Principles of Industrial Engineering
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Lecture 19
Plant Layout: Types of Layout

Hello, I welcome you all in this presentation related with the subject principles of Industrial Engineering and you know we are talking about the Plant Layouts. The plant layout is about the way by which the machines facilities are arranged in an organization in a plant. So, that there is a very smooth flow of the resources for producing the goods and the services.

So, that it can be done at lowest possible cost with the highest output and a minimum wastage of resources. There are various ways to arrange the facilities in a plant to realize this objective and that particularly depends upon the kind of the marketing strategy of the company, which means, whether it will be going for a specialized few, very few units and very high volumes or it will be going for wide variety of the products, manufacturing of wide variety of the products and their marketing in limited quantity.

So, depending upon the kind of the volumes which are to be produced, suitable manufacturing strategy has to be adopted and accordingly the production facilities to be developed. If we see the different types of the layout there are five types of the layouts which will help us to satisfy the requirement of producing the things at minimum possible cost and maximum utilization of the resources. That depends upon the number of units to be produced to a great extent.

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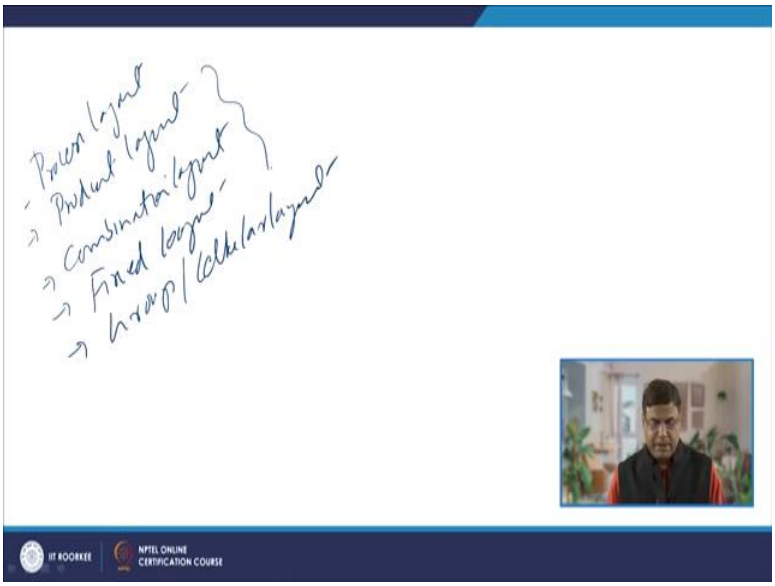

And the different types of the layouts include like the process layout, about which I have talked in the previous presentation. We will be talking about the product layout and then combination layout, the fixed layout and the group layout, this is also called cellular layout, cellular layout. So, we will be talking about these product layout combination layout, maybe the fixed layout as per the availability of the time

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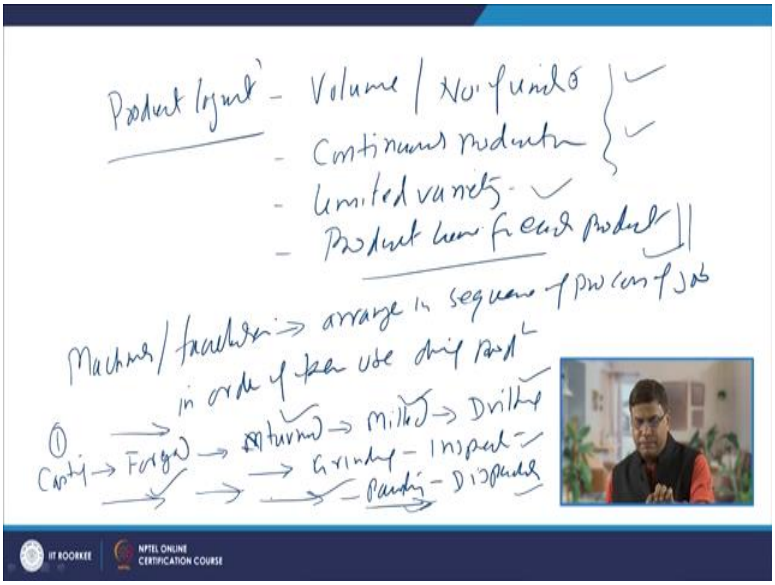

Now, we will see, in productive layout this kind of the layout is good when we can afford the volume or the number of units to be produced or such a high a number that it is possible to go for continuous production. Then we choose the product layout. In this case, we may go for very limited variety of the products because for each product there will be a one separate product line, there is a product line for each product.

