Work System Design

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Lecture - 19
Operation Process Charts

Namaskar friends. Welcome to Session 19 in our course on Work System Design. And as you are well aware that currently we are in the 4th week of our discussion and today is session 19th that is this is the last but one session for the 4th week. In 4th week if you remember our focus primarily is to understand the basic concept of method study which is one of the techniques of work study for improving the way we are doing our work.

And why do we need to improve the current method of doing the work? Because each and every organization wants to improve the productivity, the productivity maybe in terms of labor productivity it maybe in terms of economic productivity it maybe in terms of the time productivity the better utilization of time.

So all of us are doing one or the other kind of work and always we want to improvise always we want to improve the way we are doing the work in order to be more efficient and more effective. And for that first you need that how we are doing the current work; what is the current method, what is the sequence we are following; what is the correct sequence that we are following today, whether that can be corrected further, whether it can be improved further, whether it can be modified in order to reduce the time taken for a completion the work that we are doing.

So with that objective we try to record the way we are doing the work. So if you look back at what we have discussed in the course till now. In the first 2 weeks we have discussed regarding productivity and the various causes of low productivity; what are the improvement techniques also we have covered the factors affecting the productivity. Why that was discussed I have just now highlighted.

Because we need to understand that when we try to improvise on the current way of doing the work the productivity is bound change; it can in some cases decrease also. But when we cannot

stop developing better methods of doing the job. So our target is that we find out the best way of doing the job so that our employee productivity overall improves. So with that objective we try to find out the better methods of doing the job. And then in the third week our focus was on work study and in work study we have covered the different techniques followed in work study.

Also we have seen the basic work content; the excess work content, why excess work content is added; how we can avoid the addition of the excess work content. So we have seen the behavioral aspects of work study and then we started learning the techniques of performing the work study and in those techniques we have seen 2 important techniques that is, the method study and the work measurement.

And in method study our discussion will be for it is a longer topic it is maybe very exhaustive topic so we have dedicated 4 weeks of discussion on method study and thereafter we will move work measurement or time study. So method study the very first week our first session was on the basic concepts of method study then what we have done we have seen what are the various steps for conducting a systematic method study.

In the last session, we learned about the various recording techniques that are used for method study and today we are going start our discussion regarding the very first technique that is the operation process charts. Usually, if when we do the work study when we analyze the work being done in any organization we can divide the work in a very, very hierarchical and methodological manner. Now what can be this hierarchical method?

If you see if we look if suppose I am a work study analyst or I want to conduct the method study, I enter into some factory where maybe the metallic poleis are being metallic poleis. So obviously, there will be maybe a carpentry shop where the patterns are being made regarding the different designs of the poleis then there will be a foundry shop from where they are making the mold there will be Furness where the metal will be melted and poured into the molds.

Or there can be few hot chamber or cold chamber die-casting or permanent mold casting techniques also. So basically, I am entering into a factory or the example I have taken just to

explain the concept. I have entered into a factory. Now, when I have entered into a factory I need to see what is the overall sequence of operation been followed in the organization. So I want to learn the whole system.

So I may do work study at the system level I may see what are the various movements material, what are the various movements of men, women, workers who are working in the organization, what is the movement of the maybe material from one place to another to one shop to another shop so that all I will learn. So I am learning the system. Next level of my learning will be I will say okay foundry is being done foundry operations are okay.

Let me focus on the carpentry shop, so maybe on the carpentry shop I will go there and try to understand the turning operation on the wood working lathe. So now from the system level I have focused on the operation level, now I am coming to single operation of wood working lathe and trying to understand that how the work is being done there. From there I may even go to the level that how the worker is doing the job.

How he is picking up the tools, where the tools are placed, what are the movements of his body, how he is moving his torso, how he is utilizing his feet, how he is using his fingers, so from the system level to the operation level to the we can say micro motion level so the analysis of the work can be done at different levels. So maybe some times we may say from system level to the process level then to the operation then to the micro you can classify them as the company is there or as per the work methods of the company.

