Applied Ergonomics
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Module - 01
Lecture - 05
Motion and time study

Hello, and welcome to this lecture 5 on Applied Ergonomics. We were looking at time motion study in the last lecture, would like to go forward into the basic procedures which are associated with work study at the stage.

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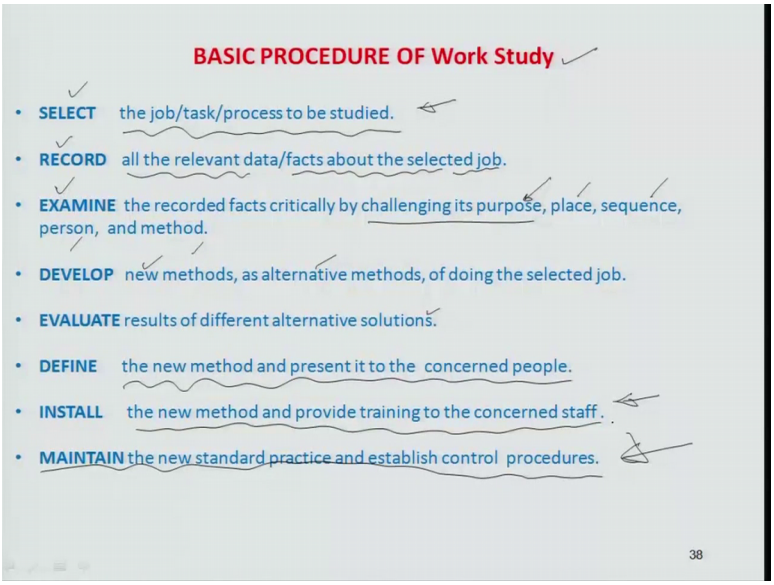

Basically, it is a step by step procedure which says that first you have to select the particular job or task or process that, you need to study you have to remember that any big activity related to manufacturing or maybe let us say unit which caterers to a product to or a service is associated with several such jobs or task. It may run in even close to 100s of thousands actually and so, the idea is to be able to locate among those tasks, those tasks where you feel that there is some wastage involved or there is something which is going wrong which is you know helping in a big way to not create productive

productivity improvement etcetera and so we had to identify some of those task. So, this comes in the select option.

So, out of all the jobs or tasks which have been laid out you select only. Probably, the few one there is some praetor analysis of something you had use. For example, as you know that the praetor last states that the top 80 percent problems come from only 20 percent of the reasons. So, the same kind of a analysis has to be carried out as far as the when the jobs are laid out together in order to be able to select those stop 20 percent of the reasons, which need to be a task which need to be really menu word are transformed. So, that it is almost about changes the productivity by 80 percent.

So, then the question of recording comes that once these task submit identify then you had do in a very organized manner record all the relevant data which is associated with the task and in fact, when we talk about time and motion studies here is there a lot of methods are used for recording the motion sequences involved in a certain task or even the times scales which are associated with those motion sequences or. In fact, trying to indicate motion sequences where some motions contribute to the overall task in terms of value addition some motions are always there by the necessity to have them, but they are un value I mean non value adding or there are some motions which slows down the primary motions which would be able to achieve value addition to the product etcetera.

So, there is a very nice classification in this recording scheme itself where you classify a task to be one which is the main task one where there is the slowing down effect on the main task another which is in disabler for the main task. So, once that recording is done then you want to examine.

So, basically you layout all recorded tasks in in in terms of the times in terms of the motion sequences. And try to record facts critically and that can be possible by challenging it is purpose. So, there are certain questionnaires is that I will at the end of this presentation make which talks about is the task very important can it be combined can the task be occurring at the different place for the different distance of time can it be carried by the same operator or the different set operatives

So, these are the sort of questions which would enable the fitting of the right task to the right person to the right time. So, that there is an optimization which is going to be there. So, this is all part of the examination process you have also record facts critically with

respect to the place of the task the sequence of the task the person involved in the task the method which is applied for carrying out the task so and so forth. So, once this examination is the done you develop. Now the iterative process starts in to picture what modification what alternative do you have in mind to the setup existing task which would do a better job in terms of time and motion sequence.