So, since each product line requires number of the specialized machines, so it would not be appropriate to go for many people products. So, we go for the limited products otherwise it will require heavy investments. In any case, there is a separate product line for each product that is why primarily we go for the limited variety and continuous production is a typical feature of this kind of the layout and when very high volumes are to be produced.

This kind of the arrangement means, in this arrangement basically the machines or the facilities which are to be used to for production purpose, they are arranged in the sequence of processing of job like the facilities will be arranged in the order in which they are to be used him So, basically the facilities are arranged in the order of their use during the production.

So, let us say once we get the cast component, cost component first of all say it is forged, after forging it is turned day, after turning, it is milled, milling is performed. After milling, drilling is performed. Then after drilling grinding is performed, after grinding, inspection is done and after inspection, all painting is done and then dispatching.

So, for this kind of product, all facilities like the input material in form of costing will be forced. So, first we will have forging machine, then lathe machine, then milling machine, then drilling machine, then grinding machine, then setup for the inspection, painting and dispatching. So, the all the things will be arranged in a particular sequence, so that there is continuous and almost linear flow of the material from the beginning to the end.

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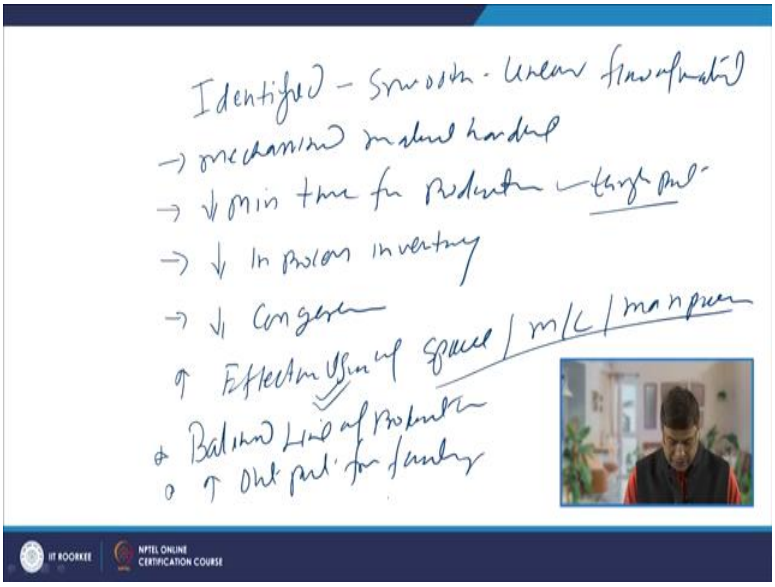

So, what is the advantage, that there is identified, smooth, almost linear flow of the material in course of production? So, advantage of this is that, we can implement the mechanized material handling system since the movement is continuous, so there is very minimum time for completion of production.

So, minimum time for minimum time for production of the product, it requires very minimum in process inventory and very minimum congestion and therefore, it offers very effective use of like space effective use of the machines, effective use of the man power. All those will be working continuously for smooth flow.

So, minimum time for production means minimum throughput time, minimum congestion minimum inventory. So, all these are various, very useful things, here very balanced line of production, which means all machines and manpower, is fully engaged for continuous work

that in turn will be helping to increase the effective utilization and increase the output from the facility. So, these are some of the features.

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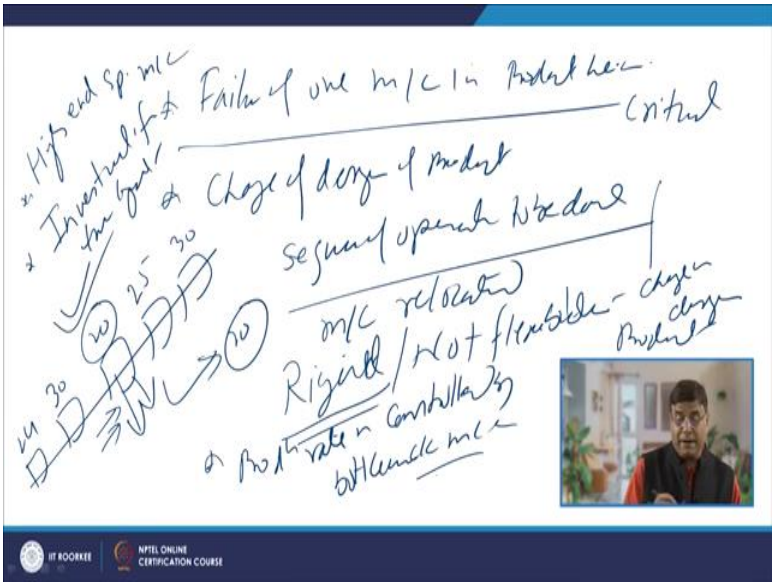

