercise our quality control on the product that we are producing. It will help us to avoid the bottlenecks.

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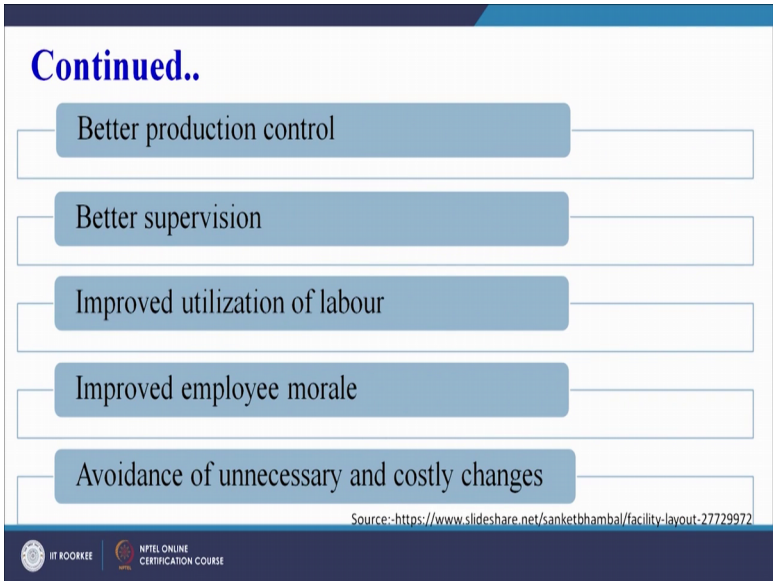

Better production control. As I have already given an example the works manager is sitting on a first floor in a glass chamber and he can directly observe the workers working on the shop floor. So, better supervision it will ensure improved utilization of labour, improved employee morale and morale and avoidance of unnecessary and costly changes.

So, there are. So, many points that have been listed here, but in nutshell we can say that if we are able to design a good layout; it will help us in improving the overall productivity of our operations or overall productivity of our organizations which can be related to labour productivity. It can be related to the productivity of our machines. It can be related to the productive or the economic productivity or cash flow productivity that whatever is the amount of investment, we are making; it will be converted into useful output or the profits will sour for the companies or profits will increase for the company.

So, overall we can say a sense of well being prevail if we are using a good layout. So, again I am not going to run through these points that are listed here because by now, every learner must have understood the importance of facility layout or an importance of a good, this factory layout.

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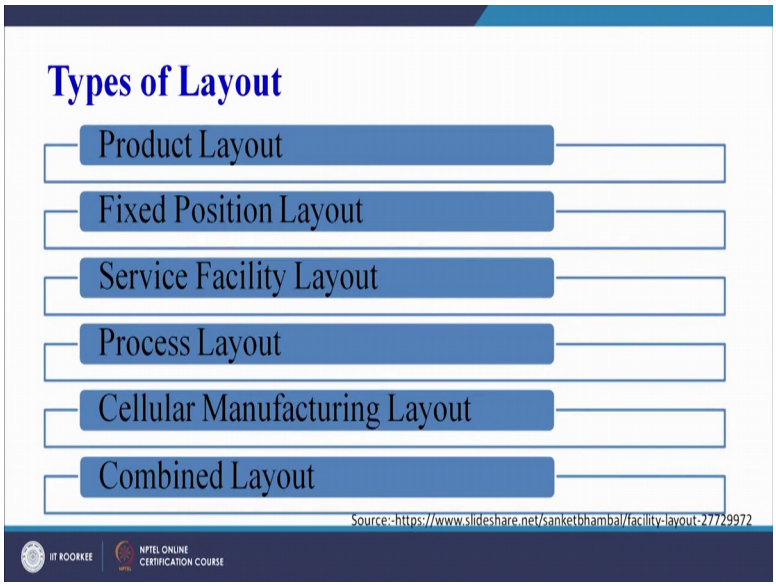

Now, there are different types of layouts that are usually used in the organization. So, one is the first one on your screen, you can see it is a Product Layout. Then, there is Fixed Position Layout, Service Facility Layout, Process Layout, Cellular Manufacturing Layout or Combined Layout. So, depending upon the factors that we have already covered, depending upon the importance that the layout has in ensuring the success of the organization, we can choose from a wide variety of standardized layouts which are usually followed by industry.

We have seen that the layout is definitely going to help us in achieving our overall objectives of operations that is to ensure, what are the overall objectives? If you remember in the very 1st week, we have covered the objectives of Operations Management.

