Product Design and Manufacturing
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Lecture - 29
Plant Layout Planning (Part 2 of 2)

So in the next part of the lecture, I will try to discuss certain other kinds of layouts fixed position layout, combination layouts, cellular layouts and certain other miscellaneous layouts and let us start from fixed position layout.

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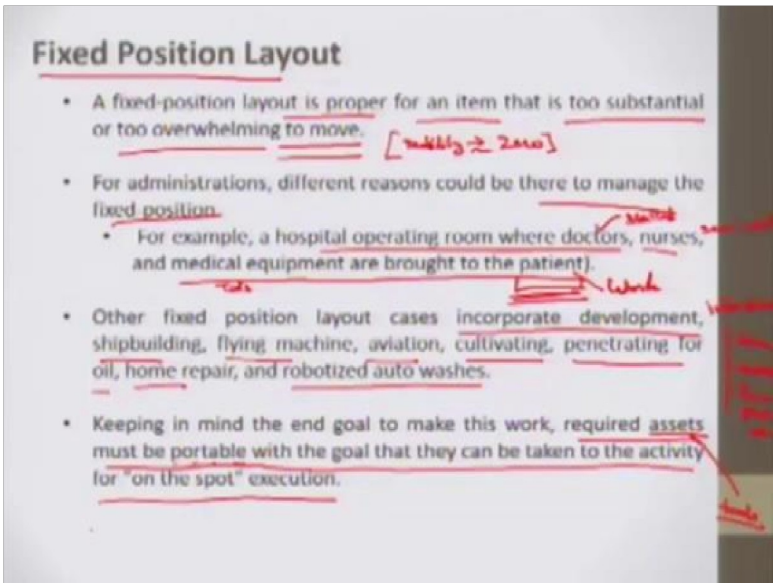

Fixed position layout can be proper or can be good for an item or a product that is too substantial or too overwhelming to move. That is the mobility is zero close to zero. So, for administrations, different reasons could be there to manage the fixed position. For example, a hospital operating room where doctors, nurses, medical equipment are brought to the patient. So, the here patient is our work. A patient is a work, these are the skilled and semi-skilled lib workers here. And these are tools and equipment which are brought to the patient here.

So, other fixed position layout case maybe incorporates development. Here why by development I would say infrastructure; like shipbuilding, flying machine, aviation,

cultivating, penetrating for oil, home repair, robotized auto washes. And in this infrastructure, I could say the dams, buildings, then some power plant etcetera. Like keeping in mind, the end goal to make this work, required assets must be portable with the goal that they can be taken to the activity on the spot execution. Here assets are my tools. Tools must be portable which can be taken to the product here that is to be manufactured.

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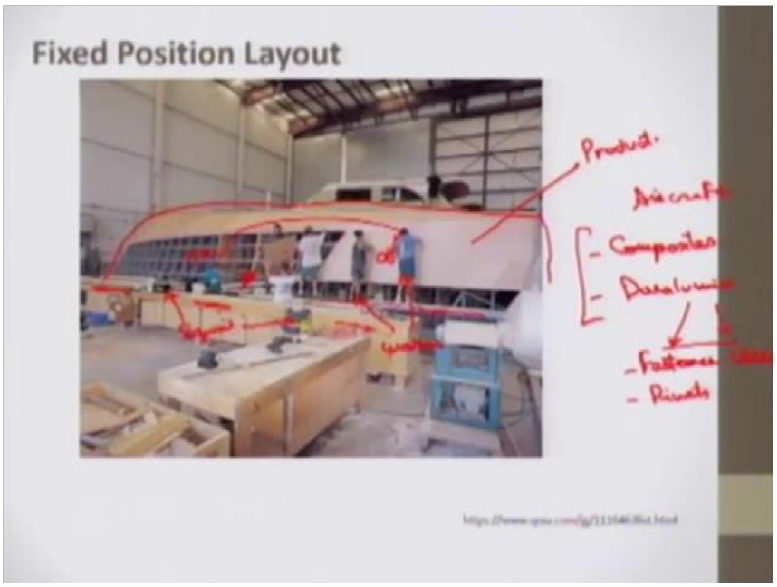

So, this is a typical example of a fixed position layout. In this, they are trying to manufacture. They are trying to produce this body of the ship here. You can see this fuselage this is not actually this is the open body, not fuselage. This they are putting these sheets over here. So, these are the workers. So, this is our equipment. So, this is the equipment. This is also another equipment and this is our product here.

