Work System Design
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Lecture - 23
Two-Handed Process Charts

Namaskar friends, welcome to session 23 in our course on work system design and currently we are in the 5th week of our discussion and the topic that we are discussing currently is the method study. Just to have a brief review for 2-3 minutes what we have discussed till now. We have discussed the basic concept of work study and our main focus in the week #2 and week #3 was on productivity, that why do we need to improve the productivity.

Or why do we need to study productivity, what are the various causes for low productivity, what are the various productivity measurement techniques, what are the productivity improvement tools and techniques, work content determination, then we have also covered certain numerical problems or practical application of the concept of productivity. Then we have seen the basic concept of work study.

That why work study needs to be done, what is the work content. What are the reasons for excess work content? How we can eliminate those reasons. So all that was covered in the discussion during work content determination. So in the 4th week we started our discussion slightly related to method study and this is the 5th week and in 5th week today we are going to start session number #3 of week number #5.

That is 23rd session in the course and today our target is two-handed process charts. So in method study what we have covered. So we have broadly covered 2 topics, first one is introduction to the concept of work study and then the concept of productivity and in concept of productivity we have seen that there are tools and techniques which can help us to improve the productivity.

And when we have to study the work being done, there are 2 major focus areas, now what are these areas, first one is that we need to identify methods which can help us to improve the current method of doing the job and we need to establish a standard time for doing the job using the standard method or the improved or the best method of doing the job or the work.

So broadly we have seen that there are 2 words that normally are associated with work system design.

The first one is the method study, the second one is the work measurement and currently our focus is method study, within method study if you remember we have already covered the basic definitions of method study. We have already covered the outline process chart or the operation process chart. We have seen that it gives us a bird's eye view of the operations being done. What are the various process charts symbols we already know?

Then in the previous session we have covered the flow process chart and the examples of the flow process charts. So we have seen that flow process chart is slightly more detailed as compared to the outline process chart. We use mostly all symbols of process chart that is operation, inspection, delay, storage and transportation all these symbols we use in case of flow process chart.

Whereas majorly in outline process chart or operation process chart we use 2 types of symbols that is operation and inspection. So we have seen 2 types of charts and which type of problems can be solved using these 2 types of charts we have already seen. In flow process chart we have seen that if you change the layout of the organization we can certainly save lot of time in the completion of the operation or we can reduce the material handling.

We can reduce the effort of the worker who is performing the task by slightly changing the layout of the plant or the premises or the factory. So this is the background that we have already covered. Now today our focus is two-handed process chart. So now we are coming down. We are bringing our discussion to the level of the worker that what the worker is doing.

So if you remember in operation process chart we had overall broad understanding of what is being done in the organization. In operation process chart if you remember we have seen that what is being done in the organization. Overview of the operations, inspections being done. In flow process chart we slightly came down and focused on each operation. We focused on transportations also.

We focused on delays also then in next level that is two-handed process chart our focus is on what an operator is doing on the machine. What is the utilization of his two hands? whether the hands are idle or he is performing the task. So the discussion is from top level if we have to do the analysis of the whole factor, we want to optimize the layout, we want to see that where are we having unnecessary movement of men and materials.

We can focus on the operation process chart. If we want to analyze slightly in detail, then we can go to the flow process chart. If we want to further boil down to the worker that what the worker is doing, what are the 2 hands of the worker are they simultaneously busy or one hand is free most of the time, so how can the work be divided among the both the hands of the worker that can be understood with the help of a two-handed process chart.

So let us see what is the two-handed process chart.

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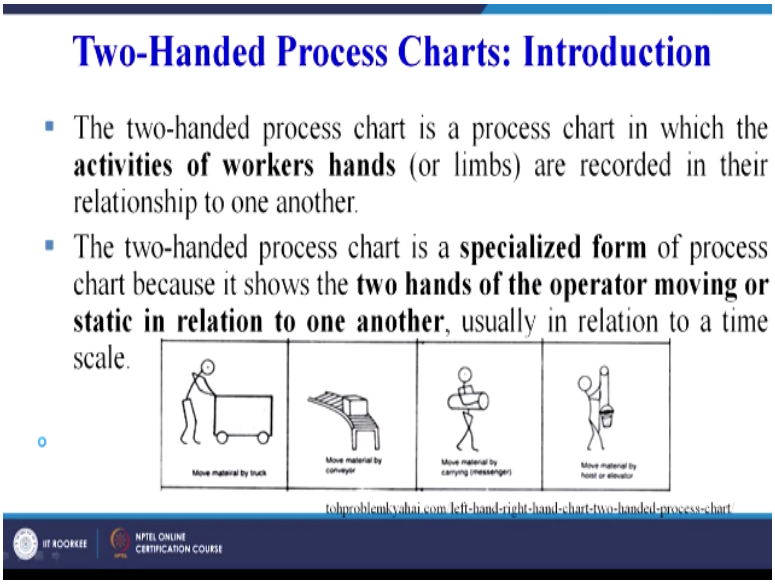

So the two-handed process chart is the process chart in which the activities of hands or limbs are recorded in the relationship to one another. So we will see with the help of an example that what are the two-handed process chart and in which type of situations these types of charts can be used. The two-handed process chart is a specialized form of process chart because it shows the 2 hands of the operator moving or static in relation to one another.