But this is the broad classification from the higher level to the basic micro motions the worker the movements of his body parts. So the operation process chart where do these fit in, so these fit in among the overall system view of the organization. So operation process chart will give us how the work is being done what are the various broader operations been followed in the organization.

What is the movement of man and material, what is the movement of finished goods, where we are introducing some subassemblies into the system? So it is a system representation or the

various operations and processes is being done at the system level. So that is very important that we understand that where this particular chart is going to be utilized. So it is our larger perspective it will provide us.

So let us now quickly try to understand that how we draw the operation process charts. Very quickly I will read the things for you, if you remember that where operation process chart is used very easily with one or 2 example you will be able to relate with it. Then for practice maybe if the learners are from a specific engineering institute you can try to draw the operation process chart in the workshop.

You take one product and try to visualize that if this product has to be made in our workshop, what sequence of operations or what sequence of labs or what sequence of shops it will travel make the shop, make the layout and then you can try to make the operation process chart, take one example and try to solve it.

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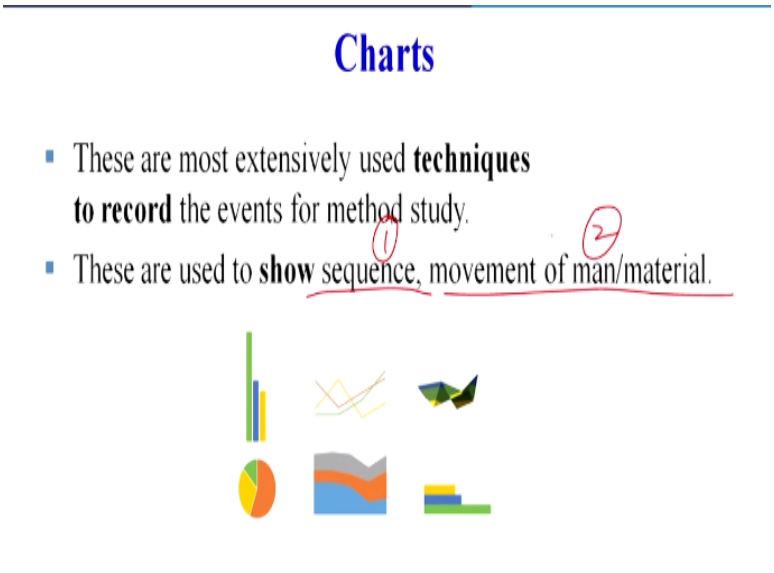

So these are most extensively use techniques to record the events of the method study. So these events can be the different operations or processes being carried out. These are used to sequence movement of man and material. So 2 things will be shown first one is the sequence and a second is the movement of man and material. So how this will be show, that we will see with the help of an example.

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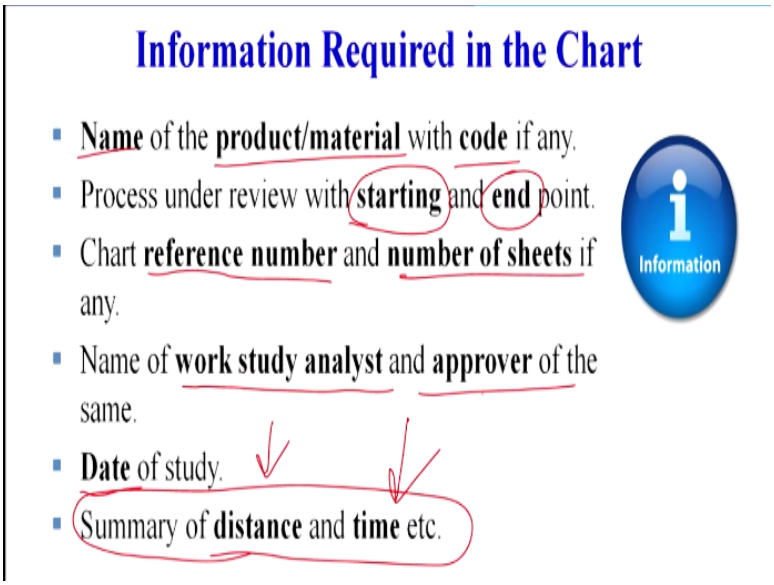

So what is the information required when we need to draw the operation process chart? First one is name of the product and material. For example, I have taken an example of metallic pulley so that is my product and material and if there is some code then we have to put the code in the operation process chart. Process under review with starting end point. So we must be completely aware the starting and end point of the sequence that is being followed for manufacturing or fabricating or processing that material.