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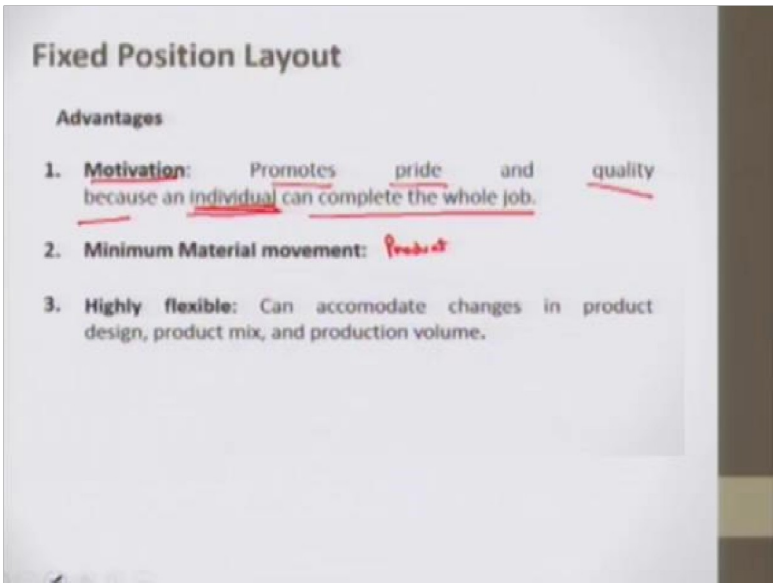

So, fixed position layout also has certain advantages. For example, motivation. It promotes pride and quality because a single individual can complete the whole job. And this brings him some happiness or pride. Then minimal material movement is here. By the material moment I would say the product movement is minimum. However, sometimes the heavy machines, sometimes for example, in this ship manufacturing some heavy welding machine has to be brought up. This is actually a wooden here.

So, in case of aircraft, it is aircraft made of either Composites or Duralumin is used to make the aircraft body or fuselage. So, this is what Aircraft. So, this duralumin sometimes it is fixed with using some Fasteners or Rivets or it might be Welded.

So, this equipment has to be portable the welding equipment here. It is not portable this material movement would be complex. Otherwise, the product movement is very less here, is minimal or maybe zero in these cases. So, minimum product minimum material movement is here. Highly flexible things are here can accommodate changes in a product, design, product mix and production volume because the product is fixed. There is no need to move. There are only this these arrangements could be these workers can take the subassemblies or components wherever they need to put it.

So, if some changes are made, for example, there are some seeds which are fixed here now the position is changed to the other place. So, this flexibility is very much high here.

This is very much possible here.

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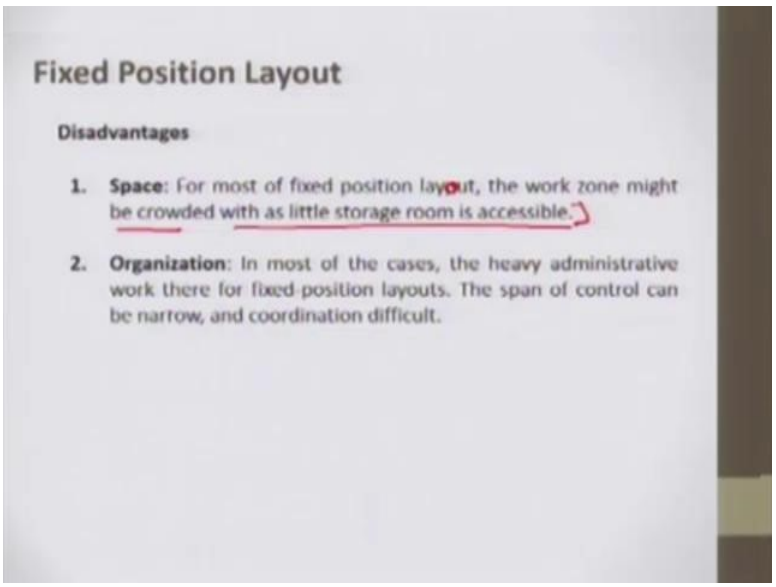

A disadvantage is a Space. For most of the fixed position layout, the work zone might be crowded with a little storage room is as accessible. We can see here in this example as well we have a little crowd here. This is crowded. This portion is crowded. So, this additionally can cause material handling issues, this thing then organization. In most of the cases, heavy administrative work there for fixed position layout. Administrative work is planning what would be the layout of tools and equipment.

For example, these benches are kept here that this layout where the benches are to be would be kept, where the worker would stand. This is a platform where worker standing here to fix. These all this it is also part of our layout planning. So, this also is important here. So, administrative work here is heavy to plan the layout. The span of control can be narrow and coordination difficult. So, this is the case here.

