Principles of Industrial Engineering
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Lecture 20
Plant Layout: Cellular and Process Layout

Hello, I welcome you all in this presentation related to the subject Principles of Industrial Engineering and you know we are talking about the Plant Layout. There are various types of the plant layouts like the Process Layout, product layout or the combination layout and then fixed layout and the Cellular or group technology based layout. So, in earlier presentation I have talked about the first four types of the layouts like the process layout, which is primarily used for the batch production purposes.

Product layout is used for the mass production purposes where the continuous operation will help in realizing the goal of the high volume production and the fixed layout is used for fabrication or manufacturing or making the things where one main component is a heavy and it is capped at a particular location while all other resources like labor, man, material, machines are brought to that and then the work is done on that, so that we can get the finished goods.

In case of the combination layout to exploit the benefits of both product and process layout or combined arrangement according to both type of the layout is carried out, so that we can satisfy to some extent, the intermediate volume or the production of the different sizes of the similar type of the products like the manufacturing of the gears involves the manufacturing of the different types of the gears of different sizes.

So, in those kind of situations, maybe the combination layout comes out to be good because the type of operations which are to be performed on the different types of the gears for making the gears of the different sizes also, those that type of operations and sequence of operation is by and large same. So, in those situations, so the combination layout comes out to be a good one.

Now, we will see in in this presentation basically, I will give you the idea about the cellular or good technology based layout and how the facilities or machines are arranged in case of the process layout, so that the objective of the cost minimization can be realized through the reduction in the kind of movement which is needed in course of the production of goods and services.

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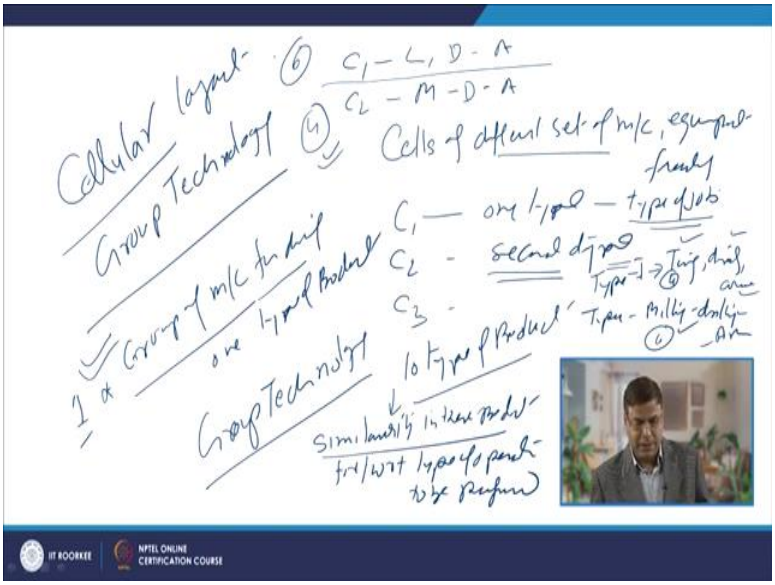

So, considering this cellular layout, this is also called the group technology layout. In this case, as name appears, the cellular layout basically we create the cells of different sets of machines equipment and facilities. So, cell one will be of one type, cell two will be of the second type, like this and each cell is made independently to perform certain types of jobs.

So, the types of the jobs will be different, which will be performed in these cells. Efforts are made to come up with the cells or combination of the different sets of the machines in such a way that each cell is independent. So, the idea is the grouping of machines for doing one type of product involving various operations. So, each cell will be in should be independent on its own to do a particular type of the jobs.

Then, the second cell which will be created that will be doing another type of the product or the job. So, like say, in the group technology as far as the group technology is concerned, this information was about the cells as far as the group technology is concerned, like say the 10 types of the products are product and types of the products or the components are being manufactured.

So, what we will do? We will identify the similarity in these products, similarity in these products for especially with respect to for or with respect to the type of operations to be performed, type of operations to be performed on those products. So, we may come up with the, we may group them like that the type one product which primarily needs the turning and then drilling and then assembly.

