Work System Design
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Lecture - 24
Multiple Activity Charts

Namaskar friends, welcome to session 24, in our course. We are discussing the method study and the previous few sessions have been dedicated towards learning the graphical tools that are used for solving problems related to method study. For the learners who may be watching this video as a standalone program what is method study. So method study basically is a graphical technique which is used for identifying the current method of doing the job.

And then suggesting a better or a best method for doing the same job, how, by using the various graphical aids. Now what are the various graphical aids that can be used, they can be operation process chart, it can be flow process chart, it can be two-handed process chart, it can be multiple activity chart, it can be string diagram, so there are number of tools which can be used for examining the current method of doing the work.

And suggesting a better method of doing the work as well as comparing the performance of both the methods using a tabulated data in terms of certain criteria. Now criteria can be that the current method maybe involving more number of operations and the proposed method or the new method or the better method maybe involving less number of operations. Similarly, transportation, delay, hold, all these parameters or criteria will help us to compare the 2 methods.

What else we can compare, the time taken, we can compare the effort required for completing the work. We can compare the number of man power or the man power required for completing the work. So there can be n number of criteria which can be used for comparing the 2 methods of doing the same job or the current method and the improved or the better method of doing the job.

So we can even perform the comparison with the help of these graphical tools. So that is the basic understanding of method study and why do we need to do method study, we have already seen that we want to be more productive, more efficient, more effective in our

operations and for that we need to understand what is our current productivity, what can be the improved productivity with the better method, with better tools, with better techniques, with better methodologies.

We can certainly improve our productivity and in order to improve our productivity we need to do the method study, we need to do the work measurement, we need to study ergonomics, we need to study the environment where the work is being done so all these are the tools and techniques which will help us to improve our productivity. So usually I take 3-4 minutes to introduce the concept that we are going to discuss.

So our target in this course is to design a work system which is not only beneficial for the organization, but is also maybe efficient and effective for the worker. The worker feels like doing the work. He is motivated, his morale is high when he comes to the organization, why, because he enjoys doing the work. So we have to make the work enjoyable. It will be enjoyable if he is not getting fatigued, if he is not getting tired.

He is feeling safe, the environment that we are providing to the worker is congenial to the type of work that he is doing. So all these things will help us to motivate our worker for performing the task or for performing the work that has been assigned to him and for that we need to understand the concepts of work study or the work system design. So in this course we are currently in 5th week of our discussion.

The 4 weeks of discussion is already over which has focused on productivity, it has focused on the basic aspects or concepts of work system design or the work study and then we have started discussion on the first technique that is the method study and in method study we have already seen 3 different graphical tools, what are these just to revise, the first one is the operation process chart, the second one is the flow process chart.

And the third one in the last class we have seen or the last session two-handed process chart, today we are going to study the fourth graphical tool that is the multiple activity chart. We will try to understand it with the help of examples as we have done in our previous sessions also. Now what is the activity chart.

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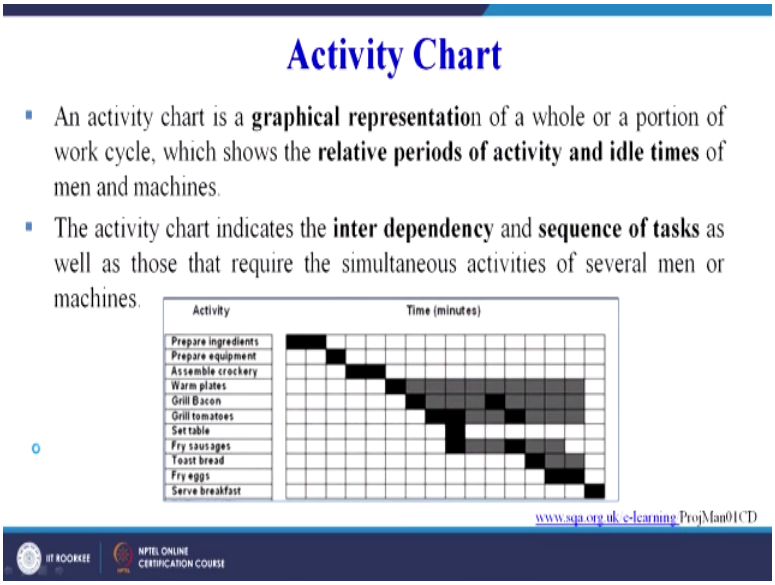

An activity chart is a graphical, already I have emphasized this word most of the tools and techniques that we use during method study are graphical tools only. So an activity chart is a graphical representation of a whole or a portion of the work cycle. So it can be a complete work cycle or it can be a portion, some part of the work cycle which shows the relative periods of activity and the idle times of men and machines.