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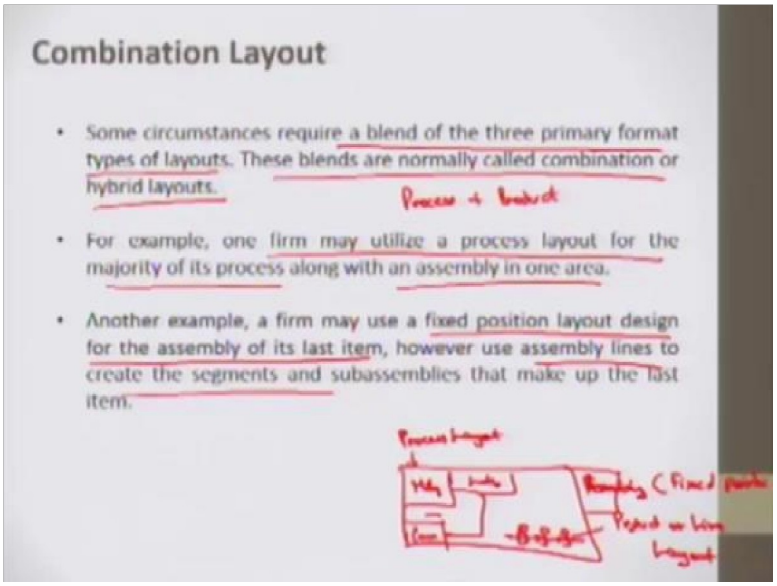

So, next is Combination Layout. So, some circumstances required a blend of three primary formats three primary types of layouts. These blends are normally called combination or hybrid layouts. Hybrid layout means using Process plus Product layout altogether. For example, one firm can utilize a process layout for the majority of its purposes along with an assembly line in one area.

For example, it is using a process layout. This is Process1, Process2, better I would put here. This is Milling, Grinding, this is an entry here. This is lathe and also it is using an assembly line here. One product is being carried out on the conveyor and worker 1, worker 2, worker 3 is here. So, this is a Process Layout. This is a Product or Line Layout.

Another example can be a firm may use a fixed position layout design for the assembly of its last item. For example, at the end, he is using a fixed position layout for this assembly of the last item. However, use assembly lines to create segments. For example, in this case only from this process layout or from these lines this is our final section here and here it is he is using a assemble. I would put assembly and here he is using a fixed position layout.

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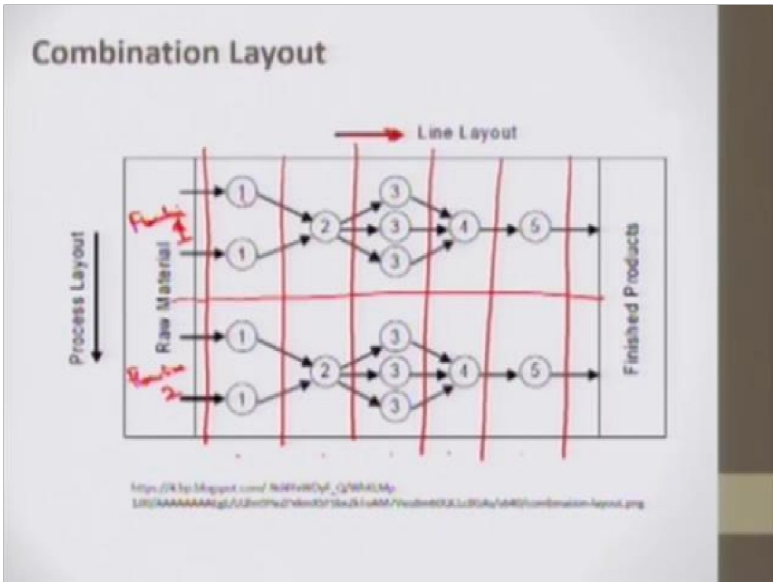

So, this is an example here of combination layout. So, these are processed layouts. So, this is process 1, process 2, process 3, process 4 and process 5. And in this side, it is line layout in this direction. Two units of process 1 are doing some processing and then delivering the workpiece 2 process two. Here obviously, process 2 would have smaller processing times. So, that is only that only then line balancing would happen well.

So, similarly, the process 2 is giving workpiece is 2, process 3. And this is the kind of a line system. This is another kind of line system. Though say there are two lines flow line 1 flow line 1 and flow line 2. So, this is a kind of a combination layout here.

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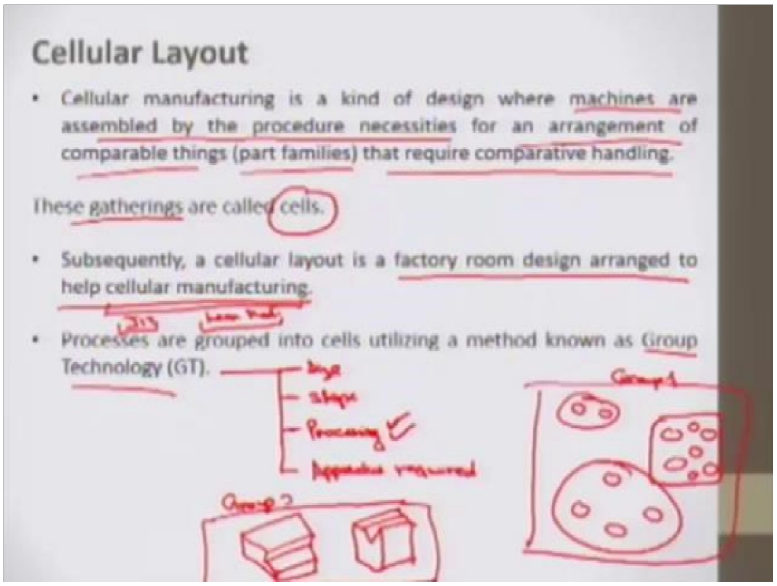