The type two products need milling, then drilling and then assembly. So, we can safely create like four products are of this type and the six products are of this type. So, we will be safely able to create the two cells where one type of the product which needs primarily turning, drilling and then assembly and the second type of products which need the milling, drilling and then assembly.

So, in that case, we will be able to have the safely 2 cells, cell 1 which will be involved in basically lathe machines, drilling machine and the platform for assembly. Likewise, cell 2 will have the milling, drilling and assembly. So, each cell will be independent. It may be used to manufacture 4 type of the products, 4 different products, which will involving the milling, drilling and assembly and this will be used to manufacture the six different products.

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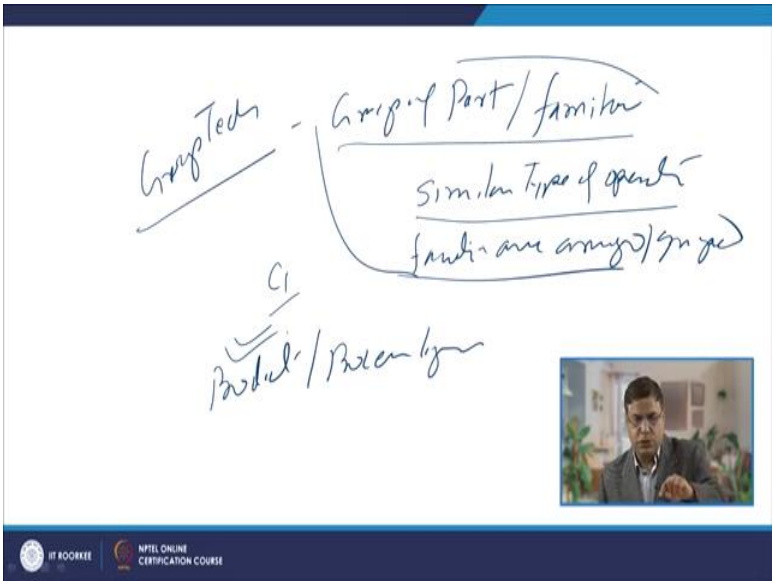

So, this is how basically, so in group technology basically we try to create the group of the parts, which we can say as a families commonly known as part families. We try to create the part families which means, we try to compile a list of the products which need similar type of operations and then accordingly the facilities are arranged and grouped, so that each part family is created or produced in each cell.

So, different part families are identified and for each part family the different cells are created. So, that is how it becomes the combination of the product as well as the process layout. Primarily it helps in having the smoother flow and unidirectional flow of the product in course of the production, there is largely there is no backtracking.

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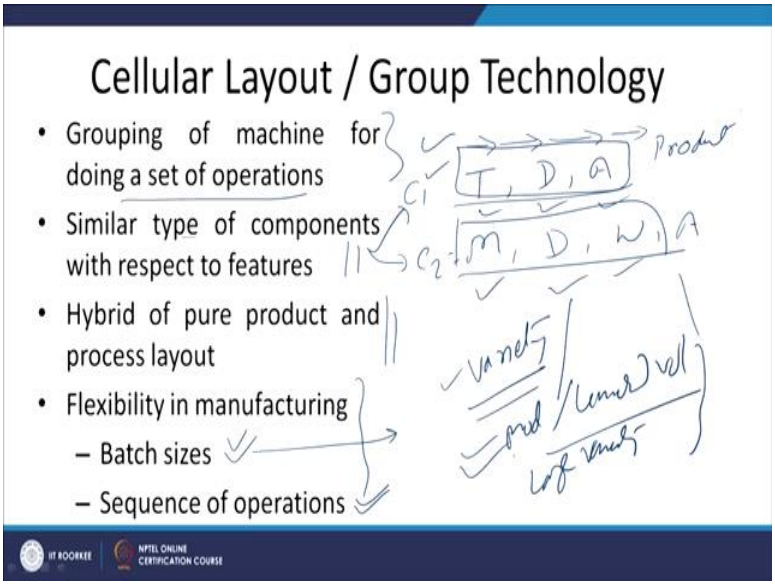

So, now if we will see through the details of this in group and a cellular layout or the group technology, basically it involves the grouping of the masses for doing a similar type of set of operations. So, different operations are performed like I gave example of the turning, then drilling and then assembly. So, the machines needed for these three different operations will be arranged in one cell like another operation which needs another component, which needs milling, drilling, maybe welding and then assembly. So, this will be created in another cell.