So, you develop new methods for example, looking at a certain task structure you can say that this task structure seems to be very wasteful. Let us develop an alternative structure like this where there is some difference between the previous task structure and the newly developed task structure in terms of reduction of face full inversions or even reduction of time scale associated with overall task etcetera. And so this new alternative if it works out well can be treated out as a standard job description or process description for that particular task and in this manner for all the 100, 1000 tasks or more which is there you do such a development of alternate methods. In fact, you know what I am referring to is again addressing probably most of the task, but then again as I told you at the very beginning that only probably about 20 percent of such task are responsible for contributing to 80 percent change in productivity.

So, there first and first should be carried out those 20 percent and then you know it trickle down the order. And it can be seen whether any further task if treated a really contributing or not in the in case. They are not then they can be left alone as such. So, you do not need to do it do it about the whole spectrum, but about those which are really wasteful in nature and contribute in a lot to blessing of productivity.

So, then you evaluate the results for different alternative solutions and then define the new method, new process presented to the concerned people convince them, that this is the process through which if you want to execute the task that you are doing your life will be better you know in terms of productivity. It will better for the system you probably get more paid for doing equal amount of work because your wasteful machine is now gone.

So, those apprehends there are lot of apprehends which happened with such task planning is done among the basic stakeholders, who are the workforce and one of the reasons that people start you know debating quite a bit, is that when the task motion analysis is carried out there will be some manpower saving and there will be people who

lose jobs, but that is it really not the goal of the overall activity the overall activity is basically to streamline within the existing framework. Those people who are coming out of because of not being necessary can be put or diploid in another wing or another you know operation, where maybe it is new initiative a new development of the same plant or the same company.

So, these issues would always have to be visited and a lot of convincing needs to be done to define the new present new method to the concerned people. And then finally, there is an install stuff which means the new method and associated equipment needs to be in place you need to provide training to the concerned staff so that they can be used to such method or such implementation of that method. And then there is of course, maintenance issue that once the new method is in place you must see that the old methods are not followed anymore and there is a sustained maintenance of these activities.

So, this is the basic procedure. So, you basically trying to organize the task structure take those which are non contributor in terms of increasing productivity trying to look at them very critically by recording all details trying to sort of you know intervene at every level, and see and examine and record what is the weakness tried to eliminate the weakness develop a solution, which would be without those weaknesses and then trying to evaluate those solutions, concerned people are empowered to implement those solutions. And then once they are implemented they have to be maintained. And in fact, whatever training whatever associated parabolises is involved in execution of such that new task has to be also in place.

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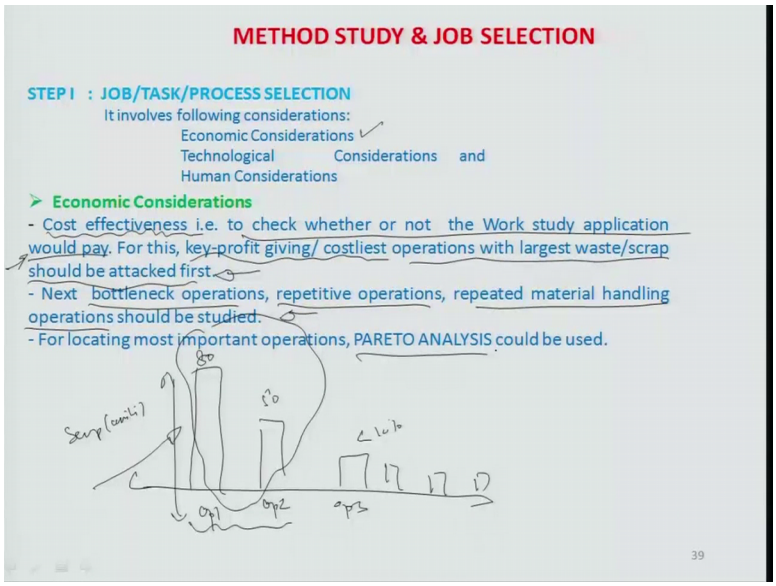