Chart reference number and number of sheets maybe from the clerical point of view, name of work study analyst from HR point of view and approver of the same, the date of the study, summary of the distance and time travel very important from the engineer's points of view because we need to optimize on the distance been travelled by the material we need to optimize the time required for completing the task where these 2 are going to be an important.

Or are going to be important criteria based on which we will develop our better method or a new method of doing the same task. So we must record these 2 things accurately that is the distance travel we will see in string diagrams that how we can optimize on the distance traveled by man and material and the time, so 2 things we must be very, very sure about when we are drawing the operation process chart that what is the total distance travelled and what is the time taken for completing the task.

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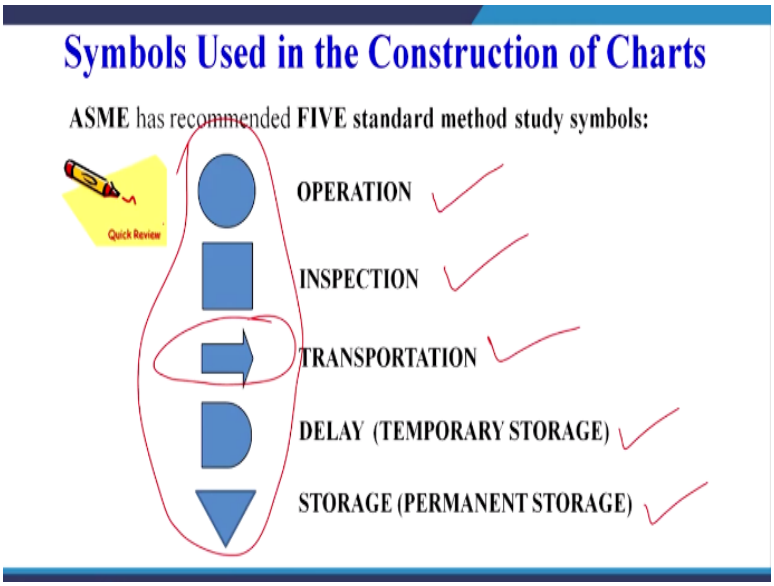

Now this is something which we are revising today. These are the standard process chart symbol as given by ASME. So operation maybe turning, drilling, milling, painting then inspection maybe we are weighing the tins ghee or we are measuring the length of the hockey stick produced by a company so it can be terms of length measurement it can be terms of weight measurement it can be in terms of measuring the surface finish of the surface produced after the turning operation a new machining operation, so inspection.

Then transportation the symbol is very, very clear an arrow so it indicates transportation, Delay and Storage. So these are the 5 standard symbols. So we will be using these symbols for drawing our process chart. So we will see this with the help of an example and these symbols we have seen in the previous session also. Let us see one-by-one with the help of an example.

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Now operation indicates the main steps in a process or the method or procedure, so main steps so maybe cutting drilling, milling, painting all these maybe the main steps in any process. Usually, the part material or a product concerned is modified, it maybe modified in shape or some material may be removed or some material may be deposited on top of the base material, so the basic material is getting modified or changed during the operation.

So examples are given turning, drilling, milling you can have other examples also, if you are painting it can be one example or there can be other examples you can think over for which operation is one thing, one thing can be cutting can be another example of an operation. So this is we will see now these you can see as per the diagram this is depicted a person is trying to fix this particular board into the complete Jigsaw puzzle. So this is a one operation been conducted by the person.