So if you see just to compare the activity chart as compared to the other charts that we have already seen. Now what is the operation process chart, it gives you a bird's eye view of the overall sequence of operations being carried out in an organization. We have only used mostly 2 symbols that is operation and inspection in the operation process chart, done. Then we have seen the flow process chart.

In flow process chart we have used all the process chart symbol and it is much more detailed as compared to the operation process chart we focus on the transportation also, delay also, hold also. So we are much more focused in case of flow process chart, then we came to the two-handed process chart, we have seen that how operator is managing a machine, what is the left hand doing, what is the right hand doing.

We have charted both the left hand, right hand activities and again we have slightly modified the definitions of the process chart symbols. We are not using inspection more you can say frequently in case of the two-handed process chart, but the other 4 symbols that is operation, transportation, hold and storage are used in two-handed process chart also. So all these charts are different and are used for specific applications only.

Similarly, the activity chart is also different. So here we are trying to see that when the men are working, when the men are idle, when the machines are working, when the machines are idle so it is going to provide a interrelationship or correlation between the two things that is the men and the machines and we will try to help us or will be definitely helping us in identifying the idle times of both the men as well as the machine.

So it is maybe a kind of a man machine chart which we will try to understand with the help of an example. So I have tried to emphasize this word relative periods of activity. So relative means when the man is working what is the machine doing, when the machine is working what is the man doing. So relative periods of affectivity more over the idle times of men and machines.

The activity chart indicates the interdependency and sequence of tasks as well as those that require the simultaneous activities of several men and machines. So here you can see one example is given, you have time in this scale and you have activities on this side. So it is not that one man is doing this activity. It can be several number of men who are doing this activity.

So what is the activity I will just read it for you. Prepare ingredients, prepare equipment, assemble crockery, warm plates, grill bacon, grill tomatoes, set table, fry sausages, toast bread, fry eggs, serve breakfast. So these are the activities being done. What is the overall target that is serving the breakfast and with the time is also given? So in the time we can see first we have to prepare the ingredients.

It is given in minutes, then prepare the equipment and the last activity here is that you can see is serving the breakfast. So what we are seeing, we are having activities, we have time on one scale and there can be number of men who are involved in completing this task. So we will try to understand it with the help of example and our target is to find out a practical application of the concept or the theory that we are trying to understand.

There can be n number of application areas where man, machine charts can be used and 2 of them we will try to understand in today's session. This is just one random example of how an activity chart can look like. So we need to have a time scale we need to have the activities.

The activities can further be divided into activities or the work done by the labour or the men and the work done by the machine.

So what is the machine doing, what is the worker doing and at what time both men and machine are working and at what time only machine is working, men is idle or there can be a situation there can be a time in the work cycle where the vice versa is taking place. The men is working and the machine is idle. So that type of chart will help us to find out in the overall cycle time for how much percentage of time men is idle.

And for how much percentage of time machine is idle and how we can redesign the work so that both can be optimally utilized or both maybe utilized to their maximum possible capacity. So let us try to further understand the concept with the help of certain examples, but before we go to that we have to learn certain standard forms in which the multiple activity chart is usually presented.

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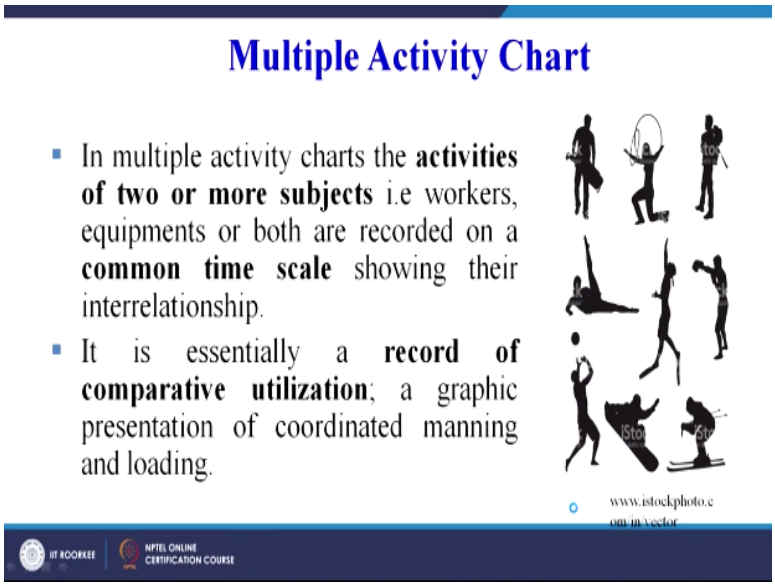

So in a multiple activity chart the activities of 2 or more subjects. Now the subject is a new word. What is the subject, it is explained, that is workers, equipment or both are recorded? So subjects are the workers, answer is given and the equipment again answer is given to this question, what are the subject.