So, similar type of the components with respect to the features are processed in each cell. This is basically the combination of the product and process layout, why product layout? Because the each product will be flowing in a particular sequence until it is completed. So, flowing in particular direction through the different stages until it is completed. This forms the situation of the product layout.

And here what we are doing? We are creating the clusters of the different machines based on the type of operations to be performed in each of the component. So, this kind of the arrangement helps us to deal with the challenge of the fluctuating batch sizes because we have to cater the need of the different varieties of the products and the size of the batches according to the variety is changing.

So, this kind of the situation when the limited volume, a limited or moderate volume and the large variety is to be catered, then this kind of the layout is found to be suitable. So, here basically it gives us the some kind of fluctuation.

If there is a minor change in the design of the product, then that can be easily accommodated because the machines are arranged according to the sequence according to the type of the operations to be performed. So, minor change in the design of the products can be easily accommodated and that is how it is able to cater the need of the variety as well as the moderate volumes, volume requirement.

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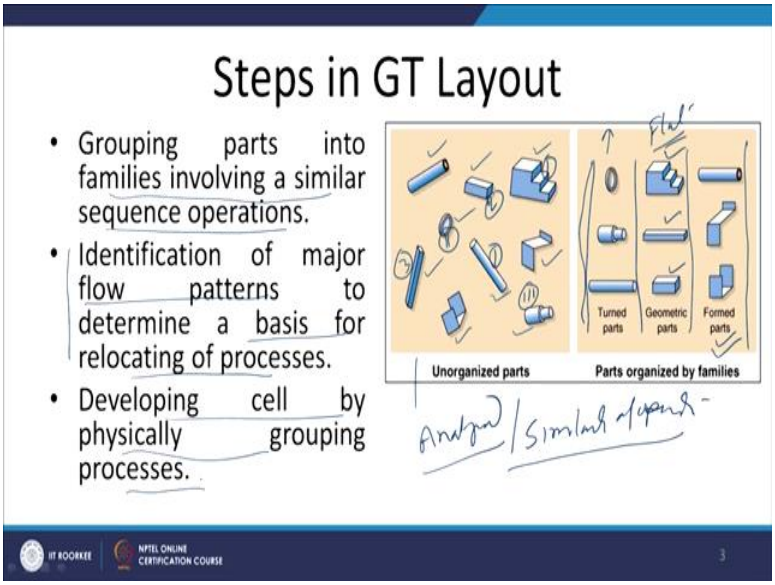

So, like for the better clarity if, we see, there are like say the nine products the, this is one the shaft with the rod with the whole, the prismatic component rectangular block, another block, the ring, the another shaft, shaft with the step, the folded strip, another folded strip and the rectangular or rectangular cross section rod. So, these are the different components being manufactured. These first these are studied and analyzed to see the similarity of operations to be performed in these products. So, if we see these three products, these three products like product 1, 2, 3, all these need to be turned.

So, they have been groped as a turned parts and then geometric part, prismatic like the row those having the rectangular section 1, 2 and 3, these have been grouped here 1, 2, 3. So, this is another category. So, in this case, mostly the turning operations or the operations on the lathe machines are to be performed, lathe and drilling machines are to be performed or even on the lathe also it can be done.

Then all flat surfaces are to be generated maybe by milling or shaping kind of planning kind of processes and then another one where formed parts, where some kind of the deformation is involved. So, the parts are grouped according to the type of operations to be performed and

then accordingly they will be moved through they will be manufactured through the different cells, you by grouping the facilities.