So, 4 keywords we must always remember; quality, quantity, time and cost. So, our good layout will help us to achieve these 4 objectives of operations management because we will be able to produce a good quality product as we have seen in the previous 2 slides that a good layout will help us to exercise our supervision effectively. It will help us in

better production control, it will help us in better inspection and quality control. So, a good layout will help us to ensure good quality. It will help us to produce the product in a most effective manner that is the quantity can also be ensured.

So, quality is ensured quality, quantity is ensured. Then, we have seen in the very first definition today that what is the definition of factory layout in that we have seen, it will ensure quick production. So, it will ensure a timely delivery as well as the time that is required for manufacturing can be optimized or minimized and finally, we have seen it has to be cost effective also. So, layout will help us to achieve a cost effective manufacturing. So, a good layout will focus on good quality manufacturing ensuring the quantity ensuring timely deliveries at competitive prices.

So, a good layout is always desirable. Now, we have to see, what are the different types of layouts that are mentioned? We will cover each one of these and try to understand the salient characteristics of each type of layout. So, the first one on your screen is a Product type of Layout. Now, what do we understand by product layout. Now product layout is a line type of layout; in line type of layout we have the proper sequence of machines raised in a line. It may not be a linear line maybe straight line it can be a s type the line means that the sequence of operations will be one after the other or thus, one subsequent to the other.

So, we will see what is a product layout? It is a straight line or layout for serialized manufacture, serialized means the sequence of operations is predefined that what is going to be or which is going to be the first operation and which is going to be the last operation and what is going to be the sequence.

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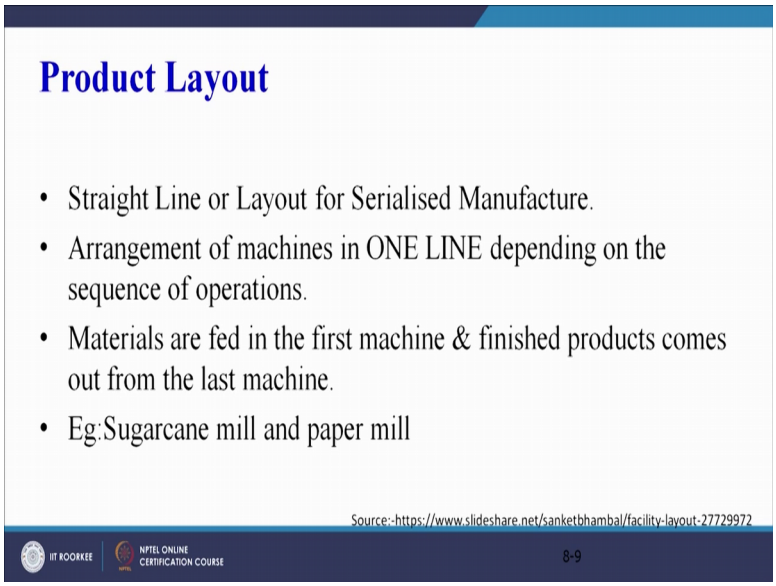

So, it will be a serialized manufacturing of the product. Arrangement of machines is in ONE LINE depending upon the sequence of operations. As I have already highlighted. Materials are fed in the first machine and the finished products comes out from the last machine. For example, sugar cane mill and paper mill and to that extent the manufacturing of automobiles also uses the line type or a product type of layout. The assembly starts from one end and that complete product comes out from the other end. So, the automobile industry also most of the times in they follow the assembly line and falls under the product type of layout.

So, we can remember from this slide that it will follow a line it can be a u type of layout also. We are entering the raw material from one end of the u; then, it follows the sequence of operations in the u and comes out from the same side only. But it follows a specific sequence of operation. It can be s type of layout also, raw material enters from one side; undergoes the sequence of operations in a series and finally, the final product comes out from the other end of the s type of line.

So, it is not a linear line only, but it can be for a straight line only; it can be s type, it can be u type or any other type that can come to your mind. So, but the sequence of operations is the key word here which will remain same.