So in multiple activity charts the activities of 2 or more subjects that is workers and equipments or we can say man and machine are recorded on a common time scale. This we will try to understand when we will see the example showing their interrelationship already I

have highlighted this point that when the man is doing, suppose the man is loading the machine at that time the machine will be idle.

So that way we will try to establish an interrelationship among the men and the machine. It is essentially a record of comparative utilization. So as I have already highlighted in the total time suppose we time for 2 cycles, let us take an example to have a better understanding. There is a drilling machine, an operator is operating the drilling machine. So the set up time is supposed 2 minutes.

The operation time is 2 minutes and the unloading time is also 2 minutes, so for one cycle loading plus drilling plus unloading that is 2 + 2 + 2 = 6 minutes. So when a worker is operating this machine he is involved in loading and unloading, during the drilling operation he is idle, because he has set the machine, he has switched on the machine it is automatic machine it will perform the drilling operation.

So 2 minutes he is idle, whereas the machine when it is being set it is not working, the machine is idle, the operator is working on the just setting up the things and when the material is getting removed after drilling at that time also worker is working, but the machine is not giving any productive output. So that way we can see that when machine is working, when worker is working.

Now the total time for one cycle of drilling a hole is 6 minutes. So out of the 6 minutes we can see that for how much percentage of time the machine is working and for how much percentage of time the man is working and then from that we can very easily calculate that what is the idle time for the man and what is the idle time for the machine.

So with the very simple example I think I have tried to explain the concept of interrelationship among the man and machine and moreover we can calculate the comparative utilization using this graphical representation.

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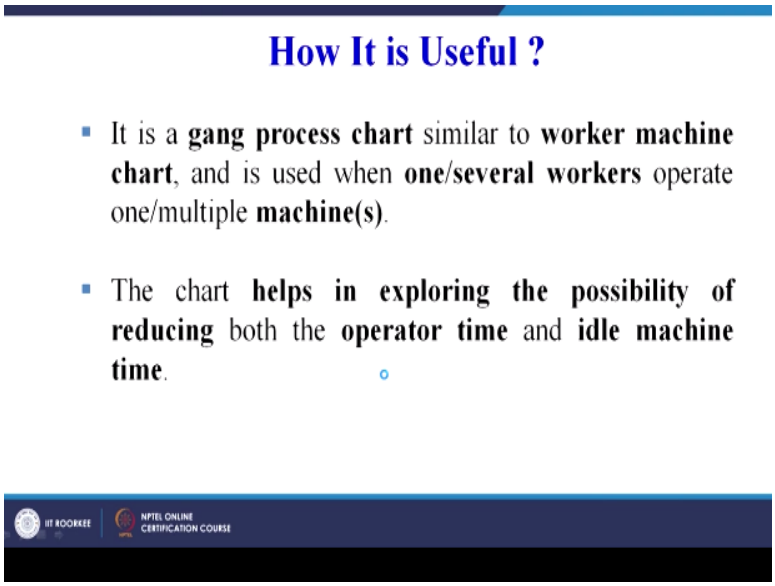

Now how it is useful, it is a gang process chart, similar to worker machine chart and is used when one or several workers operate one or multiple machines. So here we can have a single operator operating 2 machines in the vicinity or it can be 3 operators operating a single machine so different situations can be there, based on that we can have different types of man machine charts.

The chart what is the utility. The chart helps in exploring the possibility of reducing both the operator time and the idle machine time. We want to optimize the time for which the operator is operating the machine, we want to reduce the idle time of the operator. We want to reduce the idle time of the machine. So that is our target when we draw the man machine chart. So we want to reduce both the operator time and the idle machine time.

So operator time also this is slightly maybe debatable if you see because when the operator is working we want to design the system in such a way that whatever is the output expected from the operator he must be able to deliver that expected output without compromising on the quality or performance in the minimum possible time.

So that is our target so we will try to design the system in such a way that the worker is able to perform the task assigned to him in minimum possible time and he gets adequate time to take rest also. Now what are the types of multiple activity charts.