So we can see just now I have underlined this text that is 2 hands of the operator moving or static in relation to one another. So my right hand was underlining, so it was doing one activity and the left hand was static at this position only. So our two-handed process chart

will help us to understand this type of relationship among the 2 hands. So one hand was static, the left hand and with right hand I have underlined this text on the monitor.

So this type of activities can be recorded and analyzed in order to reduce the effort of the worker. So if we are able to distribute the total workload on both the hands of the operator it will become easier for the operator to perform the task. One example that I usually share with the students in the class is that when we start learning to type on a typewriter or these days on a computer.

Mostly we use only hand only, the other hand is idle, we just locate the keys and then press the keys by one hand only, but if you see an expert he uses both his hands for typing, so the efficiency improves, the productivity improves, so an expert uses both his hands for the typing activity. So that is the way, that when you distribute the overall work among the 2 limbs or 2 hands it becomes easier for you to manage the things.

It becomes less cumbersome, less troublesome for you, less fatigue you will experience. Similar example you can take that when you are driving a motor bike, you have your accelerator in one hand, you may have your clutch and break maybe in the other hand then both your feet you are using one for the break and another one for changing the gears, so you are using both feet, both hand while driving a motor bike.

So what does that mean, that means that your overall workload of driving the bike is divided in all 4 limbs. Similarly, when you are driving a car you are using both hands for changing the gears for holding the steering then you are using both your feet to press the accelerator or the break these days although we have automatic transmission vehicles also which releases our limbs.

So maybe making the driving much more pleasant and easier, but the workload has to be divided among the various limbs so that the worker feels less fatigue as well as experiences a good or a sense of well-being or a sense of fitness. So this is the basic purpose of a two-handed process chart in which we will see that how the work is divided among the 2 hands and how they are working and idle in relationship to one another.

Just now I spelled multi-activity chart that we will be discussing in our subsequent session that is session number #24. Here you can see an example. This is one example, move material by truck, move material by conveyor, move material by carrying, so move material by hoisting or elevator.

So maybe these are the different options for the material being conveyed. So wherever our hands feel comfortable, wherever our limbs feel comfortable maybe and host of other parameters are there which will maybe help us to decide that what can be the material handling or the material transfer mechanism that we must adopt.

Now some of you may be wondering that why again and again the process chart symbols are coming into picture. Your question is very, very valid, but we need to understand that in case of two-handed process charts the meaning of these symbols slightly changes. It is not changing drastically but slightly there is a way or there is a you can say change in the way we represent these symbols or the way we use these symbols in two-handed process charts.

So for your better understanding I will read that what do we mean by operation or the circle in case of two-handed process chart.

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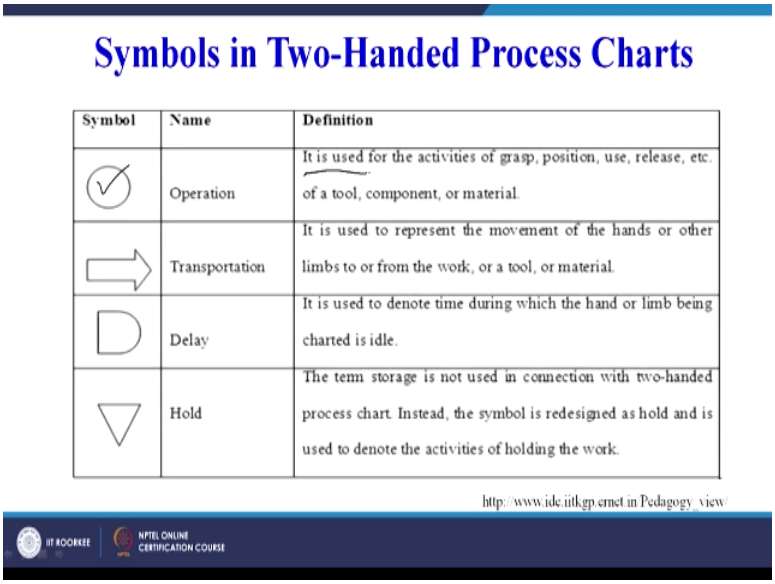

So you can see it is used for the activities such as grasp, position, use, release et cetera of a tool component or a material. Now how this is different from the operation or the symbol operation that we have used in operation process chart or that we have used in flow process

chart. So there this operation we use for casting. We use it for turning. We may use it for any other maybe we may use it for cutting.