So, let us look into details when we talk about job task process selection it. Of course, involves these from the following considerations one of them is of course, economic in nature it has to be cost effective, whatever new you know job task process selection we are making the process itself should be very cost competitive and you should check whether or not the work study application would pay, if I do all this work study and at the end of the day the productivity improvement is very minuscule then there is no use of doing the work study.

So, that first job for the management which is plating implementing the work study is to be able to find out whether their system has enough slack, which have can be reduced and it will create enough dent or impact on the overall economics. And so for this key profit giving or costliest operations with largest waste or scrap that should be attacked first.

So, that is why I said praetor analysis. So, as you know that let say for example, if we wanted to look at some operations, operation 1 operation 2 3. And then let say look at scrap you see the majority of this scraps would come from probably about only 20 percent of the operations.

So, this is let say t it is about close to let us say 50 you know. And these are some units let us say of sequence of the machines and the remaining ones, which are there are probably less than 10 percent. So, such 2 or 3 very important wasteful operations have to

be first identified for this work study. Next bottleneck operations repetitive operations repeated material handling operations they should also be studied. Because whenever we are talking about you know a process which has more than one cycles to be carried out on a regular basis. If it is wasteful then the wastefulness is adding every cycle of operations of that particular process.

So, repetitive processes of the ones which should be most targeted. For example, in assembly line worker which repeats a process for 270 vehicles for assembly is the most susceptible for introducing wastefulness in the system. So, can we really monitor that worker very closely so that we can see how much waste can be eliminated out of what he is contributing?

So, of course, praetor analysis is a very good a descriptor in this category. So, job task selection should also be done in light of technical considerations.

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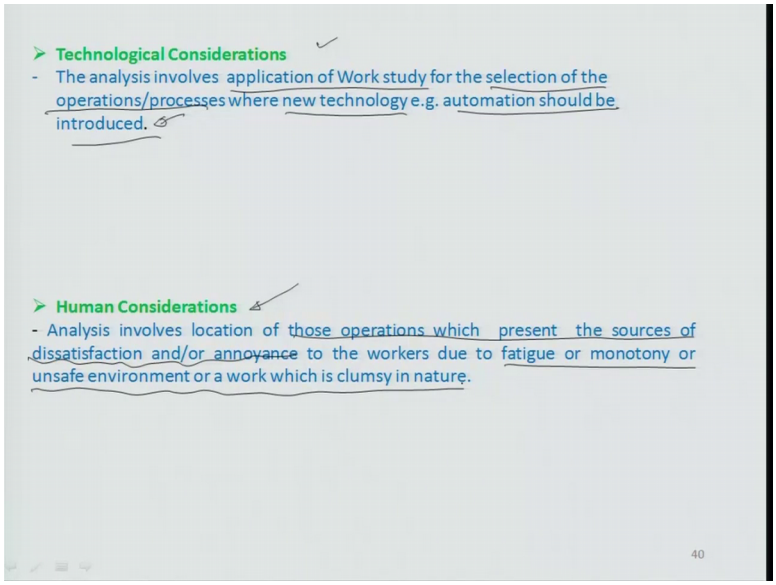

So, which means the analysis involves the application of work study for selection of operations. Then processes where new technology example automation etcetera should be introduced, I already told you about something related to a coolant gun vacuuming the coolant system in filling the coolant as the vehicle proceeds.

So, for example, if we were looking at an instance of let us say an rear axle being fitted on the under body of a j c of the car. The car typically in the under body operation goes

in a hanger and it goes over head in the operator is below. And he is trying to do various operations to the under body of the car in such instances.