Next is Cellular Layout. In certain circumstances, cellular manufacturing is carried out. Cellular manufacturing is a kind of a design where machines are assembled by the procedure necessities or the process necessities for an arrangement of comparable or part families comparable items. They require comparative handling.

These gathering, these collections or these families are known as cells. Subsequently, a cellular layout is a factory room design arranged to help cellular manufacturing. What is cellular manufacturing? Cellular manufacturing is a process of manufacturing, in which a subsection or just in time or lean manufacturing group technology is there. Cellular manufacturing in this JIT or lean manufacturing tools is used.

So, processes are grouped into cells utilizing a method known as Group Technology. Group technology includes the recognizing the parts with comparative outlines, well the similar parts can be grouped. For example, the group can be made according to their size, according to their shape, according to the kind of processing that is required; this is most important here, then the kind of a practice that is required.

So the parts or components are grouped in this way. For instance, we can group the parts that require drilling. All the parts that are that are round into one group. For example, there is one component that is round and they need two holes here. There is another component that is round. So, if the disk is there it needs four holes here.

So, these another, for example, this kind of component is where it also needs a large amount of drilling in it. So, these can be grouped into one. This is Group 1. Similarly, other components with those need reptilian air machining. This component does not need any hole to be drilled. Another component of the similar kind, let me say V block these can be grouped together. So, this is Group 2.

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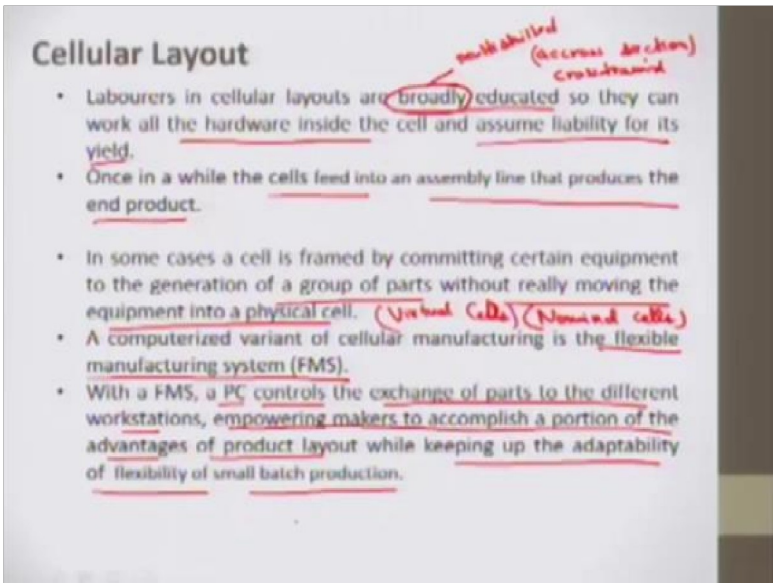

So, in the cellular layout, the laborers in the cellular layout are broadly educated. Broadly educated by means they are multi-skilled, a broadly doesn't mean less educated, but multi-skilled. Multi-skilled across or across sections or I would say they are crosstrained. They are cross-trained or multi-skilled so that, they can work on all the hardware or equipment inside the cell. And assume liability of its assume the responsibility.

Once in a while, the cells freed into an assembly line that produces an end product. The cells can also feed into an assembly line. So, in some cases, a cell is framed by committing certain equipment to the generation of a group of parts without really moving the equipment to the physical cell. So, these are known as Virtual or nominal cells. So, what are virtual cells? No cells are made physical, but some machine or some equipment from the processes. In the case of process layout some equipment is dedicated for this cell only.

So, whatever refer to the one for section 1 and say, for example, there is a equipment in the drilling section, another equipment in there in the milling section. This one machine in the drilling section and two machines in milling sections are dedicated to this group only, this cell only. So, this would be a virtual cell not physically arranged into a single space. But the movement of the material would be high, but they are arranged though they are dedicated I would say. So, this is known as virtual cells, also they are called Nominal Cells.