But here we are using it for the operations being done by hand. For example, this pen is lying here. I am grasping it. So my right hand has grasped the pen. So from the two-handed process chart our operation is in terms of grasp. Now I have grasped the pen, I have positioned it on the monitor then I am drawing a line. I have drawn now 2 parallel lines on the monitor. So this is the use I have grasped it, I have used it.

So both will be depicted by the symbol O that is operation. So there is a slight difference between the symbols that we use for operation process chart and flow process chart and in this case the two-handed process chart. Similarly, transportation that is the second symbol. It is used to represent the movement of hands. Whereas in case of OPC or flow process chart what do we use. We use it for transport of a case of material or a box of material from one work station to another work station.

So in that case the transportation has a different meaning. Here the transportation means the transportation representing the movement of the hands or other limbs, to or from the work or a tool or a material. Now for example I am standing slightly at a distance, so I move forward and move my hand towards this pen and then I grasp it and lift it so this will represent the transportation, the movement of my hand to the pen to pick it up or to grasp it.

So grasp will represent circle, this movement of my hand to the pen to lift this up, lifting is after grasping, so the movement to reach the pen will depict the transportation. Now delay, it is used to denote the time during which the hand or the limb being charted is idle. So the idle time of the hand. For example, now my right hand is having transportation or the movement towards the subject or towards the object that is the pen.

So this is the transportation, but this is for the right hand. If you see focus on the left hand, the left hand is idle, so this left hand when I draw for the left hand during this period my left hand will be depicted as idle and right hand will have a transportation that is the movement to the pen. When I reach the pen, I grasp it, it will be depicted by a circle that is operation.

So then the last symbol that we usually use is hold the term storage is not used in connection with two-handed process chart normally this triangle is depicted for storage in case of operation process chart, but this is not the case here, instead the symbol is redesigned as hold and is used to denote the activities of holding the work. Now I am holding this pen. Now quickly we can have a brief features of the two-handed process chart and then quickly we will move to the examples.

The advantages of incorporating a time scale in the chart form is that the symbols depicting the activities of 2 hands at any given movement are represented opposite to each other.

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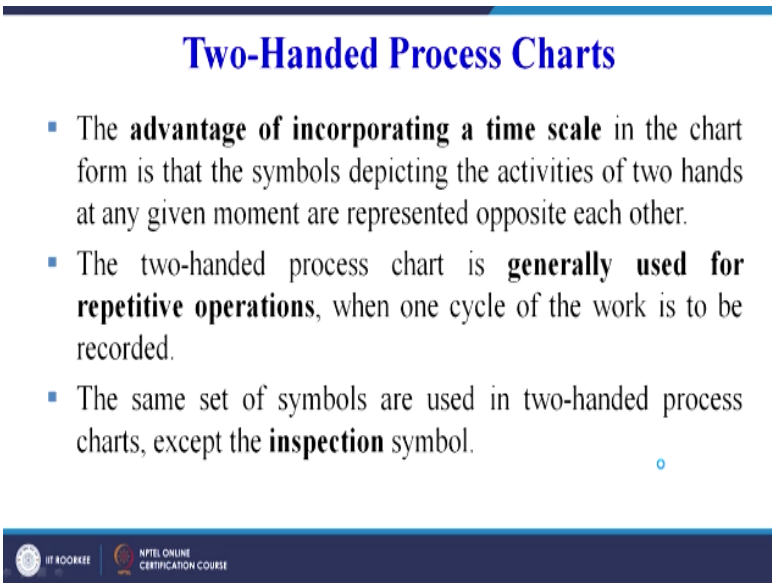

So we will have everything depicted on a time scale. So we will have a time scale, we will have whatever activity is being done by the left hand, whatever activity is being done by the right hand. Now at the same level if the left hand is idle, it will be depicted that at this much level of time the left hand was idle. The right hand was performing this task. The two-handed process chart is generally used for repetitive operations when one cycle of the work is to be recorded.

So this is used for repetitive operation and if you remember in flow process chart we have seen that they are mostly drawn when the job is changing with time. So it is not basically too much applicable for repetitive type of operation that is the flow process chart but here the two-handed process chart is applicable for the repetitive type of operation. The same set of symbols are used in the two-handed process chart.