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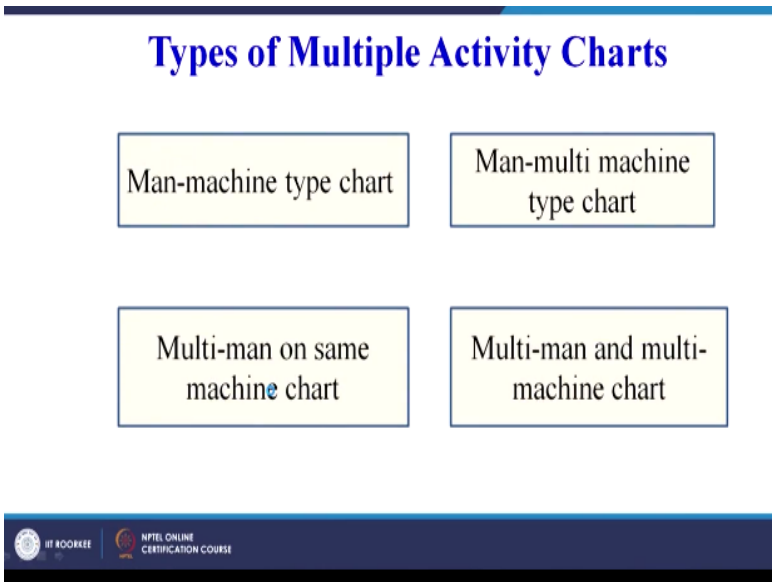

There are maybe a man-machine chart which I have already spoken about, this term I have already used the man machine chart, then man-multiple machine type chart, so maybe a single man is operating 2 machines or 3 machines, multi-man on same machine. This also I have told that there can be a bigger setup for which 3 people are working on the same machine. Multi-machine and multi-man chart or multi-man and multi-machine.

There are multiple number of people, there are multiple number of machines. So this is maybe we can have different types. So basically we are trying to establish the interrelationship among the time, the man is spending while working and the time in which he is idle with the time for which the machine is working and then time for which the machine is idle. We are trying to perform a comparative analysis between these 2 important resources that is the machine as a resource and the man power as the resource.

Now this we have already seen just briefly that why do we need to draw the multiple activity charts so this gives you another idea in a very, very systematic manner so we are able to detect the idle time of machine and the workers.

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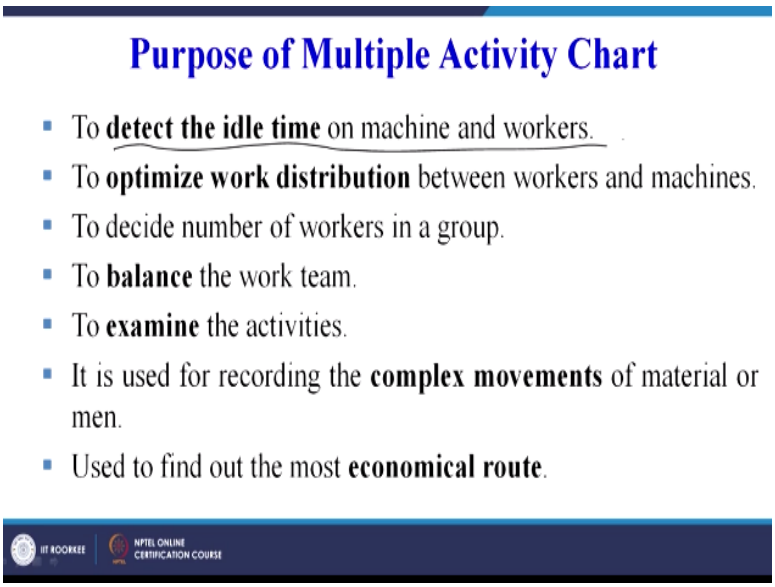

As I have already given an example an operator is making a hole or drilling a hole on a drilling machine. So we can very easily calculate that how much percentage of total time he is working and how much is the idle time for the worker and how that idle time can be utilized. So it will help us, the multiple activity charts will help us to detect the idle time on machine and workers.

To optimize the work distribution between the workers and the machines maybe the machine may also require certain rest period in order to function properly so in that case we can schedule our operations in such a way that we are able to utilize the idle time of the machine and the worker to ensure that those rest period.

So we can optimize the work distribution to decide the number of workers in a group that is also maybe an important outcome of the multiple activity charts if we see that a person is operating a single machine, but for 60% of the time he is idle because at that time it is having a long cycle time. The machine is operating in the auto mode.

So what we can do, we can ask the same worker to operate another machine in the vicinity or do some inspection or manual inspection of the parts produced by the machine during the same period. So that will help us to decide the number of operators that we require. So when we know that the person is going to be idle for 60% of the total time that he spends on the shop floor very easily we can utilize the time for some other purpose.

So it will help to optimize the work force size in the organization to balance the work team this is outcome, offshoot of the third point only, to examine the activities we will see that when we examine the activities when we systematically see that how the work is being done we will come up with better solutions and when come up with better solutions we save time both for the workers as well as for the machines.

It is used for recording the complex movements of material and man. So that is also one advantage of the multiple activity chart used to find out the most economical route. So maybe this is the specific to some specific type of multiple activity charts may not be relevant to each and every type of multiple activity chart.

Now we have understood what is the multiple activity chart, so we can see, as we have seen a two-handed process chart we know that we are going to see that what are the activities being done by the left hand, what are the activities being done by right hand on the same time scale we will plot them. Here by now we have understood we will see what the worker is doing. What mean when he is working, when he is idle, what means that does not mean that we are going to go into the detail that if he is making a mould for casting.