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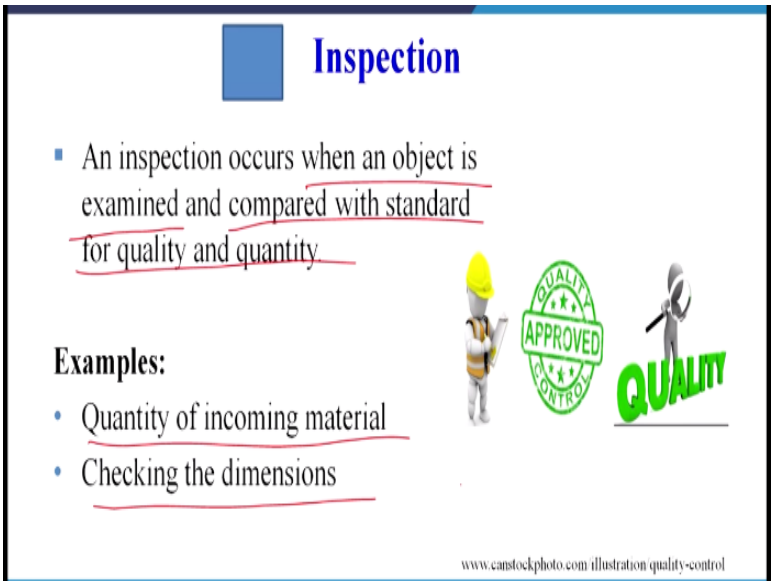

What is inspection? As the literal meaning the inspection is to perform some task for checking or measuring or comparing with the standard value so that is the basic concept of inspection and inspection occurs when an object is examined, so when an object is examined and compared with the standard for quality and quantity.

So you maybe sometime be checking the quality what is the surface finished produced, you maybe sometime checking the quantity maybe 1 kg has been put into the box or not, what is the weight of the box or what is the length of the scale that you have manufactured so that all these operations or all these activities will come under inspection. So examples can be quantity of incoming material, checking all the dimensions as I have told the length of the hockey stick.

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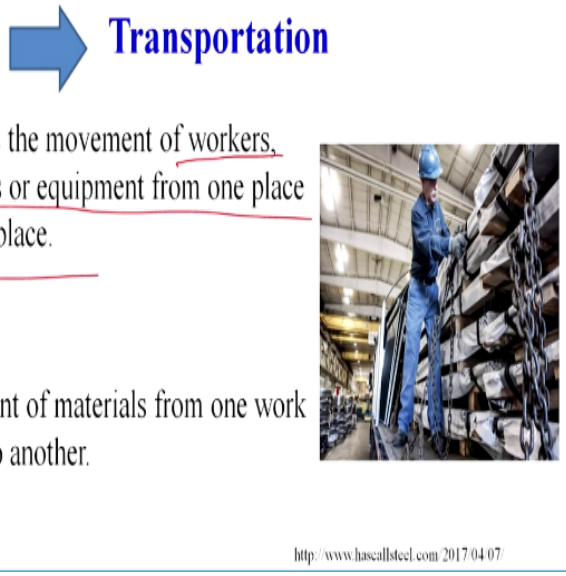

Then transportation the symbol itself is very, very self-explanatory indicates the movement of workers, materials or equipment from one place to other place. Example is movement of material from one work station to the another work station then the next one is Delay. So the first 3 are very, very self-explanatory operation, inspection and transportation.

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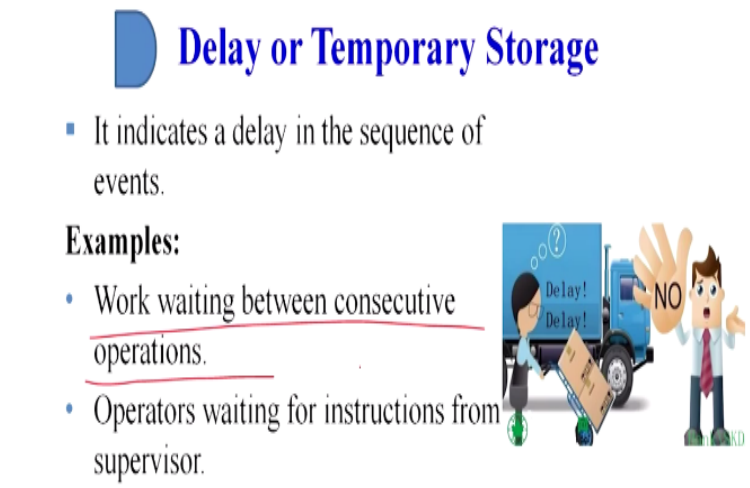