So, grouping of the parts into the families involving the similar sequence of operations, similar type of operations and then a sequence can be identified, then identification of the major flow like what will be the sequence which will be followed. So, it will be turned first and then grinding will be done and then holes will be drilled.

So, what will be the sequence of the determining the flow pattern, so that machines can be arranged accordingly? So, what will be the sequence in which our operations will be performed, so that the facilities can be arranged accordingly? And then, once we arrange the facility then we develop the cells by physical grouping of the processes. So, that is how the cells are developed.

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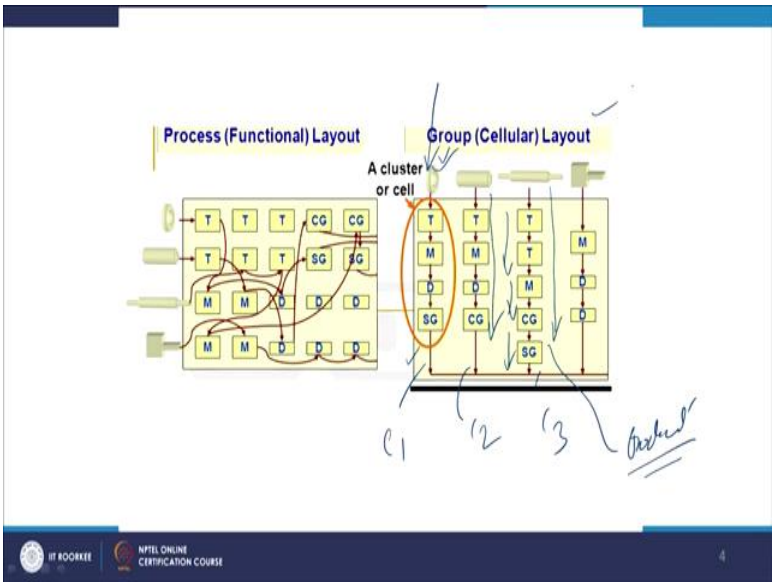

Now, here we see, if we take the example of the manufacturing of the components like a ring, the shaft with the whole or the shaft having steps or this rectangular component with the whole. So, the kind of if the, if these four components are manufactured using the facilities having the arranged according to the process layout.

In process layout, what we do, the facilities are grouped according to the type of operations to be performed so all turning machines, all milling machines, all drilling machines and then the grinding machines like cylindrical grinding and surface grinding machines are grouped together.

If we want to manufacture these components, then what we will notice that what we will notice that the flow to manufacture this kind of component this ring having the whole kind of component it has to be turn, then it has to be milled, then after the milling, then it has to be mill and then what if we take another component than what we will notice?

It will turn then milled and then drilled. The third component if we see here it will turned then turn step turn, first cylindrical turning then step turning and then the milling and then cylindrical grinding, for this rectangular shape component having the whole milling and then drilling and then another drilling.

So, if we see the movement to manufacture these four components, the movement or flow is very complex and crisscross and in this process, sometimes we end up with the large movement, the distance is to be covered in course of the production are high. So, the crisscross movement, extended movement will be increasing the cost of production and unnecessary complexity in the movement.

If the same four components are arranged according to the kind of features or the jobs to be performed on the on these components, so this is one where. So, we are trying to group the systems in such a way that the, this component is completely processed through these processes and this component is processed through the set of the processes, this component process to the set of processes.

So, what we are able to have for same number of the machines if they are arranged according to the type of operations on each type of the job, then, this will be forming one cell, this will be forming another cell, this will be forming another cell and each will be independent and the flow will be very smooth and it is in one direction. So, this will be giving us the feeling of the product layout where we start from one end and get at the end we get the finished product. So, this is the cellular layout.