So, let us say for example, the operator carries the axel which is very heavy in nature. And he carries it from rack which is placed site in a assembly line and goes down to the under body region, while one worker actually holds the axel close to the under body of the car the other goes and titans the bolts. Now this is a very wasteful activity. So, if I wanted to automate this whole process the best idea, would be to mount this axel from a sub assembly stage an axel sub assembly stage rather than putting in to a trolley the axcel of sub assembly can be made just adjacent to the under body assembly. And the axel is assemble by of a few worker and supplied through a pallet or let say a jig to which the axel is resting down to the main chassis assembly area, and basically there can be a sort of lift you know could be a seizer lift which otherwise is covered on all sides.

So, it basically is safe operation which is operated numatically or something. So, lift comes and alliance as the table to the rack which is supplying of rollers this pallet us. So, the pallet comes into the lift. And then as the axel is loaded onto the lift the lift gets engaged to the hanger of the car and moves along with the car while the axel is lifted along with the pallet. So, the axel goes and positions itself and the only job that the operator is left with us to do the lift operation. And probably one operator can just titan all the 4 bolts which are there in place to join the axel to the main body.

So, this is an automation step. So, this actually has a technological consideration that how I have innovatively design something, where instead of an effort of 2 people one lifting the axel another mounting the axel. We are getting it done through a single person with using some kind of a automation. So, this is where technological considerations come into picture, there also human considerations which is basicaly involved the analysis involved location of those operations which present the sources of dissatisfaction or annoyance to the workers due to fatigue or monotony or unsafe environment or a work which is clumsy in nature for example.

Let us talk about something which is related to paint. Let us say you know there is a there is a chance. So, there is a possibility that during the painting process, because of some small particulate inclusions there are dust spots which come on the surface of the car body. Now these are typically analysed at the painted body stage where the car go

into the assembly line and just prior to that, and supposing there are such a dust spot which is coming continuously in the area where the repair should be carried out typically by sending the dusk spot away. And then putting you know different layers of pains or cotes and then baking it through the oven.

So, this is a sort of a repair activity we it should be offline, but typically this repairs on if the assembly lines are quite productive in nature and they are associated with many cars per shift they are done online. And so let say look at the illumination level of such an area and we see that it is poorly eliminated. So, the operator who is going to look at the dusk spots and repair the dusk spots go to be very frustrated because of the lack elimination.

So, the first thing that comes to once mind is those considerations, where can I argument the system in a manner. So, there it is comfortable for the particular you know the task provider to deliver the task. So, in this case extermination in the area is pertinent because that will help to the market you now any defective vehicle from going outside the painted body region.

So, these kinds of considerations are always there when we are talking about doing tasks selections. So, we must select the task in a manner with considerations given to the economics the technological constrains. And can we develop solution and then also the overall human factors which are involved in doing. So, if there something where it frustrates the operator, this is of primary importance for us when we talk about developing a motion study to select those task and trying to revisit some of the system is associated with those task. How do we perform?

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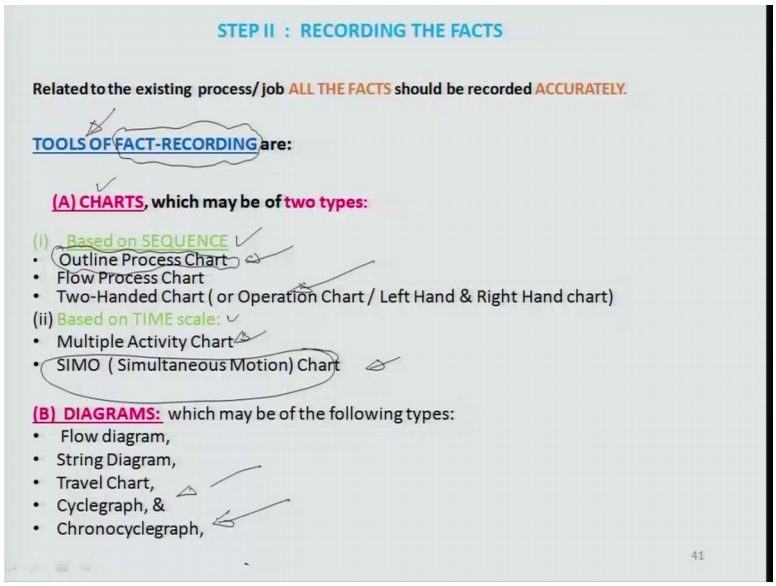