Now delay it indicates the delaying the sequence of events examples are given. Work waiting between consecutive operations. So there can be work-in-process so some material has got piled up in front of the machine it is waiting to be processed so it will represent a delay or the operators waiting for instructions from supervisor so that is also a delay.

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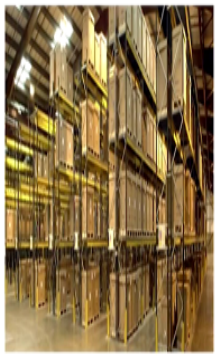
Storage or Permanent Storage

- Indicates a **controlled storage** in which material is received into or issued from a store.



Example:

Materials kept in stores to be distributed to various work centres.

Storage or permanent storage indicates a controlled storage in which material is received into issued from a store. So material kept in store to be distributed to various work centers. So the materials kept in stores will indicate storage. For example, how storage we will use in operation process chart.

Now the first thing maybe the raw material that we are using for preparing or for fabricating our metallic poleis may come from the raw material may come from our warehouse or storage. So from there we will first indicate an inverted triangle as it is given here. So first operation is storage the material is already stored in the store from there it will be transported to the first place where the operation has to be done.

So storage followed by transportation followed by suppose it is cut into respective so it is followed by operation then we can check whether we have cut it properly or not whether the dimensions are accurate then it will be followed by inspection after inspection suppose it is going to be join together 2 sheets have to be join together or if we take example of metallic pole suppose it has machined after cutting it into desired length.

So cutting is also an operation then measuring it whether we have cut the right length is inspection and then further removing the material from that machining or a turning machine or on a lathe machine we will say it is again an operation. So now we will not talk in language we

will talk in symbols and symbols can further be slightly maybe one word or 2 words can operation being done at this particular place whether it is the inspection, what is being inspected.

So very quickly we will see one example of operation process chart. So then sometimes at single place 2 or 3 activities maybe going on simultaneously so there we can use the combined activities for example the example is given here.

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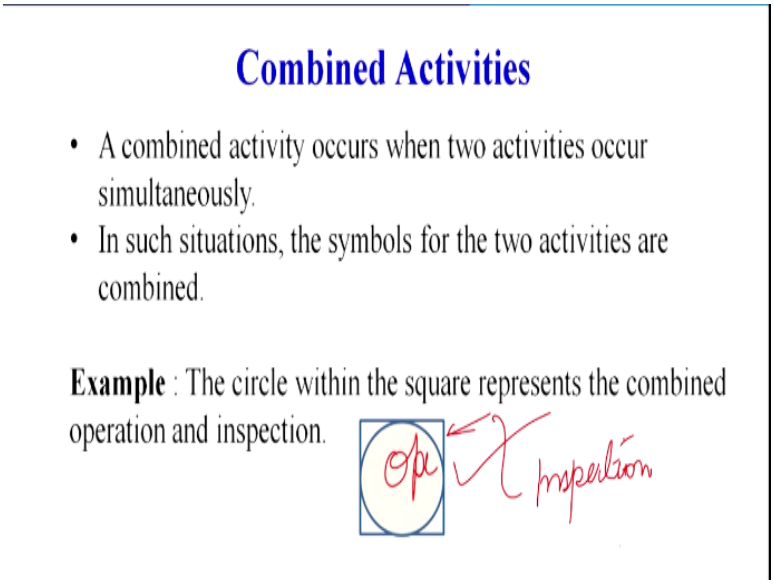

The circle represents an operation and the square represents an inspection. So wherever inspection—so wherever we have this symbol very easily we can say that here the operation and inspection are being done simultaneously. The circle within the square represents the combined operation and inspection. So we can have combination of 2 symbols also. Now when we combine all these symbols it makes a chart. Now the operation process chart it is also called outline process chart.