So which I have already explained, the same set, the same set is operation, transportation, storage, and delay. So we are using same symbol but except the inspection symbol. So majorly we are not using the inspection symbol in the two-handed process chart, why it is not used. We will see.

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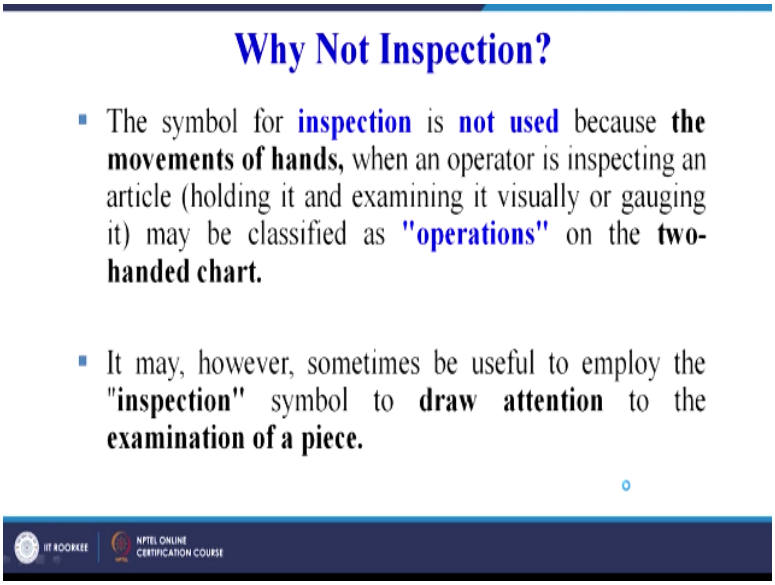

The symbol of inspection is not used because the movement of hands when an operator is inspecting an article holding it and examining it visually or gauging it. So maybe classified as operations on the two-handed process chart. Now for example I am holding particular job and then trying to see visually that whether the quality is good or poor. So this can be represented as an operation instead of being represented as an inspection.

So again I will read this for you. The symbol for inspection is not used because the movement of the hands when an operator is inspecting the article. So movement of the hands when an operator is inspecting the article that is how he is inspecting, he is inspecting it by holding it and examining it visually or gauging it. So when he is performing these task this can be considered as operations, instead of being considered as inspection.

It may however sometimes be useful to employ inspection symbol to draw attention to the examination of the piece. So it is not mandatory that we cannot use the inspection symbol, in special cases we can emphasize the inspection symbol also in the two-handed process charts. Now how to construct let us quickly see.

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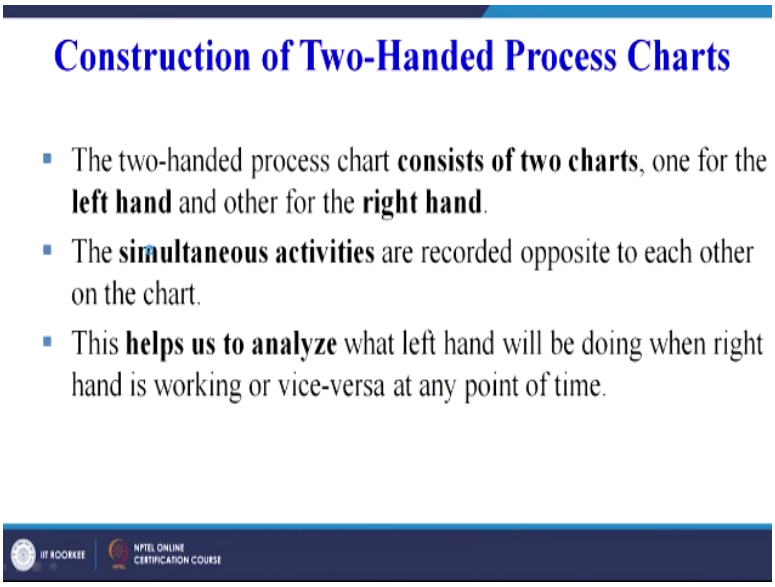

The two-handed process chart consists of 2 charts, one for the left hand and one for the right hand. So will depict the activities of left hand in one particular left hand side and the activities of the right hand on the right hand side so the two-handed process chart is the combination of 2 charts, one for the left hand, another one for the right hand. The simultaneous activities are recorded opposite to each other on the chart.

And one thing I must address here on the time scale. This helps us to analyze what the left hand will be doing when right hand is working or vice versa. So what is the right hand doing when the left hand is working. The construction you can see all symbols are used but inspection and storage are not used in the conventional sense. So the conventional sense we may not use the inspection symbol.