The disadvantage site if there is a failure of one machine in the product line takes place, then whole production is stopped. So, failure of even a single machine is very critical, it will lead to the breakdown of the breakdown of one machine will stop or halt the production process as a whole.

Now, if there is a change of design of productive then it cannot be accommodated in this kind of the arrangement because change in design means change in the sequence of operations to be done and the change in sequence of operation to be done means machines need to be relocated.

So, again we need the modification of the layout which means this kind of the arrangement or plant layout is a rigid. It is not flexible, especially with regard to the change in the design, change in the production rate all those things cannot be done, production rate is also fixed.

So, although here production rate is controlled by the bottleneck machine, bottleneck machine, out of all those stations, the station having the minimum capacity that will be dictating the production rate, say it can produce 24 units, it can produce 30 units, it can produce say just 20 units, here 25 units here 30 units.

So, the maximum production rate which is possible through this kind of the facility, this kind of the product line is 20 only. This will be dictating the maximum production rate which can

be realized and this will be the bottleneck station here because others can do more, but they will not be able to do because here.

Otherwise it will held up, it will be holding up the production at this stage. So, this will be governing the rate of production. Additionally, this requires very high and specialized machines. So, in general investment which is needed for this layout is very high

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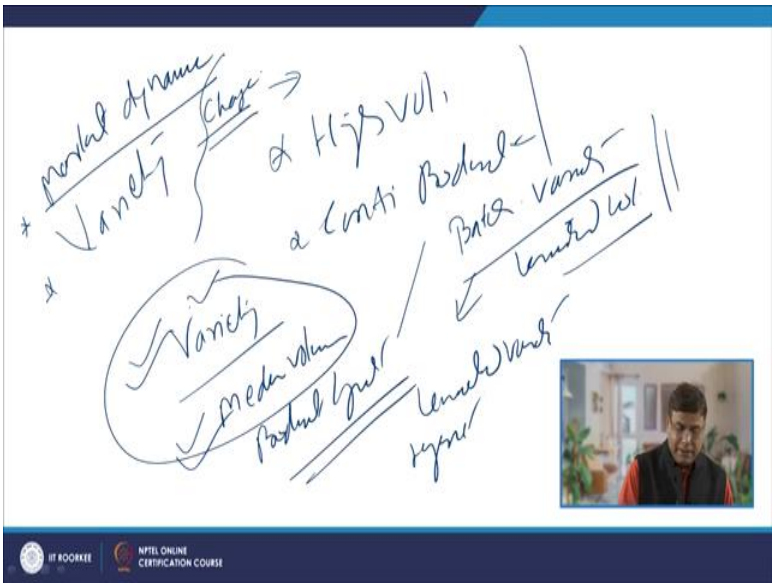

And that is why the product layout is justified only for very high volume and continuous production mode. If the volumes are limited and the production mode is not really continuous then we need to then this kind of the layout is not justified. But what we see nowadays, like people are looking for variety, designs do not sustain they do not the design of a particular product in the market will not sustain more than 1 or 2 years. So, the market is very dynamic, market is very dynamic, the change is dominating.

So, if you have one product of particular design in 1 or 2 years, it will get modified. It will be updated, it will be upgraded, because of the changing demands for newer designs and therefore, the companies or the plants, they are now working primarily on the intermediate kind of the arrangement where they can produce the variety as well as the medium volumes.

So, that they can deal with the variety as well as the middle size, the production requirement, since what we have seen earlier like batch production deals with the variety, but very limited volumes. So, batch productions may not be able to justify this kind of, may not be able to satisfy this kind of the demand.

While in case of the product layout, we need very high volumes and very limited variety, just opposite. So, limited volume batch production for variety of the products while in case of the product layout, what we have? We, the product layout is justified when very limited variety and very high volumes. So, these two are just of the opposite kind.