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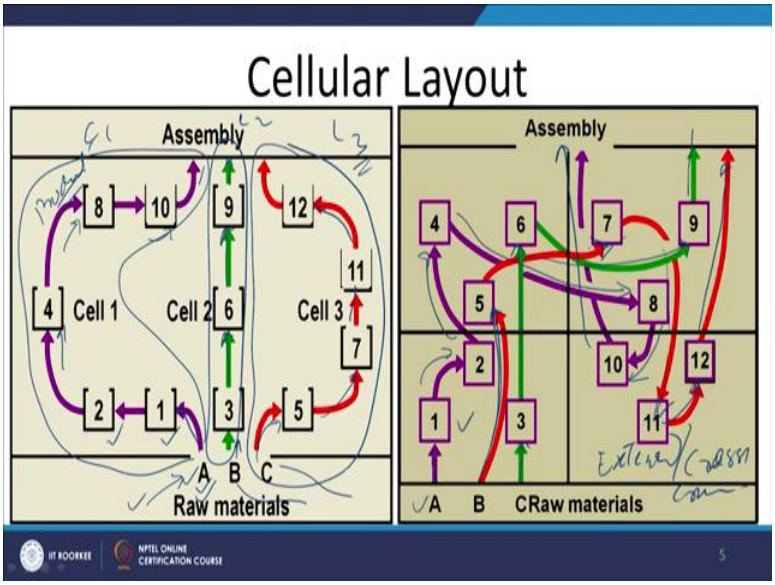

Like say this is the another example, where we are seeing like if the product A is to be manufactured using the process layout then the flow first of all it is processed at station 1 then station 2 and then a station 4 after station 4, it is processed at station 8 and then station 10 and finally, descent for assembly. Then third, then the B component is processed, first it will be sent to the station B then station C, now 7, station 5, B component is first processed at station 5, then at a station 7 and then station 11 and station 12 and then sent for assembly.

Similarly, third component is processed at a station 3, then station 6, then is station 9 and sent for assembly. So, again here what we see in case of this kind of arrangement where facilities are arranged according to the type of operations then the movement is very extended and it is very clumsy, it is very crisscross kind of the movement. So, to make it streamlined, if the facilities are arranged in such a way like, the then first of all operation one, then then A will processed at station 1, then station 2, then station 4, station 8, 10 and then send for assembly.

So, this is how we are able to create one cell where the movement of the type of movement of the material in course of production of the A type will be in one particular direction. So, this is a kind of product layout for one type of the product and efforts are made to arrange the systems and facilities in such a way that each cell is by enlarge independent. Similarly, for manufacturing the component B, the facilities are arranged in such a way that the movement is very straight, clean and similarly, for component C like processed 5 with 5 station 5 then seven and then 11 and then 12 then send for assembly.

So, here we are able to have 3 cells, one cell, another cell and third cell. So, C 1, C 2 and C 3 clear cells are there and they will be manufacturing the different products of A type, different products of B type, different products of C type, each will be independent to manufacture.

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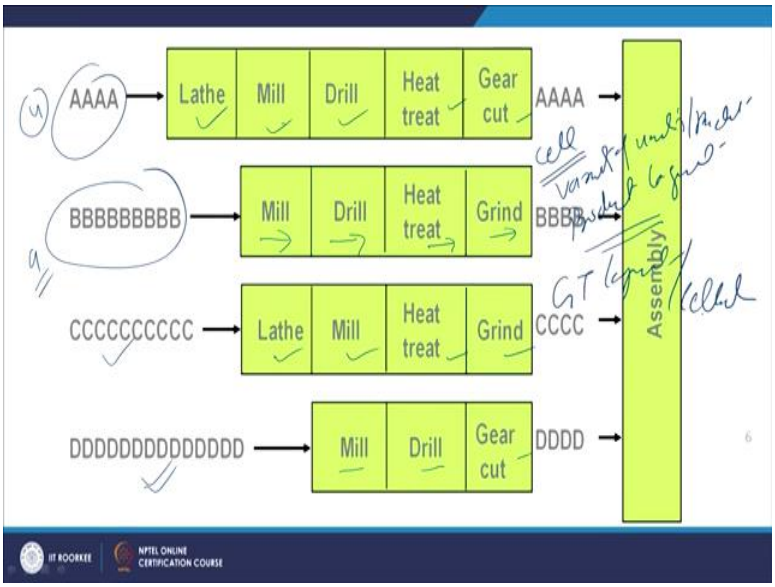

Likewise, if the component A is to be manufactured and if it is going through the different processes, so like there are various products of the A type related with variation, then they will be processed through the milling, then lathe milling, then drilling, then heat treatment and then gear cutting course of the production of the gears. There are like say the many, here 4 components of the A type and 1, 2, 3, 4, 5, 6, 7, 8, 9, 9 components of the B type, they will be preprocessed through the stages of B milling, then drilling, heat treatment and then grinding.