But maybe in a specific or a special case it can be used, for example inspection symbol is used when touch or feel by hand is to be recorded. So in special case we can use the inspection symbol also, for example when we want to record the touch or feel by hand. Storage symbol can be used when hand is used as a grip or vice versa or to hold the object. So these are 2 special cases when we are using the inspection symbol and the storage symbol.

Already we have seen in the previous maybe I can go back and show the same thing again that where we are using the storage symbol, it is used to hold. So the symbol is redesigned as hold and is used to denote activities of holding the work. So same thing is given there if we see, it is used to hold the object. So whenever you are holding an object you can use the inverted triangle symbol.

Which is usually used as storage symbol in case of operation process chart and the flow process chart. Now how to compile the two-handed process chart.

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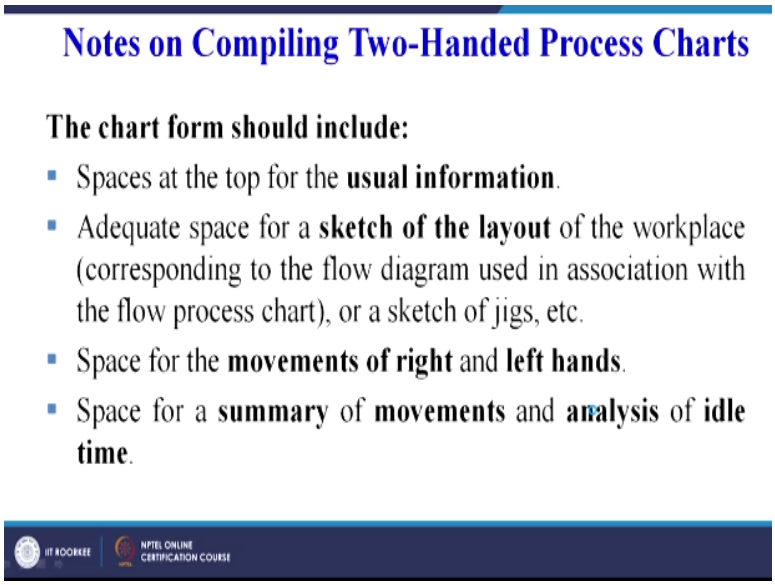

As usual spaces at the top for the usual information that is who is preparing and what is being charted all that detail the date, the name of the operator, who is being charted all that detail is required. Adequate space for a sketch of the layout of the workplace corresponding to flow diagram used in association with the flow process chart or sketch of jigs and fixture this is not mandatory sometimes maybe used, may not be used also.

Space for the movement of the right and left hands that we will see with the help of an example. Space for a summary of movement and the analysis of idle time maybe later on we may like to compare 2 different methods or the improvements that we suggest so why are we using this two-handed process chart or for that matter why are we studying this graphical tool such as operation process chart, the flow process chart or the two-handed process chart.

Why are we doing it, we are doing it to improve the current method of doing the job. We are currently working with a specific method of performing the task. We want to redesign it. We want to improve it. We want to make it more efficient. We want to make it more effective. We want to make it more productive. So for that purpose we are doing all these activities. We are learning all these charts.

We are learning all these techniques. So what we need to do first. We need to examine the current method of doing the job and then we have to device, we have to invent, we have to discover, we have to create, we have to innovate a better method of doing the job. So when we have 4-5 alternatives at hand we will work out for those alternatives and try to find out the one best method of doing the task.

And then we will compare it with the current method and show the savings in terms of time, in terms of cost, in terms of man hours, so all that has to be depicted. How that can be depicted if we use a scientific method of representing our data and tabular method can be one of the method. We can tabulate all the results and show our findings or show the improvement. So all that is required.

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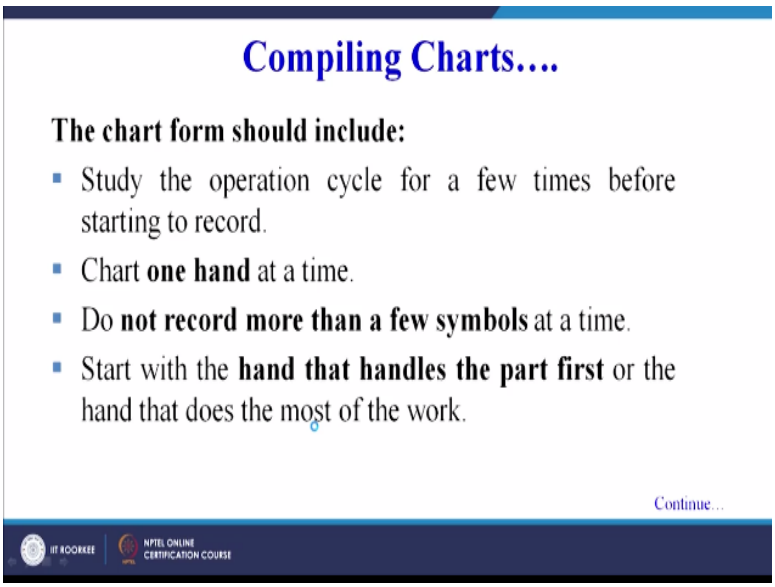

Study the operation cycle for a few times before starting to record, so maybe one of cycle we look that how the worker is working and start drawing that is not going to help us. So we must first properly analyze that how the operator is working, what are the two hands working, what is the movement of the left hand, what are the activities of the left hand, what are the activities of the right hand.