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Operation Process Chart: Introduction

- It is also called **outline process chart**.
- An operation process chart gives the "**bird's eye**" view of the whole process by recording only the **major activities** and **inspections** involved in the process.
- Operation process chart generally uses **two symbols**, i.e., **operation** and **inspection**.

An operation process chart gives the already I have told that when you are entering into the organization and you are trying to look at the broad system as a whole you will be drawing a outline or a operation process chart. It gives you a bird's eye view. For example, you look view want to observe the movement of man and material within a factor so you go to a high rise building and from there you are able look that how the material is moving how the people or the workers are moving.

So it is a bird's eye view that you have for the organization or the factory or the enterprise and that you draw on a piece of paper that is basically representation in black and white or in the form of a chart and a chart we call as an outline or an operation process chart. So an operation process chart gives the bird's eye view of the whole process where recording only the-- this is very, very important it is major activities and inspection involved in the process.

As I have told you when we are doing the work study when we are conducting the study when we are performing the work study we can do our analysis at the system level. We can do our analysis at the process level. We can do the analysis at the operation level. We can do our analysis at the micro motion level where we are indicating how the fingers of the worker are moving.

So from a system level to the micro motion level we have different levels of work study and this particular chart operation process chart it is at the top level where we are having bird's eye view it is a broader picture of the work being done and it only focus on the major activities and the inspection is being carried out by the factory. So operation process charts generally uses 2 symbols.

So although there are 5 symbols but most of the time you will see that operation and inspection symbols is been used.

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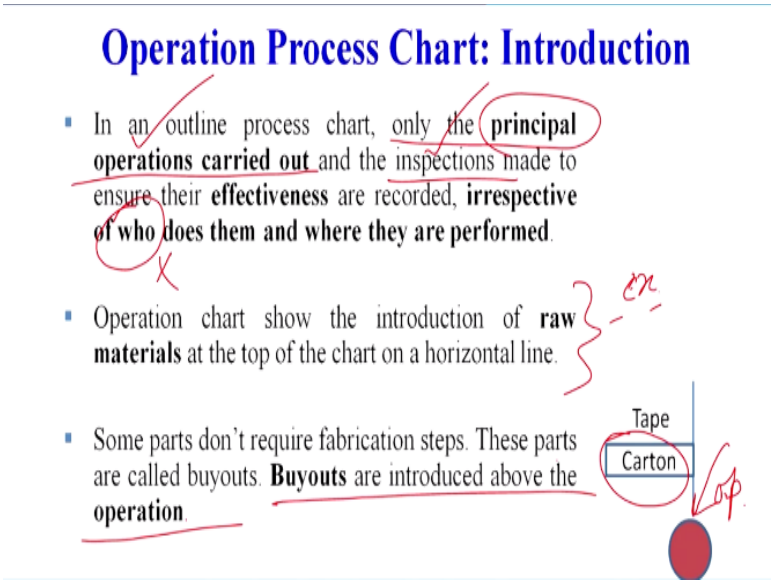

In an outline process chart or on a operation process chart only the principal operations are carried out, so principal is important operations are carried out and the inspections made to ensure their effectiveness are recorded, so basically their focus is on operations and inspection as has been cleared in the previous slide also. The (()) (19:58) made to ensure effectiveness are irrespective of who does them.

So here who is doing is not that important we are only focused on the sequence and the operation and the process is been carried out and where they are performed, who does them and where they are performed, so that may not be that relevant. So the sequence is very, very important. Operation chart show the introduction of raw materials at the top of the chart on the horizontal line, this we will try to see when we see the example.

So we will try to understand this with the help of an example that where the material is depicted. Some parts do not require fabrication steps. These parts are called Buyouts and Buyouts are introduced above the operation. Now this is representing the symbol of operation and this maybe a carton is bought from some other person and it is introduced into our operation process charts, so something has to be packed in the carton so the carton is introduced as it is.