So, that you can record the facts which come out of once, the task has been selected come out very concisely may be on a single sheet of paper. And so there are certain tools which are provided you know by various practitioners which actually is responsible for fact recording I would say a bridged fact recording on a piece of paper. And these can be related to charts which are based on sequences processes or charts which are bases on times scales the sequel charts could include typically like things like outline process a chart. I will just come and explain to you these in more on an individualistic bases. Just a little bit later, but outline process chart typically includes 2 different kinds of motion one is associated with a process another is a associated with an inspection.

So, you basically laying out the whole process in terms of those where the process contributes to the value and other is that whatever contribution is made by the process is being evaluated; so a process and evaluation. So, this kind of a outline schematic would lay out what are the different processes, and what are the different value let us see evaluating mechanism which are involved in caring out a full process. So, process is described in terms of those symbols. So in fact, 5 different kind of symbols which will signified different aspects related to if it is the task or if it is the in fact, task or if it something related to the forward motion or something related to delay. So, I am come to the next line, but that is how the outline process chart comes out

The flow process chart is the little more than the outline process chart, if basically looks at not only the process and the evaluation, but also how the flow is going to happen of the material which comes into the process as well as outside the process. This gives you in totality a picture of the whole process of production. And then of course, there are 200 chart 200 chart typically are related to executing the task in a time vice manner by looking at your what your left hand would do and what you are right hand would do. For example, if I wanted to take a cover and put it on the top of let us say the engine head and then fit 3 bolts or 4 bolts on this cover to attached to the head.

So, typically my left hand would probably do the job of picking up the head cover and then placing the cover over the head is going to come to me from the last station where there was some other manufacturing on the head. And then there would be my right hand which will take about 8 bolts or 9 bolts and put it around this engine head and then you know there would be a sort of gun which boths the hands would be needed to pull. So, that this this gun which has fort 8 different sockets would equally equal space in a equal space manner sit on those bolts and try to task those bolts.

So, there is some cycle time given till the operator has to use both hand to hold the gun before the talking indication comes. And then release the gun show that the gun goes away by spring action and once it goes away it is a limit switch on the gun goes back to your next stations. So, till and until this whole process is happening the gun is being carried along with the engine assembly from one station to another assuming that the engine kept on paral. So, what essentially is happening where using both hands to do that? So, if I can make a time chart what my left hand is doing on my right hand is doing and then maybe introduced some clock times, where as a function of time from 0 seconds on words I project you know for 0 to so many seconds this particular operation is done by my left hand then the right hand comes on both of them come together.

So, this is the way of representing the sequence of operations associated with the certain task again, we could have time scale charts we should talk about multiple activity charts of simo charts of basically related to the same concept of right and left hand, but here the idea is to be recording the times scales independently of the right on the left.

So, that we could be able to sort of describe the total time involved in doing the sequence of operation in that earlier case the 200 chart would normally be for a sequence in time.

So, we are using the time scale to record what follows what without giving an instance of how what amount of duration is involve between 2 operations, but in the simo charts it is the duration more important. Because we are going to have a time value for all events being done by the left hand and all events being done by the right hand and recorded in that particular manner.