Similarly, the sea many components of the sea type process through the lathe, milling, heat treatment and grinding and likewise the D type component milling, drilling and the gear cutting. So, in this way, we are able to create the different cells, which will be capable to process the variety of the units and products and where in the movement still will be in one particular direction just like a productive layout.

That is how we are able to produce a variety while having the benefit of the product layout that is the kind of benefit which the group technology or the cellular layout offers. So, these are the, these are the typical features of the cellular layout or of the group technology.

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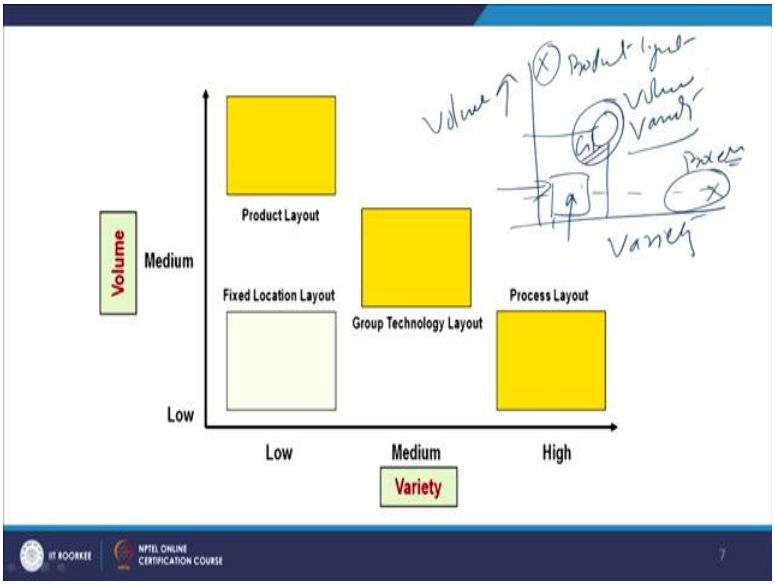

So where, so how to choose the suitable type of the layout as I have said, when extremely high variety, so there are two factors like we can have like if the variety in X axis and the number of units or volume to produce in Y axis, then for extremely high variety and very low volumes like in batch production, we try to have the process layout.

And when the situation is just reversed very limited variety, but very high volume, the limited variety but very high volume then we prefer to have the product layout. And if the situation is in between where we want to have the moderate volumes and the moderate varieties, so intermediate cases of the variety, moderate volume and moderate variety, so to deal with that, we prefer to go for the group technology or the cellular layout.

On the other hand, if we are dealing with the large variety, limited variety and the limited volumes then we prefer to go for the fixed layout. Basically, the volume is very limited and we can go for manufacturing different types of the units, but here the volume is very limited, we do not go for many larger number of units through the fixed kind of the layout. Now, if you have to design the process layout, then what we should keep in mind?