How he is making a mould, but mould making is one operation and we will try to time that operation that how much time he is taking for mould making and that time we will record. Similarly, the machine, when he is making the mould, suppose at that time our furnace is working. We are melting the metal so we will see at that particular time when the mould is being made the metal is being melted in the furnace.

So we are trying to establish a correlation, establish an interrelationship between the men and the machine as well as the activities both are performing to complete the job at hand. So how to construct that, it consists of a series of bars or columns placed against a common time scale.

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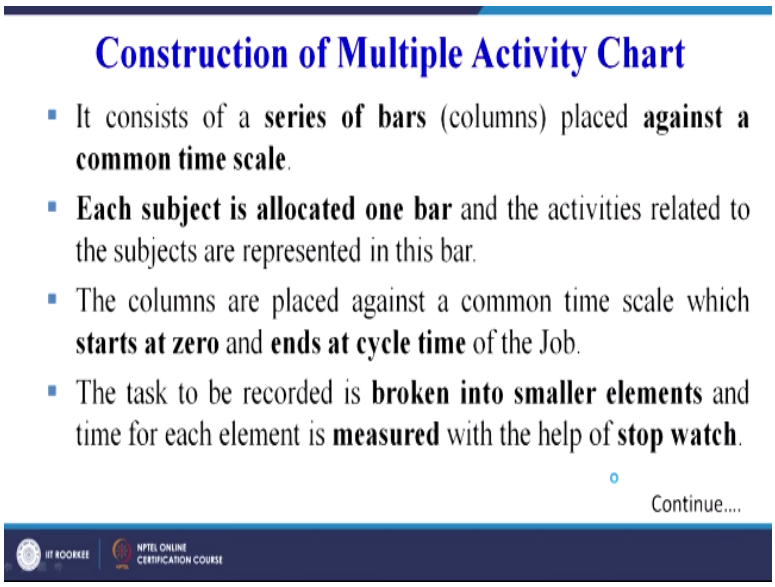

So we can have both ways, we can have different as we have seen the very first example the time was on the horizontal scale and the activities were on the vertical scale, but it can be opposite also. We can have the time on the vertical scale and the activities on the horizontal scale or we can have a time on the vertical scale, we can have bars representing what the man is doing for at what time he is working, at what time he is idle.

And another bar indicating when the machine is working, when the machine is idle. We will try to see this with the help of an example. So it majorly when we have to construct a multiple activity chart it has to be constructed in the form of series of bars or columns placed against a common time scale. Each subject is allocated one bar, so one bar means one column is given to each subject.

Now what is the subject, a subject is a worker or a machine and the activity is related to the subjects are represented in this bar. The columns are placed against a common time scale which starts at 0 and ends at the cycle time of the job. For example, the drilling case I have taken 6 minutes is the total cycle time, so from 0 to 6 we can have graduations of 1 minute each.

So 0-6 minute is though we can have one vertical bar representing what machine is doing and one vertical bar indicating what the man is doing. Suppose initially it is loading so the worker will be working, machine will be idle then drilling action is taking place, machine is working, worker is idle and then unloading is taking place. Worker is working machine is idle. So that way we can construct a multiple activity chart.

So the task to be recorded is broken into smaller elements and time for each element is measure with the help of a stop watch which I have already told that we will find out that for how much time the person. For example, I have taken the example of mould making. So we are not going to focus on the procedure a person is following for making the mould how he is ramming the sand, all that is not the object is our discussion here.

Or object of our recording here. We are going to only find out the time taken for mould making. So that we will measure with the help of a stopwatch. The activities are then recorded in the chart in their respective column.

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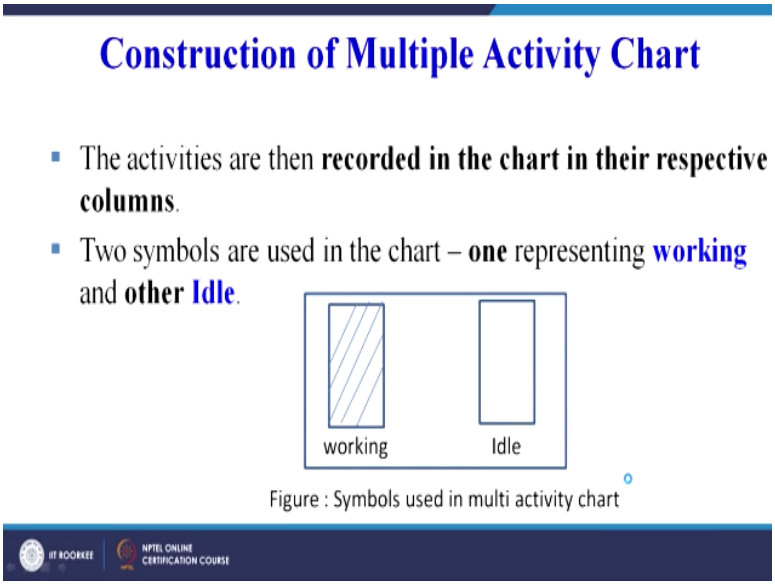