Now in the case of virtual cells, the factory stays away from the workload of revamping its present design. Because whenever the cellular manufacturing requirement is there, the rearrangement of equipment is required sometimes. So, in the case of virtual cells rearrangement is not required only the thing as a material handling would be a little high and revamping is not there. So, in the case of virtual cells there is no revamping and in case of physical cells, the revamping is high.

So, a computer variant of cellular manufacturing is known as a flexible manufacturing system. In a flexible manufacturing system a computer, a process computer controls the exchange of parts to the different workstations, empowering makers to accomplish a portion of the advantages of the product layout while keeping up that adaptability of the flexibility of small batch production. So, what is FMS? What is a flexible manufacturing system? I will just put some more light into this.

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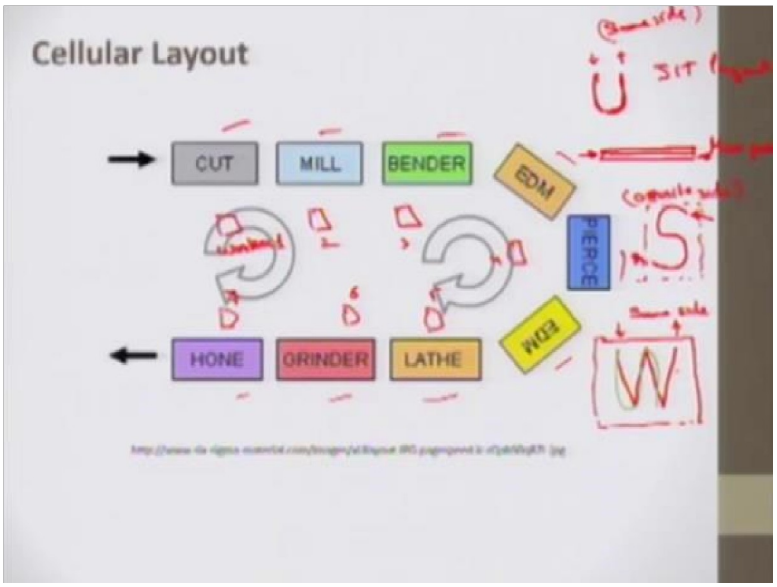

Let us first see what is this cellular layout? So, in this case, this is one cell. The part is CUT, MILL, BEND, EDM, PIERCE, then EDM, LATHE, GRINDER, HONE. This is kind of a U cell. There are certain cell shapes. So, in U kind of pattern of the cell what is there, the input and output are on the same side. So, this is made when receiving and shipping is to be brought to the same side. So, U patterns are also preferred in just in time layout, GIT layouts.

So, workers are generally placed in the center here. Workers are generally placed here of U layout. So, these are workers; worker 1, 2, 3, 4, 5, 6, 7. I have put so many workers here, but in time situation then there would be not more than one more than two workers or more than two or three workers you do working here. The other kind of patterns is also there. It is a straight line pattern. In a straight line pattern, what is there? The cell is just straight. The straight line pattern is generally used when the product is produced in large quantities.

So, this is known as straight line production. This is for mass production. Though this is a cell, it has the properties of process layout: U, then a straight line, then also another kind of pattern is S kind of layout. In S kind of pattern, they are used for long assembly processes that are to be fit in the small area. See the long length is put in this small area. It is not in one line. And also when the receiving and the shipping are on the opposite side. The same side, this is the opposite side. In this case, the receiving and shipping, receiving and shipping is on the opposite side, 180 degrees opposite here. So, this is S kind of layout. The combination of U and S layout is a W kind of pattern. So, there is.

So, here we can see in W we also have kind of S here, this S is here. So, this is also used when in a small space large line is to be fit in, but receiving and shipping is required on the same side in this in the opposite side. So, this is W kind of pattern here. So, in cellular layout, every cell contains a group of machines which are dedicated to the production of parts families. One of the problems is to identify the part families here, that is the group technology or to group the part families. And these are also called as group technology layouts obvious.

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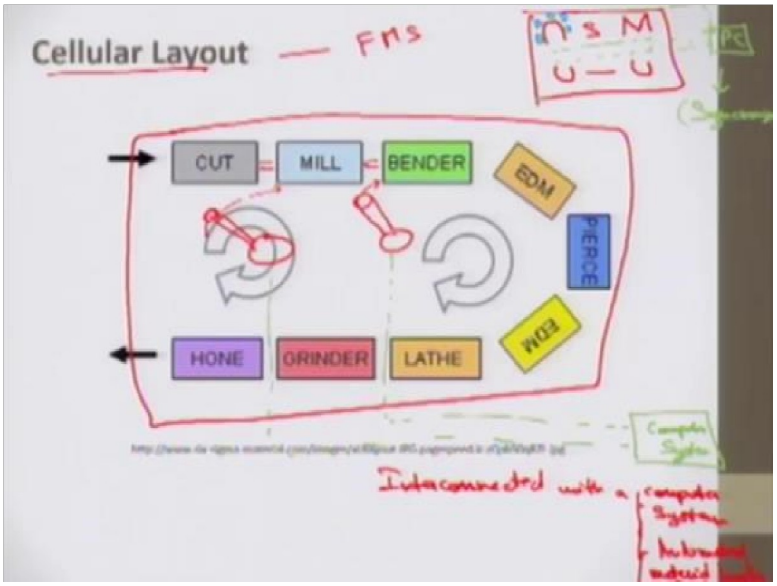