We must observe number of cycles before we start to record. Chart one hand first, first we must focus on left hand only. Then we must focus on the right hand and then combine the activities of the 2 hands. Do not record more than few symbols at a time. Start with the hand that handles the part first or the hand that does the most of the work. So we can focus on the hand which is performing more number of activities or which is performing most of the task.

These are just standard guidelines that we must follow when we are going to construct a two-handed process chart.

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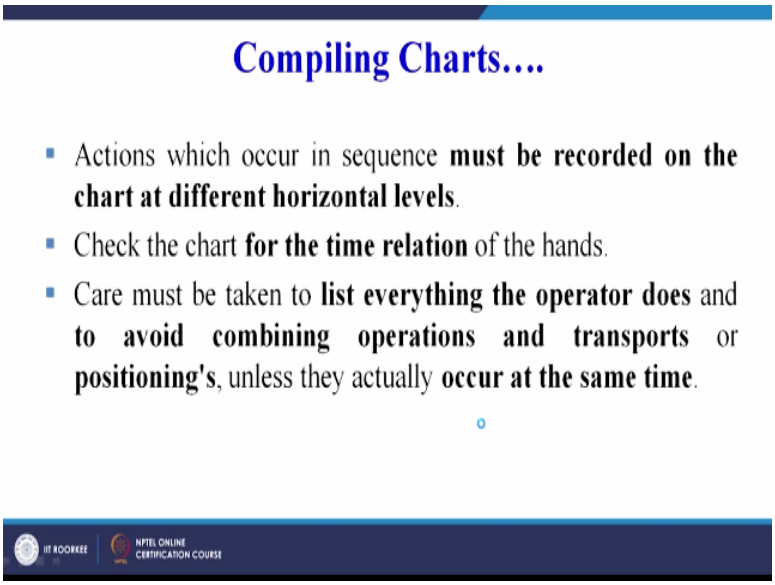

Actions which occur in sequence must be recorded on the chart at different horizontal levels that I will indicate when we see a chart that what are the various horizontal levels. Check the chart for the time relation of the hand, this is very, very important that at maybe at 10 seconds what is the left hand doing and what is the right hand doing. So that has to be checked. Check the chart for the time relation of the hands.

Care must be taken to list everything the operator does and to avoid combining the operations and transports or positioning unless they actually occur at the same time. So we must chart the each and every activity separately, independently. We must not use our own interpretation of the way the worker is doing his task by combining 2 or 3 operation this is being done together only.

If it is being done independently it has to be represented independently only, why, because we need to improve this method. We need to work on the current method and try to find out alternatives which can give us a better method. So if we start combining the things during the recording stage only during the representing or during the graphical representation of the current method only we may not be able to find out too many alternatives later.

We may not be able to develop too many alternatives. Therefore, it is better that independently we must depict each and every activity. Now let us take few examples. Now this is for example one layout. So there is a position for the bolts.

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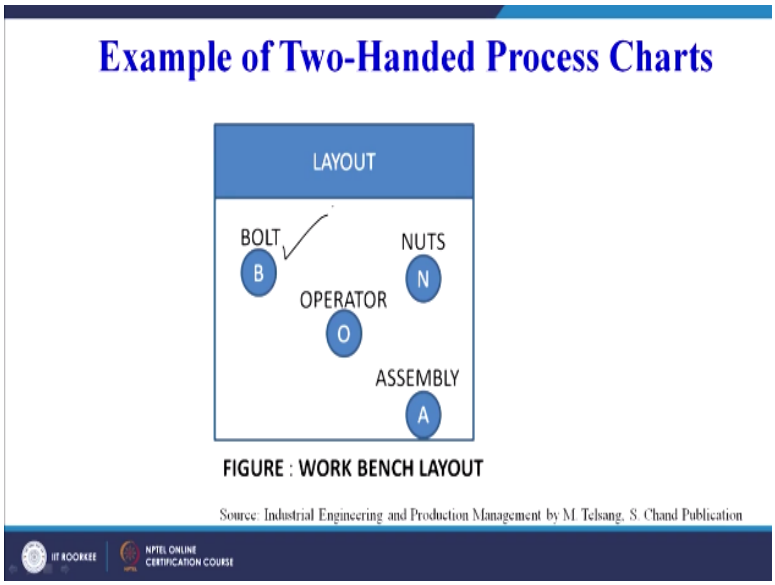

There is a position for the nut and there is an operator who is performing the task, now you can see he can use both his hands, left hand and right hand and finally he is assembling the nuts and the bolts. The bolts are assembled to nuts and then they are placed in this box, assembly box. So now we can see how we have to draw the chart and how the two-handed process chart would look like.