So that is what is called as Buyouts. So we are not fabricating the cartons. Suppose carton is also fabricated within our premises within our factory we will have a maybe line depicting the sequence of operations involved in making of carton also, but if suppose you are buying it from outside it will be called as a Buyout and it will be introduced into our operation process chart wherever it has been used. Now what is the importance?

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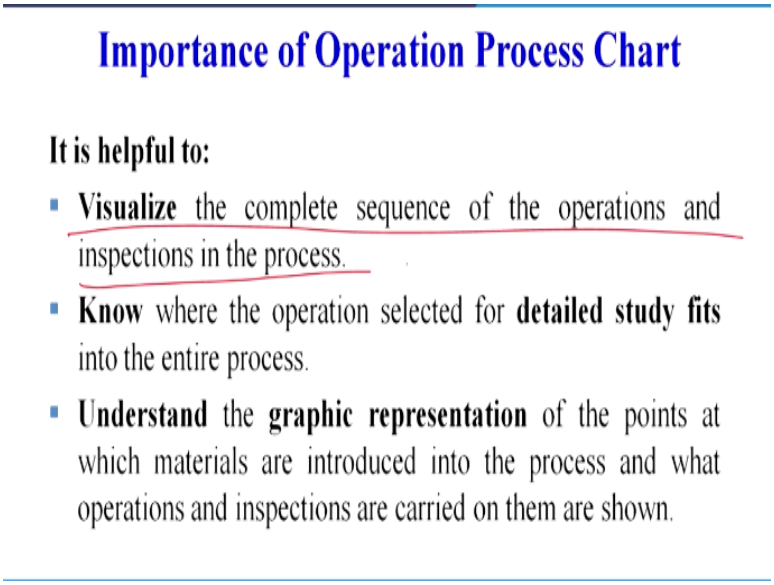

It will helpful like, we have understood operation process chart. Now what is the importance of this chart it helps us to visualize the complete sequence of operations and inspections in the process it will give us a bird's eye view. Now suppose some new person is joining the organization so he need not visit each and every shop and each and every place.

He can only have a bird's eye view of A4 size sheet where we can see where which operation is taking place where the inspection is taking place or what is the sequence that the material is

following from being converted from a raw material into the finished good. Know where the operation selected for the detailed study fits into the entire process, so we are focused on the system from there we can select the operation where we want to do the detailed study.

Understand the graphical representation of the points at which materials are introduced into the process, and what operations and inspections are carried on them are shown. So basically we are as we have taken an example in the previous slide the Buyout, now where the Buyouts have been introduced, what are the operations being done and what are the inspections being done are clearly depicted in the operation process chart.

And when we look at these we are able to understand very, very clearly, in a very, very elaborate manner we are able to understand that what is the sequence being followed, what are the inspection being done, what are the operations being done on the different subassemblies and where they are assembled together and where the final product is ready all that is depicted on the paper with the help of operation process chart. Now steps for construction of a chart.

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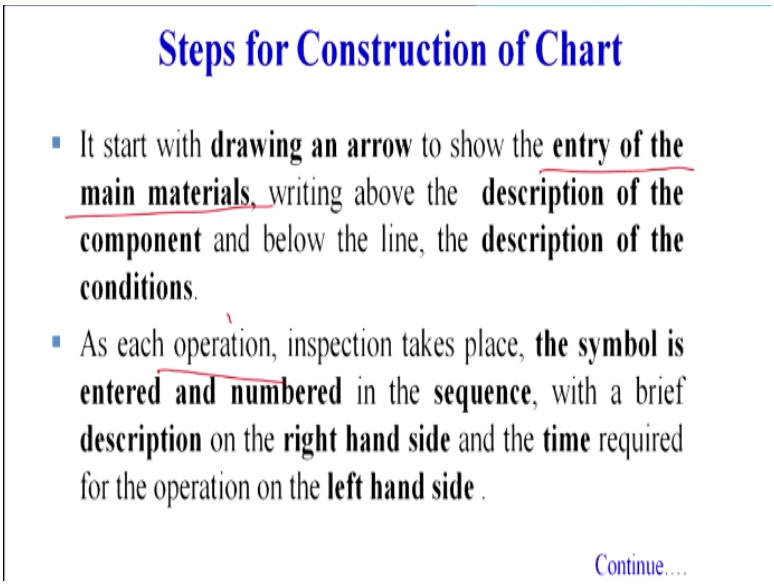