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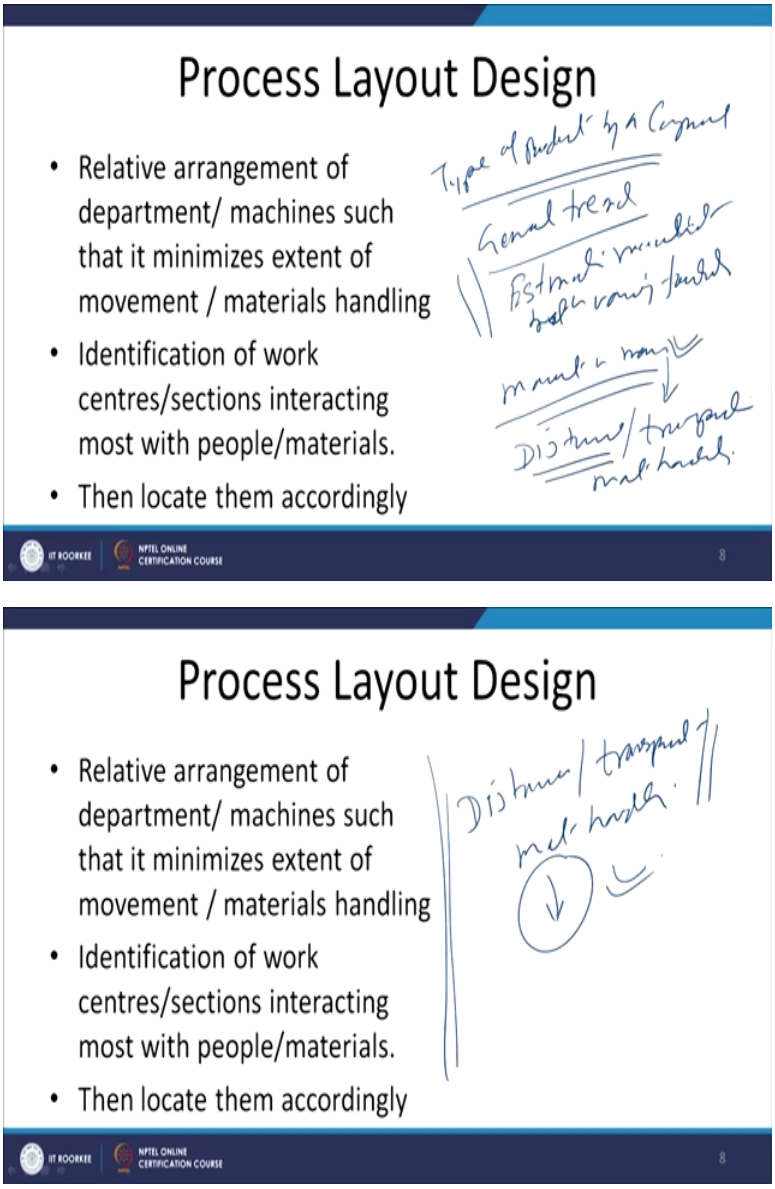

You know that in the process layout the facilities are arranged as per the as per their function or the type of operations they will be doing. For example, we may have all costing facilities at one place, all machining facilities at another place all heat treatment facilities at another place.

So, there will be different shops and they will be accommodating the different facilities dealing with all say costing processes, all machining processes and here all the furnaces variety of the heat treatment. But since we are so, this kind of the arrangement allows us to manufacture the products in batches or very low volumes, but very wide variety.

So, when we manufacture the wide variety of the products, then the movement of the material or the man through the different shops, different facilities will also be changing. So,

depending upon the type of the products which are commonly manufactured, type of the products commonly manufactured by a company for which layout is being worked out, we have to see what is the kind of the general trend or the kind we have to estimate the movement, movement between the various facilities, idea is here to see what will be the kind of the facilities where the movement is maximum.

So, identify those facilities, then somewhat less identify those facilities where movement is somewhat limited then further less. Idea here is to bring those facilities where movement is maximum close to each other. So, that the distance to be traveled in course of the production or the kind of the transportation which is involved or the kind of the material handling which is to be done in course of production that is reduced.

So, this is the main objective behind the layout design like how to arrange the facilities. So, that the distance to be travelled in course of the production as a whole for variety of the units as per the type of the industry and the transportation or the material handling. These things can be minimized.

So, how to arrange the facilities so the costs associated with the material handling or the movement of the resources that is minimized that is the main idea. So, what strategy we will be following, so that this objective is realized about that I will talk in the next presentation. Now, here I will summarize this presentation. In this presentation, I basically have talked about the features of the cellular layout, under what conditions cellular layout is more beneficial and what we keep in mind while designing the process layout, thank you for your attention.