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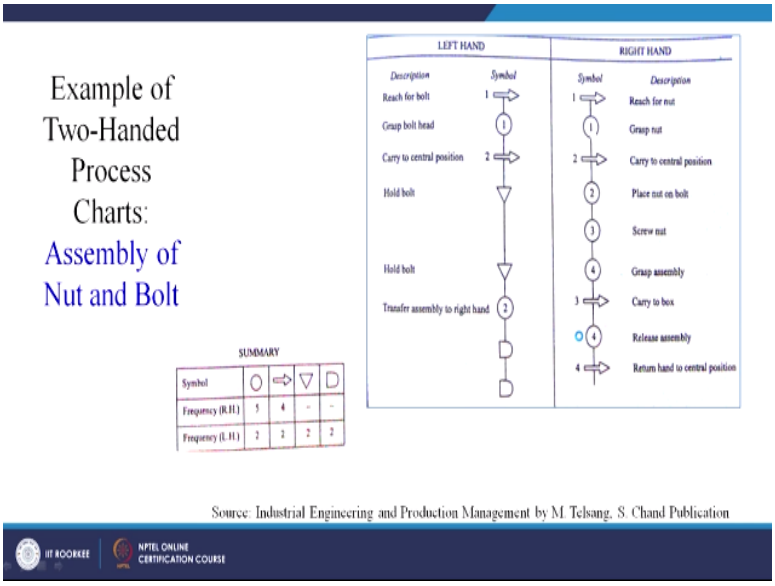

This is a simple representation. The operation is assembly of nut and bolt, so very quickly I will read the description. What is the left hand doing and what is the description of the right

hand? The symbols already we have discussed. So the left hand reaches for the bolt, the right hand reaches for the nut. So suppose I have on one side the bolts another sides the nuts. This is my left hand, so left hand reaches for the bolt, the right hand reaches for the nut.

Grasp the bolt, grasp the nut which we have seen grasping is coming under the operation, so you see that for operation we have O symbol, so we are grasping them then we are carrying them to the central position. So this is my work table, these are the boxes where I have the bolts and the nuts, so I am picking the bolt from here, picking the nut from here, bringing them onto this table.

Now bringing them to the central position you can see here, then left hand is holding the bolt, right hand is placing the nut on the bolt then it is screwing the nut on the bolt, then it is holding only you see, holding the bolt, holding the bolt and nut is being screwed on the bolt. Then the right hand will grasp the assembly then the right hand is grasping the assembly carrying to the box. This is transfer assembly to the right hand.

The bolt is in my left hand, if you see the left hand is holding the bolt, the right hand is performing the screwing operation so the assembly, this will grasp the assembly, this is the total assembly right hand, then from left hand I will transfer the assembly to the right hand then the right hand carries it to the box releases the assembly there and return hand to the central.

So my right hand now if you see we can go back and see that it is towards my right. This is operator I am the operator so where I have to place the assembly it is at the right. So from my left hand I have to transfer the bolt or the nut bolt assembly to my right hand and right hand will transfer it to the box where I have to keep the assemblies. So this giving me the two-handed process chart, left hand and right hand.

So now we can calculate for frequency for right hand how many operations are there, left hand how many operations are there, so left hand operations are less why because the left hand is holding the bolt, the right hand is performing the screwing operation. Similarly hold, the right hand is not having any hold activity, but the left hand is having the hold activity. Similarly, the delay is for the left hand only there is no delay for the right hand.

Because when my right hand is going to deposit or deliver the assembly into the assembly box the left hand is idle at that time. So this way we can represent the activities of left and right hands and understand that how our two-handed process chart can be drawn. Let us take a very simple example again.