So, I am going to come and explain this little better details then there are all also some diagram part from chart which are use from time to time. For example, I would like to illustrate particularly the cycle graph on the chronocyclegraph, where we talked about video filming or process operations and video filming could be done with the with an instance of carrying out some indicator on the hand of a particular person to understand the hand motion.

So, let it be like for example, l e d a small l e d which has been carried on the hand and if the hand moves l e d moves along with the hand and in one instance just by a proper camera shutter control, I could get a flow path of how the hand moves in space. So, this according to the whole cycle time of the particular operator non other instance, I could basically tried to shut down the camera as a function of time as the hand propagates. And so between different operations let us say in one particular task also there are different operations you could actually get a sense of direction as the camera shutter closes on as a function of time for between one operation to the next operation.

So, you get sense of direction of your hand movement between one operation to the next operation in this way in this following manner in organised manner, you could actually get a very good detailing of how the hands and limbs are moving of an operator in assembly line with respect to whatever operations he is delivering or recording.

So, let us look at the first process chart and the symbols involved there.

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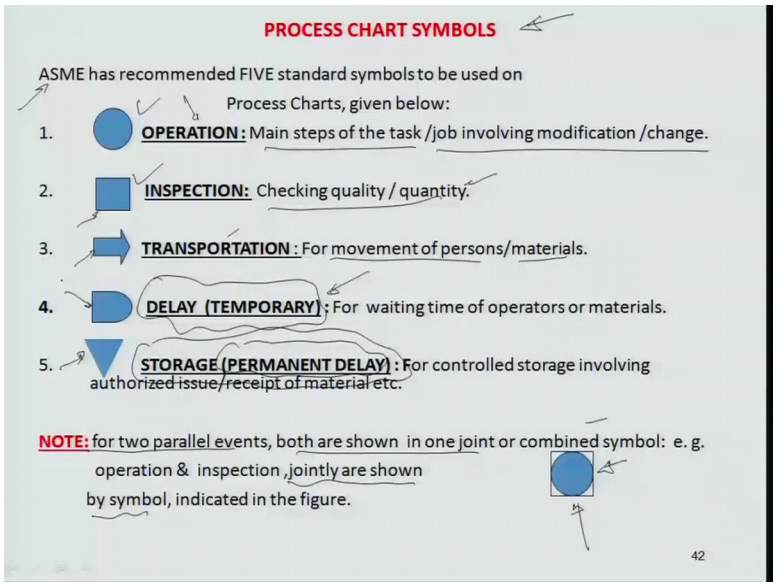

So, typically the American society of mechanical engineering has recommended 5 different symbols which are used for process charts. So, they are symbols circle related to an operation this is the main step of the task or job involved in the modification of the change, there is something involved in inspection recorded by as square which checks the quality of quantity of what has being produced in the last step there is also an arrow symbol, which represents the transportation particularly for movement of persons in materials. There is also a d signal here which represents delays particularly temporary delays temporary delays could happen because of the waiting time. For example, material is there is not online materials not arrived online on the operator is simply waiting because you want the material to come and place before it starts assembling it to the vehicles.

So, this is more like a temporary delay and immediately has to be resolved. So in fact, that is where the lean manufacturing principles and concepts come there is a system of if you look at how toyota production system is made there is a system of unknowns which are basically calling bells on different stations related to lines. And there are 2 different grades of such an drones one is a yellow battery of light and other is a red battery of light red indicates process stoppage, where because of such a criticality like a delay a temporary delay I process has stopped. And the yellow battery of light indicates if you know there is now process stoppage, but the process is carrying out with some short coming.

So, this information from station to station is quite highlighted and the highest level and at the function of time everybody including the senior most manager in the whole production unit is a witness to what is going on. And a real time basis on the different production processes within that system. So, delays in that manner can be categorised and then there are certain permanent delays these are more related to material storage issues. For example, let us say there has been some issues related to authorised issue or a receipt of materials. For example, a material is coming from vendor and there is a compliance issue on that material there is some quality problem which is there on the material because of waste material tractor still not being able to upload itself on to the assembly line.