And I would have put some light on Flexible Manufacturing System here as well. So, in a flexible manufacturing system, the automated machine cells are there. And these are consisting of this is one cell and if we have a material handling system, for example, there is a material handling system there is a robot here who is picking up material from here and taking it to the second part. There is another a robot here who is picking up a material and taking here.

This may be a robot or this may be a conveyor in between conveyor belt. And these are all controlled by a computer system. It has a connection with a computer system. This is a flexible manufacturing system. These all systems are interconnected with a computer system or computer system or you can even say within automated material handling system, material handling system.

So, what would have here in a typical flexible manufacturing system? This is one cell.

We would have a number of cells here: U, S, W, U straight, whatever is a requirement. If I put U and W here it would probably would in this direction. So, these are different cells and there is a material handling system here. There is a material handling system here between these which is controlled by a computer. And these machines are machines which are there are CNC machines.

In one cell there are CNC machines and these machines can also be connected to this automated system. So, as material handling, machining, processing. setup is all synchronized by the computer.

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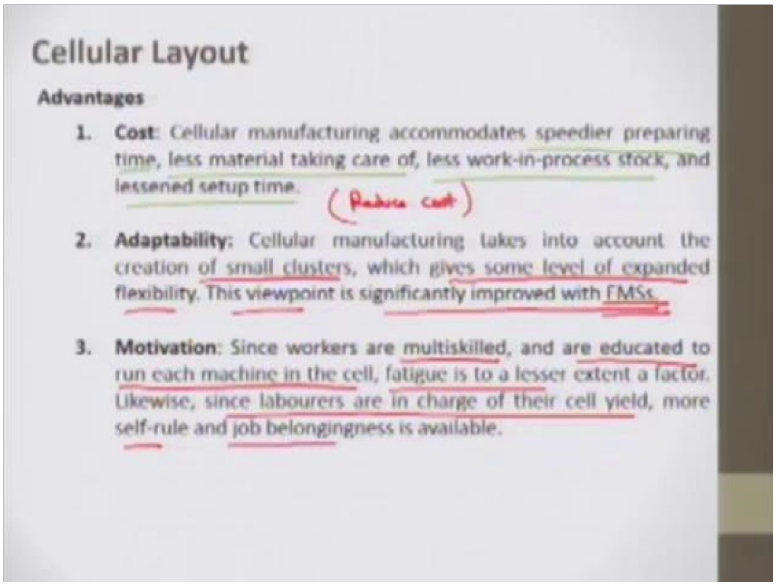

So, next is some advantages of the cellular manufacturing system. The cost in a cellular manufacturing system. Cellular manufacturing system accommodates speedier or quick preparing time. That is setup time, less material handling and less work in progress inventory and less set up time. So, this all would reduce the cost. Then next is Adaptability or flexibility I would say. Cellular manufacturing system takes into account the creation of small cluster or small groups, which gives some level of expanded flexibility. This viewpoint is significantly improved with FMS flexible manufacturing system.

Then is motivation for the workers here. Since workers are multi-skilled here, they are cross-trained and are educated to run each machine in the cell, fatigue is less. Likewise,

since laborers are in charge of their cell yield, more self-rule or more job belongingness is there.

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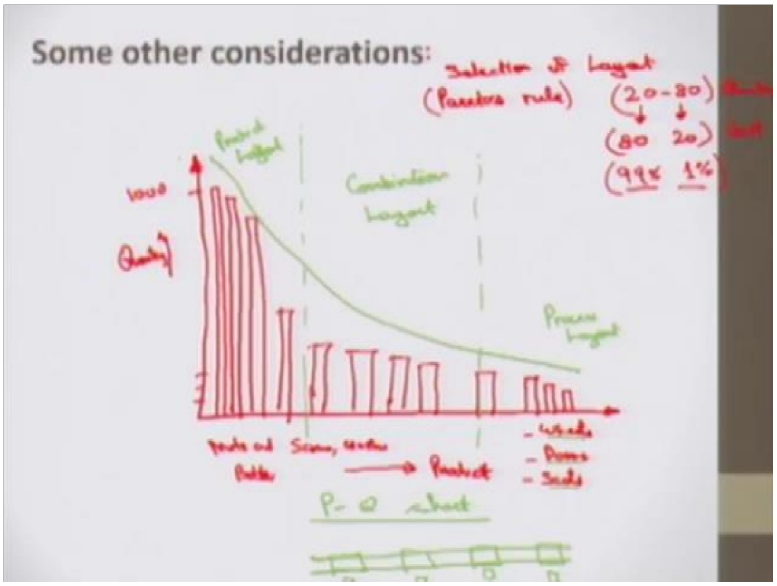