So we have a respective column for man, we have a respective column for machine and for machine we will record the activities when the machine is working, what it is doing, when it is idle, what is the time for which it is idle all that will be recorded on the bar representing the machine. Similarly, the bar representing the man we will record all these activities what the man is doing.

Two symbols are used all of you must remember one representing the working, the other is idle. So working is represented by this symbol and idle is represented by this symbol. It is written here. This is idle and this is working. So this we must remember the hashed portions are usually used for working and the blank portions are always used for being idle when the man or the machine is idle.

So basically just to summarize in 2 or 3 lines how to construct a multi activity chart we need to have a time scale, normally we use a vertical time scale so it starts from 0 to the total cycle time and then we will have individual bars and each bar will represent each subject. Now subject is a worker or it can be a machine. So when for a worker we will have workers.

What the worker is doing and for machine we will have different times, we will divide that bigger task into smaller work elements and for each work element we will record the time and put it there and then we will see how much percentage of time the machine is idle. For how much percentage of time the worker is idle. Now let us quickly take some examples. This is the first example.

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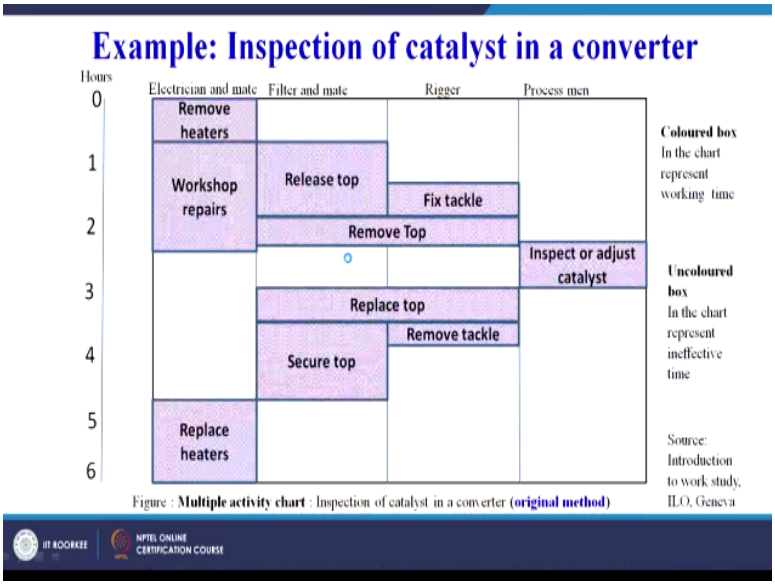

Let us first see that what we have tried to understand whether it is there, this is one-time scale. It is coming like this 0 to 6 then there are subjects this is one subject, electrician and mate, fitter and mate, rigger, process men. The coloured boxes are representing the working time. Which is the coloured box one example is this and the uncoloured boxes are representing the ineffective time, uncoloured boxes.

What are the uncoloured boxes this is the uncoloured box, this is also uncoloured box, this is also uncoloured box. So we have to focus only on the coloured boxes. Now see what is being done. Now this is inspection of a catalyst in a converter. So we can see that remove the heaters is the first task which is being done by electrician and mate, then workshop repairs are done, then replace the heater.

This is the job of the electrician and the mate. Then fitter and the mate release the top, remove the top and then replace the top and secure the top. Then rigger fix the tackle, remove the tackle. Then process men inspect or adjust the catalyst. So there are 4 different type of people who are working. So here the job is inspection of catalyst in a convertor and it is done on a time scale.

Now we can see that there is lot of idle time for all the men. So can we try to somehow understand the nitty-gritties of the process and try to do some of the things simultaneously so that we are able to save some time. So we can see that electrician and mate are also free from maybe 2.5 to 4.5, for some period of time the electrician and mate are free, similarly process men are free here, they are free here.

So for each one of them there is lot of idle time. So here we can see that how we can improve. Now here we can see some of the activities have been done simultaneously.