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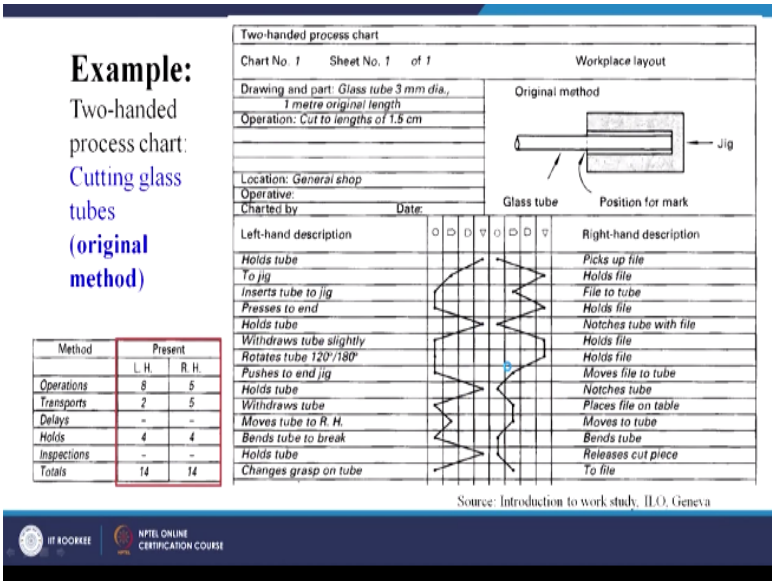

Although there are lot of activities here, this is another way of representing the two-handed process chart this is representing the left hand description, this is representing the right hand description and this is the original method of cutting the glass tubes and the diagram is shown here. So here in the original method this is the glass tube, the glass tube is pushed into the jig. This is a jig and this is the positioning of the mark from where it has to be cut.

So the left hand and right hand will both perform the task and this cutting of the glass tube is done. So this is the current method of doing this work in which what are the left hand operations what are the right hand operations, transports, delays, holds are given. We have already seen that in two-handed process chart usually we avoid the inspection so there is no inspection involved for left hand and right hand.

So what is being done, we have to cut the glass tube to the lenses of 1.5 centimeter. What is the original length, original length is 1-meter? So what are the activities just for maybe for left hand I will quickly read the activities. Left hand holds the tube then it takes the tube to the jig, inserts the tube to the jig, presses to the end, this is the end. So I have with my left hand I am pushing the glass tube into the end.

So that is pushes to the presses to the end, holds the tube, withdraws the tube slightly, rotates the tube by 120 degree to 180 degree, pushes the end to the jig, holds the tube, withdraws the tube, move tubes to the right hand, bends tube to break, holds tube, changes grasp on the tube. So each and every maybe activity of the left hand is recorded. So when left hand is doing it, right hand also is holding the file.

So left hand is basically holding the work piece, right hand is actually holding the tool with which we have to cut the glass tube. So the length of the glass tube is 1 meter. We have to cut it into pieces of 1.5 centimeter, this method is being used. So we can change or find out the improved method. This is the improved method you can see you are in the present method for left hand there were 8 operations which have been reduced to only 2.

For right hand there were 5 operations reduced to 2. There is no transport in the new method, no transport. Similarly holds were 4 for left, 4 for right. Here it is 1 and 1. So what we are doing. This is the improvements I have shown. What we are doing here we are using a jig here and a stop here. So my left hand will push the glass tube and this will be act as a stopper and this jig, this is a notch from where it will be cut.

So just the left hand pushes the tube to the stop in this direction the tube is being pushed to the stop, rotates the tube and holds the tube. What is the right hand doing, right hand holds the file, notches with file at the position where we want to cut the piece, what is the length, so the length is 1.5 centimeter, taps with file and end drops to the box? So at the bottom we have a box where the cut portion 1.5 centimeter length glass tube will fall down.

So what we have done we have slightly improvised our method in a way that both the activities of the left hand and the right hand have reduced. The operations have reduced, the holds have reduced, the delays have reduced and it will lead to improvement in the productivity, improvement in the efficiency and effectiveness of the operator or the set of operator who are performing the similar tasks.

So just by slight modification in the way we are doing our work we have been able to improve the efficiency and effectiveness of our operations. So here we can see that we have been able to reduce the effort of the worker and in addition improve the productivity of the work that he or she is doing. So this is a very simple method, this method has been taken

from this is available in number of good books, this specifically is given in ILO's book on work study.

You can refer that and just read the details because I think I have been able to explain it properly, but still if there is some doubt you can refer back or in the discussion you can ask all kinds of doubts we will be able to address those doubts with the help of the problems available in various books specifically this problem.

So here we are using a different type of a fixture stop arrangement to push the tube up to a specific length and then notch it and in the previous case there were more number of operations and holds and delays. So here we can conclude that whatever graphical tools we have used such as the operation process chart, the flow process chart, two-handed process chart all these will help us to improvise the way we are doing our work. In our next session our focus will be on the multiple activity charts. Thank you.