So, there is some cost because of which a delay is being intentionally made and their more permanent in nature because, unless the vendor comes and solve the problem ascends alternate truck that material cannot be loaded onto the assembly line. So, these kind of things are actually storage related delays a permanent delays and so the idea is that a process chart should be able to in terms of all the symbols give you us an idea of the sequence of operations which is involved in such a process.

So, for 2 parallel events both are shown in one joint or combined symbol. For example, if I had an operation inspection all at the same station let us look into a flexible manufacturing line associated with the machine shops. So, you have a couple of CNC machines and there are certain automatic inspection stations which are within those CNC machines. So, I can say that in if a machining an engine block, for example, and I wanted to on the internal surface of the engine cylinder there is the gauge which would use online which is a pressure gauge or a air gauge. Let us say we inside the gauge there is the back pressure recorded through which you could see; what is the surface finish of machining operation this is actually done within that CNC setup.

So, in such kind of automated 100 percent inspection equipments a line to a certain process, you now it is it can be represented through these kind of mixed symbols where are production inspection carried out simultaneously known 100 percent inspection or inspected to inspected parts. So, you can jointly show such symbols for even inspection and transportation. For example, then maybe optimum number of cases where you are able to inspect let say a door while transporting it.

So, for example, there is a door from assembly which comes and it is being fed to a conveyor through with it comes to the main line to get in installed in between there are certain image recorders which would analysing the door as a name then. So, this is actually an inspection being carried out along with a transportation. So, you could actually have a mix symbol of a square an narrow representing that. So, this way you could have various symbols where multiple operations are carried out together or even processes are either operation inspection transportation delay or storage related representations.

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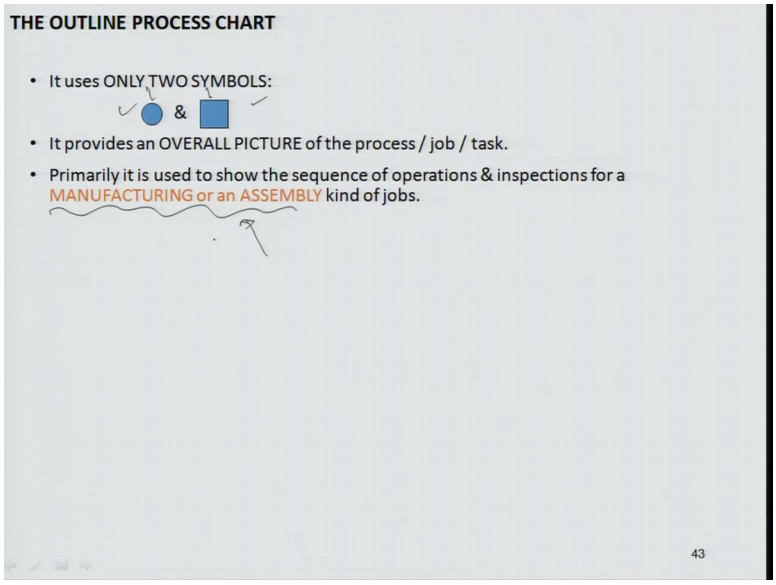

So, as I told you earlier outline process chart typically combined are one these to symbols where there is the process inspection. So, it provides the overall picture of the process job or task primarily, it is the sequence of operations used for any manufacturing engineer to understand that what is being done and what particular station.

So, it is like just more giving an information to the manufacturing engineer. And in fact, one has to remember that if will layout everything together like this on one particular chart for a certain process it may be very conveniently able to get identified in terms of which areas of the ones. We should really focus if there are times scale attached to such as representation. So, I will like to conclude here todays lecture, but in the next lecture I would give a little more details simo chart and also how motions a time study could be done through techniques like cycle graph or chrono cycle graph.

So, as of now thank you very much, and goodbye.