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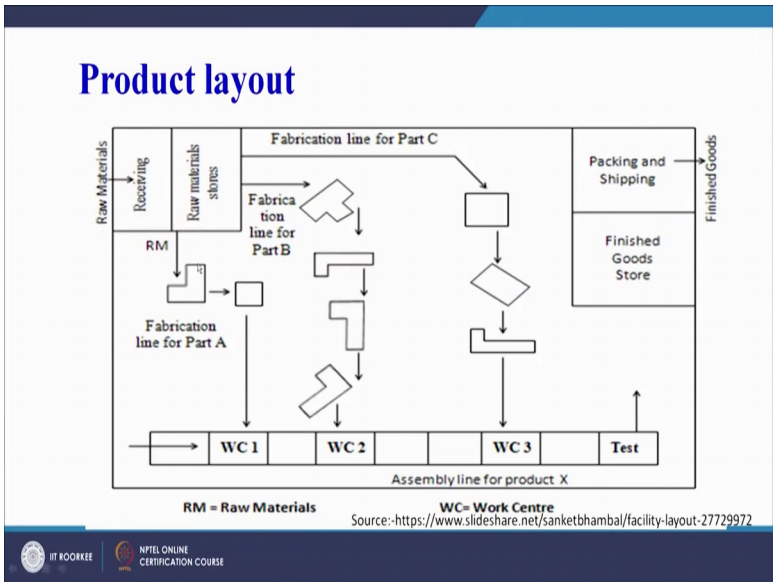

Now, this is an example of a product type of layout, you can see. The raw materials this is a raw materials being received here; raw materials store. So, Fabrication of part A, it is coming to WC 1 and then, this is Fabrication of part B, again WC 2; Fabrication of part C coming here and all these 3 assembly line of the product which is coming here and finally, after testing it is going to packaging and shipping and finished goods store.

So, we can see a particular sequence or a line is follow WC 1, WC 2, WC 3 testing and finally, it is going through the Packaging as well as Shipping. And the additional materials are stored in the Finished Goods Store. So, you can see the sequence is followed WC 1, WC 2, WC 3 and the assembly line for product x, WC as you can see here it is clearly mentioned, it is a work center. So, all the 3 work centers are arranged in a single line or in a linear fashion one after the other. So, all the 3 parts part A, part B and part C come to the assembly line and they are assembled together to form product x and finally, after testing the product is sent for shipment.

So, this is a product type of layout sequence of operations are followed. Then, the second is Fixed Position Layout.

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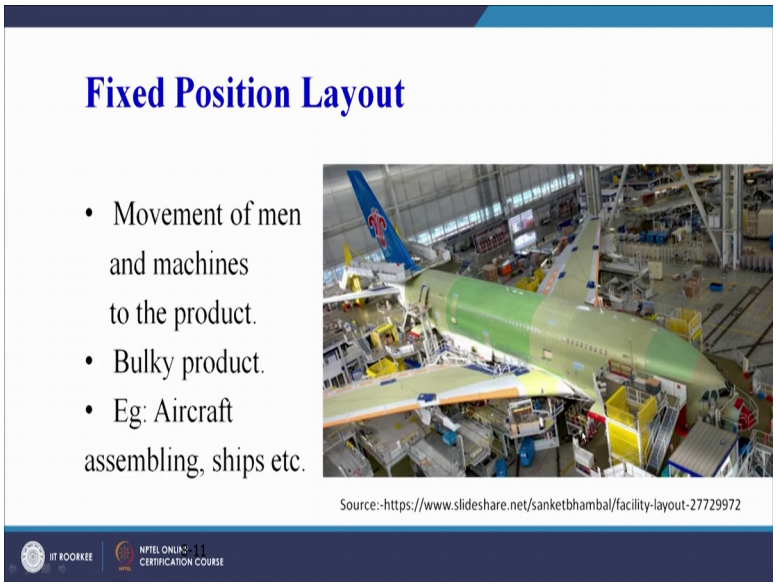

You can see here, this is a manufacturing of our Aircraft. We see the product here is not moving in case of product type of layout or line type of layout, you can see there is a line and the product is moving. Part A is coming to Work Center 1 and here, it is moving forward and getting assembled with part B at Work Center 2 and then this sub assembly moves further and at Work Centers 3. It is getting a sub assembly of A and B is getting assembled with part C and the assembly of A plus B plus C is finally, going for testing.

So, the product is moving on the assembly line. Whereas, in case of Fixed Position Layout, the product is fixed at a single point; you can see here the product is fixed here, fixed position layout, so the movement of men and machines to the product. So, the product will not move from its location; it will be fixed at 1 point only. And men and machines or equipment that has to operate on that product will move to the product and do their operation and the example is given Aircraft, one of the characteristics is that this type of layout is used for a large or bulky product and for example, Aircraft assembling or building or fabrication of ships.

So, with this, we come to the end of today's session. I am again, thankful to the researchers, to the engineers, to the academic fraternity who post their valuable lectures and videos and presentations on the website. And this particular presentation again, the source is given you can follow the complete presentation at www dot slide share dot net slash Sanket Bhambal slash facility layout. The link is given, you can follow this link

and may also try to look for other beautiful presentations, other well meaning presentations, other easy to understand presentations by the same author.

Thank you very much.