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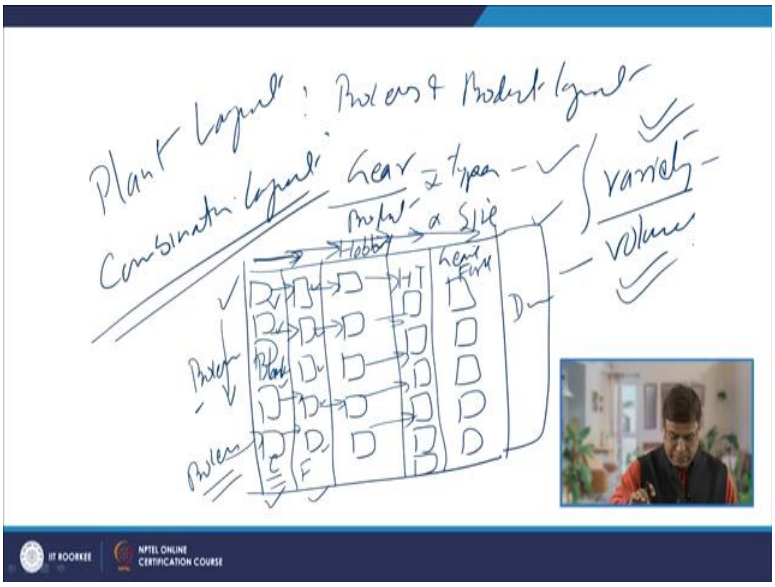

So, to deal with the requirement of the medium volumes and the wide variety requirements, the organizations are trying to come up with the plant layout which will have the features of both, the process and the product layout and that is why a one layout that is called combination layout this kind of the layout is also developed.

This type of layout is like say I will give very simple example like a company is manufacturing gears, we know that there are different types of the gears like spur gear, helical gear, herringbone gear, so many types of the gears and these gears also vary in terms of the sizes. So, the variety of the gears and the different sizes, these are to be manufactured say in one company.

So, and so, like say the here we have the variety as well as the volume, intermediate volume and variety. So, to deal with this kind of the requirements organizations come with the combined layout, where the facilities will be arranged in such like say, initially in the costing section, the blanks are produced.

Then these are say forged. So, different costing facilities, what our types of the gears are to be produced, they are blanks will be produced in this section. So, this basically belongs to the process layout arrangement and then after costing these blanks these need to be forged.

So, different forging machines will be there in the next section. All these forging machines will be used for giving the approximate shape to the different types of the gears which are to be produced. So, after costing it is to be moved in the forging section. After forging say it is to be processed by hobbing machining.

So, different hobbing machining, after hobbing say the heat treatment is done. So, the different heat treatment of furnaces are there like that case hardening, carburizing, nitriding, etc, whatever is to be done. After heat treatment again say gear finishing is needed. So, the finishing machines are there. So, whatever types of the gears are to be produced, first the blanks will be produced, then they will be forged, then they will be hobbed, then they will be given the heat treatment, then they will be giving the finishing and then like this dispatching.

So, here if we see there are different sections and each will be accommodating the different facilities of the same type. So, this is like say, the process according to the process layout and after performing the one type of the operation, the material is moved in forward direction, like say this after the costing it will be forged, then it will be hobbed, then heat treated like this.

So, this is the kind of setup where it which combines the features of the process layout and the product layout to both and this kind of the arrangement will help in dealing with the production of the variety of jobs and the moderate volume. So, this is the typical feature of the combination layout

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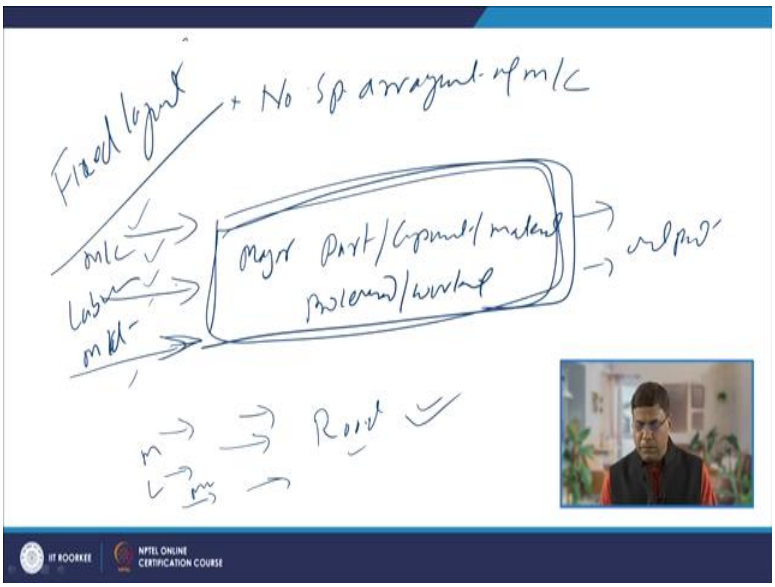