Next, I would like to take certain considerations for this selection of the layout. One of the methods is Pareto's rule. Pareto has a 20-80 rule. He says 20 percent of the items contribute to the 80 percent of the cost and 80 percent of the items contribute to the 20 percent of the cost. That is there are some, very for example in the automobile. There if I these are these are 20 percent is a number of items.

The number of the item is 20 percent. For example, the body of the automobile, the major interiors. Then part count is very less, but the cost is high. And 80 percent of the cost is of these things only. And there are small components which are of very high quantity. For example, nuts and bolts, screws, some small rivets, some rubbers, some gaskets. So, these that quantity is very high, but the cost is very less.

So, in that case, this quantity 20 percent of the quantity would have 80 percent cost and 80 percent of the quantities having a 20 percent cost. So, this is Pareto's principle. I would like to compare it with a recent news which I had from BBC maybe a year back; that top 1 percent rich people of the world have wealth equivalent to the other 99. percent So, there this rule comes to 99 1. 1 percent of the population has their wealth value equivalent to the other 99 percent.

So, this also holds good in case of product. We have P Q chart. As I took the example of a car, I will put the same thing here. This is Quantity on this side and this is Product. So, if I say nuts and bolts, screws, washer's etcetera and here I have the car wheels, car doors, seats. So, how many wheels we have 5. How many doors we have maybe 4. How many seats we have 1 single back seat and 2 front seats in a simple B-class car; 3 seats, 3, 4, 5. And how many nuts and bolts we have maybe a few hundred, I put 1000 here. So this chart would like this one.

So, here we would have these many numbers of components. So, a general rule is there that for more number of components what do you suggest? Which kind of layout would you suggest for these high quantity products, high quantity components. I think you are making a right guess. We will have a product layout here and here because the number of products is less, we will have a process layout. Please mind it I am not talking about the car manufacturing, car assembly here. Car assembly is mostly done in a line. The car is kept on the gear or is overhand in the material in handling equipment and the workers are just assembling this thing.

I am talking about the manufacturing of these components, these subs and components of subassemblies or the parts of the car. So, in between the product and process layout, we have combination layout. This is known as the P Q chart. So, this is a general rule to decide which kind of layout should one use.

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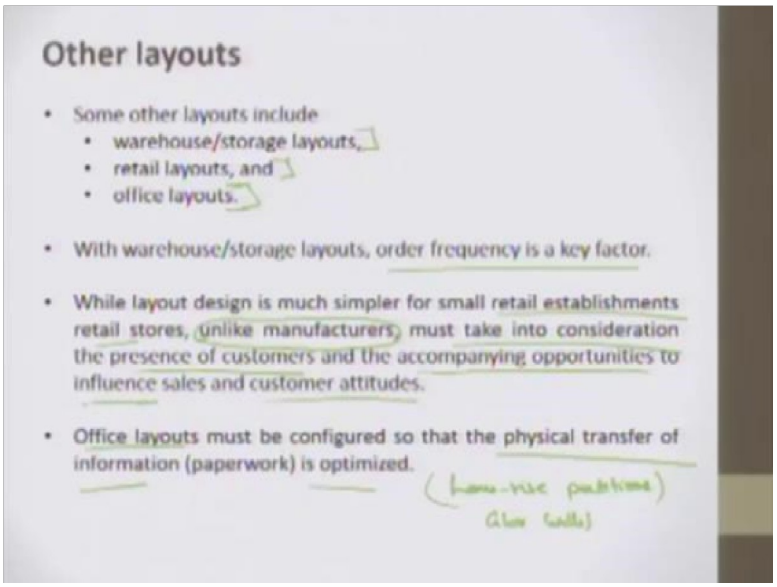

So there is certain kind of layout. For example, warehouse layout, retail layout, office layout. Warehouse or still a storage layout, a retailer like your departmental store, your medicine shop. Then office layout means the kind of buildings and the kind of the arrangement of the cabins for various employees in the office. Now with warehouse layouts, the order frequency is a key factor. In warehouse layout, if the order frequency is too high, for example, you might have seen a wine shop; a shop with a wide bench. There would be that the queue is the number of customers to line up; with that is the frequency is too high.