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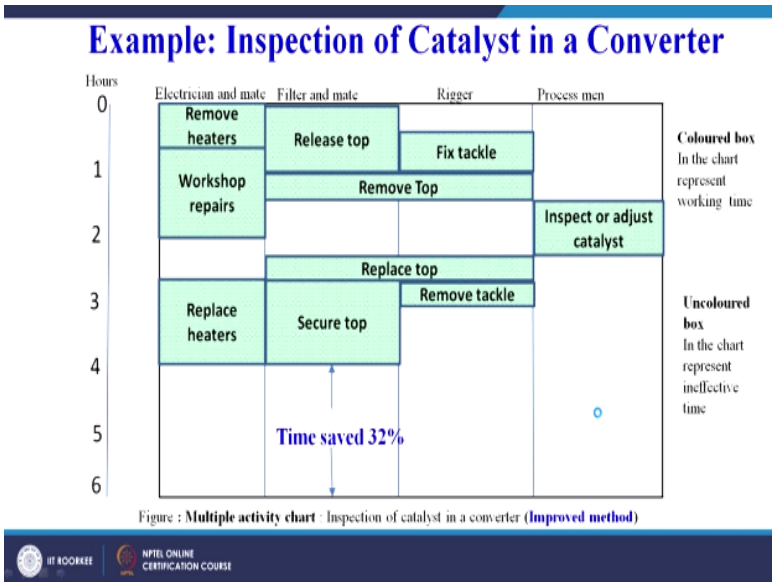

And the time saved is 32%, so interdependence of the activities is we cannot disturb that this activity can only take place after the predecessor activity has already taken place we cannot disturb this relationship but wherever possible we can try to club the activities or we can try to do the activities simultaneously wherever technically feasible and possible and try to optimize the time required for completing the task.

So here time saved is 32% and this is achievable only with the improved method. So here we can see that by slightly adjusting the sequence and as well as trying to do the things

simultaneously we have been able to save 32% of the time. Let us take another example. So this is original method.

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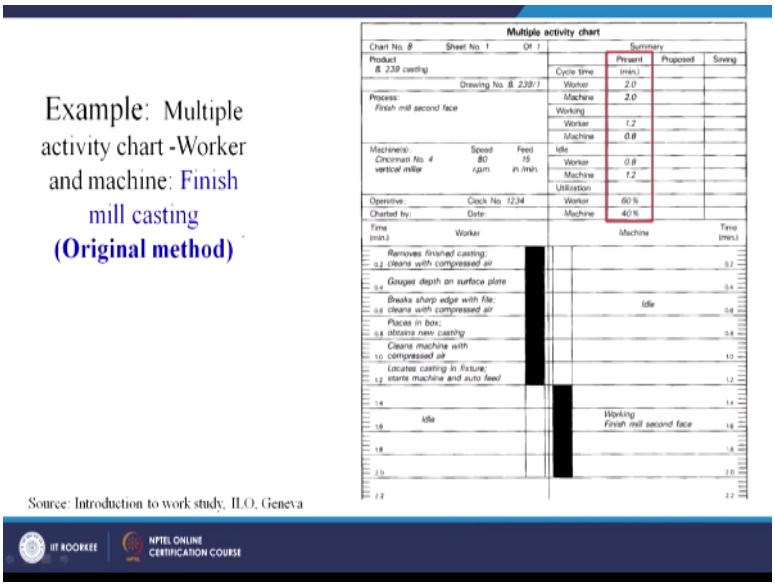

And this is for finish the mill casting, finishing operation for mill casting so what is the overall work being done in the current method. This is the worker, this is the machine and this is the time scale already mentioned on the screen this is the time. So solid portion here is depicting the working and the blank portion is depicting the idle time. Similarly, for the worker this is the idle time.

This is idle time for machine, this is the idle time for the worker. So let us try to see what he is doing, removes the finished casting, cleans with compressed air, gauges the depth on surface plate, breaks sharp edge with file, cleans with compressed air, places in box obtains new casting, cleans machine with compressed air, locates the casting in fixture, starts machine and auto fit.

So what the person is doing. He is taking out the casting measuring whatever gauge the depth on surface plate then the sharp corner then finishing operation is being done then cleans the machine again then he puts up the new casting and switches on the machine and puts it on the auto fit. So he is taking out unloading the casting, then doing few operations on that and then finally setting a new casting on to the machine table and starting the machine.

So during this period the machine is idle and once he starts switches on the machine after placing the new casting on to the table locates casting in the fixture, starts machine out of it

after this step the machine comes into picture and then working finish mill second face. So this is the you can say machine working. So we can see that this is original way of doing the work. Now what can be the improved method. So the improved method can be.

He removed the finished casting same as the previous method. Cleans the machine with compressed air.