Now, we will be looking the features of the fixed layout. In case of the fixed layout, there is no specific arrangement of machines. Basically, in this case a major, we can say a major part component or the material, its location is fix and then all machines, machines, labor, material are brought close to it and they will be processed. They will be working on this major part, the major part or component is processed using the different machines, materials and the labor and at the end, we get the output.

So, here like in case of the road construction, what we do? The material is brought, labor is brought and all machines are brought in and then the road is constructed and at the end we get the road. So, close to the location or the plant, we bring in all the man, material machine and the work is done under the out in output we get them the product.

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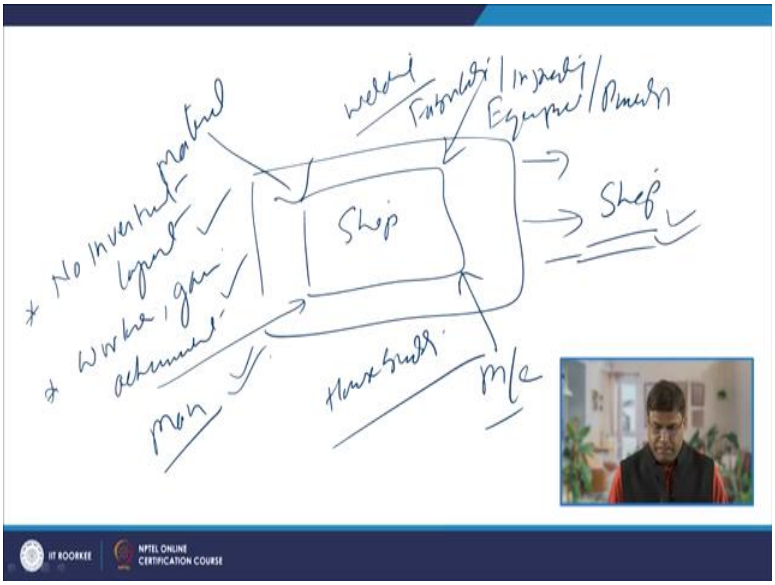

Similarly, like in construction in ship industry, like there is a shipyard. So, one major part is there where all the materials, one major material is there and all the labor, the machines, the tools, the equipment's are brought in and they will be welding, fabricating, inspecting and painting, everything is done on it and after processing as a result we get the ship.

So, all heavy structures are developed and made using this kind of layout where the man, material, machines, all equipment's needed for production are brought in close to a particular location, they will be working on that and as a output we get some kind of the product or some kind of the, thing which is constructed like same thing is done in house building, road construction, the similar kind of the arrangement is used.

In this case, the good part is that there is no investment as far as the layout is concerned and whatever the workers will be working, they gain a lot through the experience and there is a feeling of the achievement through the development because individual workers will be doing on such kind of the things and all those will be having the feeling of accomplishment of something. So, investment is limited and they gain experience and expertise and they feel pride in realizing something in this kind of layout.

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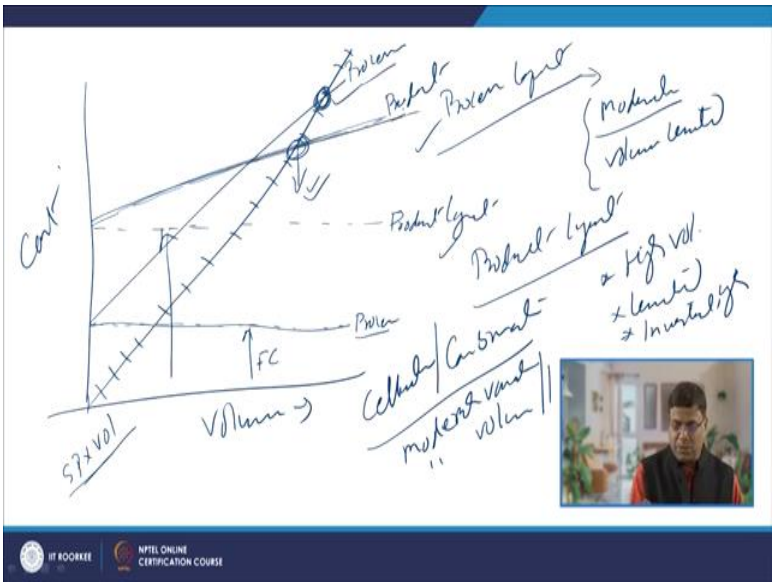