In there certain of the shops in which the bench is not provided the frequency is not very high here. Here frequency is the arrival of the customer. Or in small retail establishments, the layout design is very simple, unlike manufacturing concerns. It must take into account the presence of customers and accompanying opportunities to the to influences the sales and customer attitudes. So, in retail design, you must be knowing that the display of the product is very important.

So, they had they generally display the product. They make display cabins or display showcases to display most of their product varieties. So, in those cases, it is important to have layout accordingly. So, office layouts must be configured. So, that the physical transfer of the information that is paperwork is optimized. So, in office layout, the communications can also be enhanced by having low rise partitions, low raise partitions.

So, that the communication could be good and maybe glass walls.

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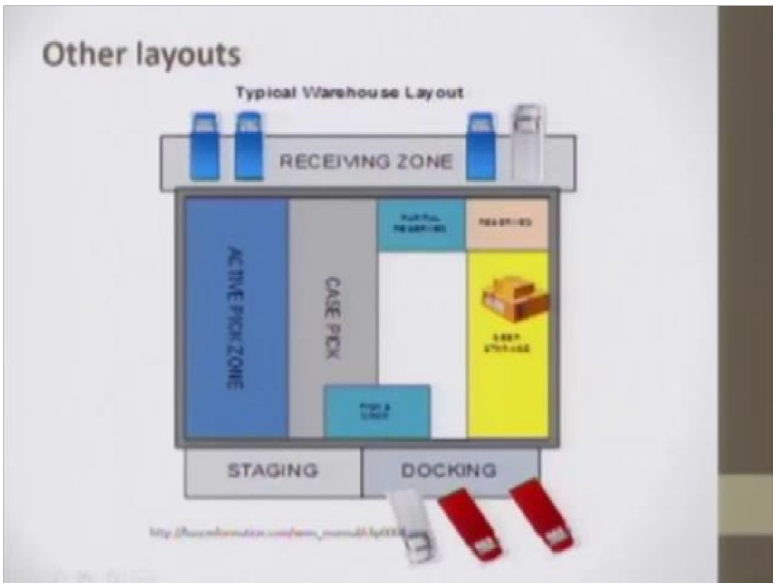

So, this is a typical Warehouse Layout. So, we have storage Deep Storage Zone here, where deep storage is there. There is a Case Pickup here, then Active Pickups Zone here, Receiving Zone is here. The customers are lining up here. And Partial Reserved Zone, then we have Reserved Zone. See partial reserved, reserved, deep they are going into depth in this way. Then staging and docking all these things. So, this is a kind of a typical warehouse layout.

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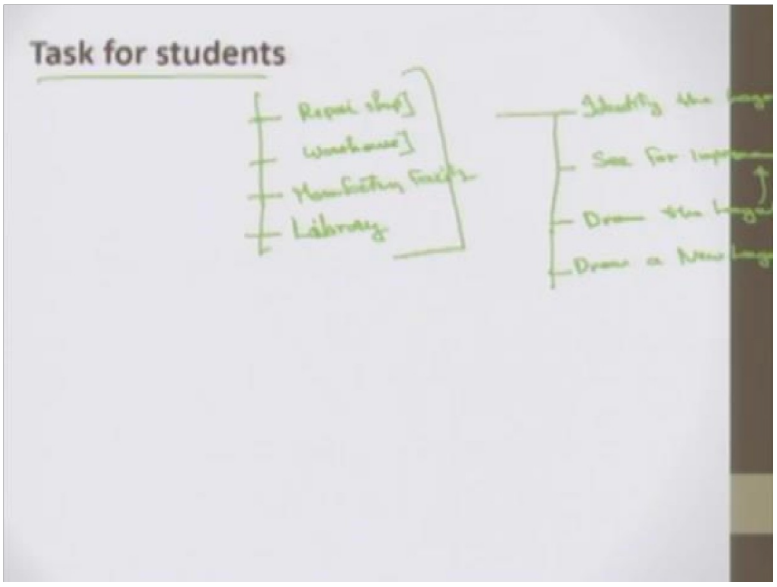

So, with all this information and after reading the notes, I have a task for you people. So you select an area; select some area like you select a Repair shop or when you go to buy something you select a Warehouse and try to deliver into the layout which whatever is there and think of some improvement. Could you provide some cells? Could you suggest some combination here? Could you suggest some relocation of the equipment or relocation of the storage desks there?

So, one of the production room is there in our homes only. That is the kitchen. In the kitchen the food is being processed, the storage of the raw material is there, the dishwasher is used to wash the stale utensils. You try to see is everything there all good or could you suggest some improvement? So, select some warehouse or some kind of manufacturing facility if you have some access or maybe in your institute library and try to look.

So, the steps here would first try to identify the layout. That which type of layout is there, Then see for improvements. Then use take a paper and a pencil, draw the layout.
That will give you a better feel of the layout and then see for improvements. Then draw a new layout. So this was all in the product or the plant layout study here.

Thank you.