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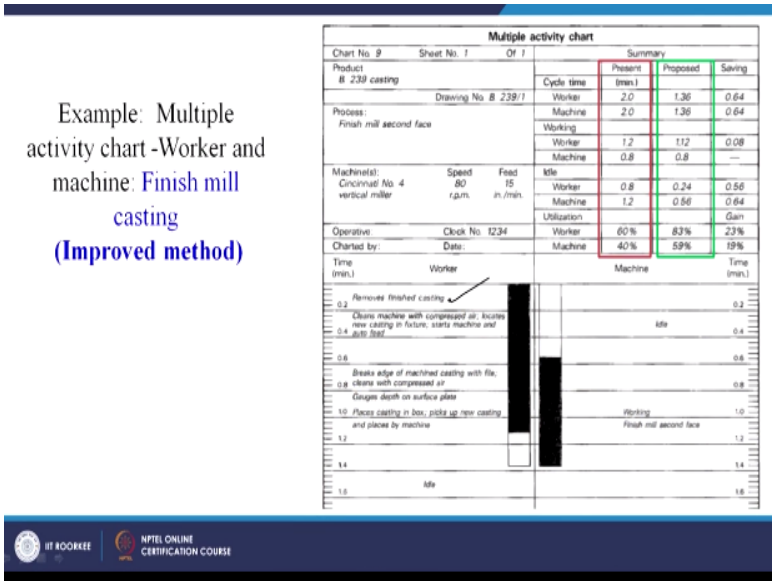

Locates the new casting in the fixture, starts machine and auto fit. So he starts the machine, the machine starts after this point. So this is the idle time only for the machine and then what he is doing he breaks the edge of the machine casting with file, cleans with compressed air, gauges the depth on the surface plate, places casting in box, picks up a new casting and places by the machine.

So what he is doing some work, some reallocation of the sequence he has done, some sequence has been changed, the amount of work that he was doing initially before fixing a casting on to the machine or a new casting on to the machine that work has been done simultaneously. Now here you see the machine is also working during this period and he is also doing some work which was earlier done before the start of the machining of new casting or finishing or new casting.

Simultaneously if you do the work we can have better utilization. So the summary we can see in present method utilization of worker was 60% and utilization of machine was 40%, but with this slight change in the sequence of work that he is doing the worker is now 83%

efficient and machine is 59% utilization is there. So we can see that now we are utilizing both our subjects, the worker as well as the machine properly.

So by slightly telling the worker that how he must perform his task we have been able to improve the utilization of the time that for which the worker is spending in the industry as well as the capability of the machine also we are utilizing to it is full or to it is maximum. So that is the way the man machine chart can help us to improve the way we are doing our work. So the present method was not that effective and efficient but the proposed method of doing the work is better as compared to the current method of doing the job.

So this is the man machine chart for the improved method. Now what are the applications of multiple activity charts they can be used in maintenance, they can be used for reducing the idle time of machine and operator which is already highlighted.

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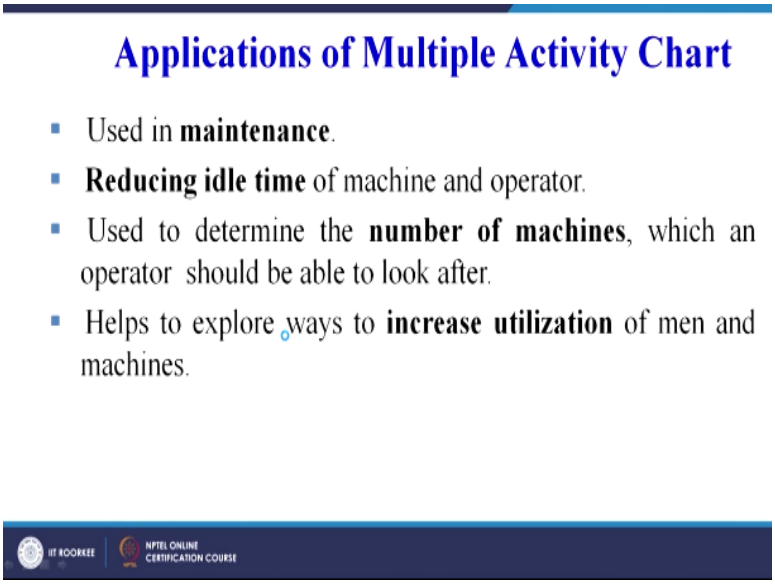

Used to determine the number of machines which an operator must be able to look after because this I think I have already explained that if the worker is idle for 60%-70% of the time that he spends on the shop floor he can be allocated another machine on which he can work and improve his efficiency also as well as the organizational efficiency also. Helps to explore ways to increase utilization of man and machine.

The last case study that we have taken. So we have been able to improvise or improve the utilization of the worker also as well as utilization of machine also by slightly educating our worker the way he must sequence the various work or work elements that he is doing on the

casting. So if he is able to sequence them properly he will be able to be more efficient and more productive in discharging his duties.

So with this we come to the end of today's session in our next session we will try to conclude the discussion on this week that is focusing on the different graphical tools that are used for performing the method study. Thank you.