Now, if we see, the process layout as far as the investment is concerned, investment is moderate. But the volumes which it can produce is also very limited. On the other hand, the product layout, product layout is used for very high volumes and very limited variety but the investment is very high.

And on the other hand the cellular layout or the combination layout, which combines the advantage of both, process and product layout. In that case, what we will notice that the moderate variety and moderate volumes, both are realized. So, if we see in terms of the total cost which comes out from the process layout and the product layout.

So, the as far as the initial cost and the variable cost like for process layout say the fixed cost is less, but the variable cost is high. So, total cost will come like this. So, this is the case of the say process layout. Here, we have volume and here we have the cost.

So, this is the fixed cost for FC for process layout, the fixed cost for product layout is very high, but the variable cost is limited like this variable cost is limited. So, this is coming like for product layout. So, the number of units if we see, if we have one like if we see the

revenues where the sale price into the volume or the number of units which is sold and that will be simplest one straight line like this.

This is the revenue line, so the revenue line if we see where the revenue line is cutting, revenue line in case of the product layout is coming here and the revenue line for process layout is cutting here. So, for this particular situation, the fixed layout, the volume for fixed layout, volume for the product layout is less and volume for the process layout is high for this particular situation, when we consider that the fixed costs for the product layout is high, but the variable cost is very-very low.

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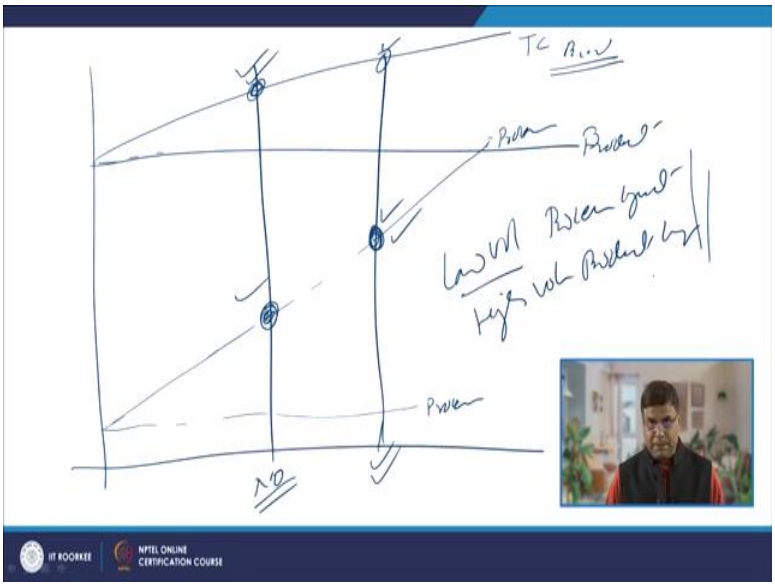

Mostly what we observed that the fixed cost for process layout is very less and variable cost goes in like this. While so, while in case of the product layout, so this is the case of like say the process layout, total cost for process layout. If we consider the product layout fixed cost if very-very high.

In that case, the total cost line will be coming like this TC, total cost line for product layout. So, if we see for the same number of units to be produced, the total cost for process layout is this and product cost is this. So, the total cost for product layout is very high as compared to that for the process layout.

So, likewise what you will see, the number of units as the number of units increase this difference of the total cost in process layout difference of the total cost for the same volume of the number of units, increase of the process layout and the product layout that will be reducing.

And, what we will notice? For very high volumes only the total cost for the product layout will be justified over the process layout. So, normally what we see, for the low volumes, the process layout is justified, while for high volumes, product layout is justified because it is the lower cost for given volume.

Now, here I will summarize this presentation. In this presentation basically, I have talked about the three types of the layouts and their features like the product layout, the combination layout and the fixed layout. The product layout is suitable for high volume production and the limited variety products, while process layout is suitable for the limited volume and the h variety products, thank you for your attention.