It starts with drawing an arrow to show the entry of the main materials, so it will show entry of the main material from where they are coming, they may be coming from storage, so there we will depict in maybe inverted triangle so that, that shows that the from the storage the raw

material is entering now into the fabrication shop. So it shows the entry of the main materials, writing up the description of the component and below the line the description of the condition.

So we will try to understand this with the example. As each operation inspection takes place either it will be an operation or it will be inspection So as operation takes place or an inspection takes place the symbols is entered and numbered in the sequence. Now suppose 4 operations are taking place, we will see where the first operation is taking place, we will draw a circle and inside that circle we will write 1 then maybe it is inspected it will be a square.

We will write the first inspection then after the inspection the second operation is taking place, we will draw a circle and put 2, so if by looking at the number written inside the circle we can very easily say this is a 7th number operation in the whole sequence of our operation process chart or of our system or of our procedure. As each operation inspection takes places the symbol is entered a number in the sequence with a brief description on the right hand side.

So we may write cutting, if the material is being cut on the right hand side briefly we will write a cutting s taking place, and the time required of the operation on the left hand side. So if you draw a circle right hand side we can write maybe for you right hand side will be the right hand side we write operation name of the operation left hand side we write the time taken. Maybe after this we have an example which will clearly indicate how are operation process chart will look like.

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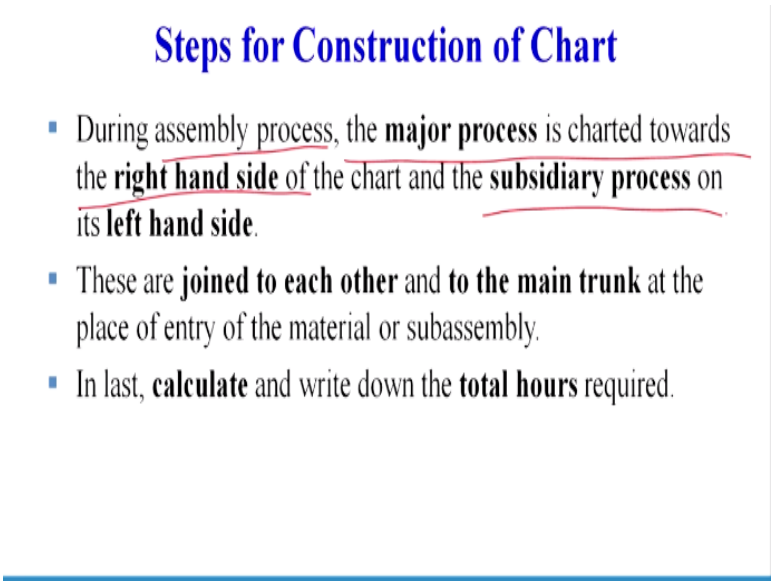

During assembly process the major process charted towards the right hand side of the chart and subsidiary process on the left hand side. Now suppose there is assembly operation 2 or 3 different materials are getting fabricated then these 2 subassemblies are getting fixed into the main assembly so the main assembly line will be towards the right hand side of the chart and there can be 2 subassembly lines also maybe after 3 or 4 operations been done on the subassembly.

It will finally get assembled into the main assembly or the main body of the product. So that the main body will be on the right hand side that is the during assembly process the major process is charted towards the right hand side and all the subsidiary process maybe small subassembly small component that have to be put into the main component of the major part are on the left had side. These are joined to each other and to the main trunk at the place of entry of the material or subassembly.

So where this material is fixed into the main part or main product there it will join the main line or the main trunk. In last, we calculate and write down the total hours or total minutes taken for carrying out the operation. Now this is I think very, very clear.

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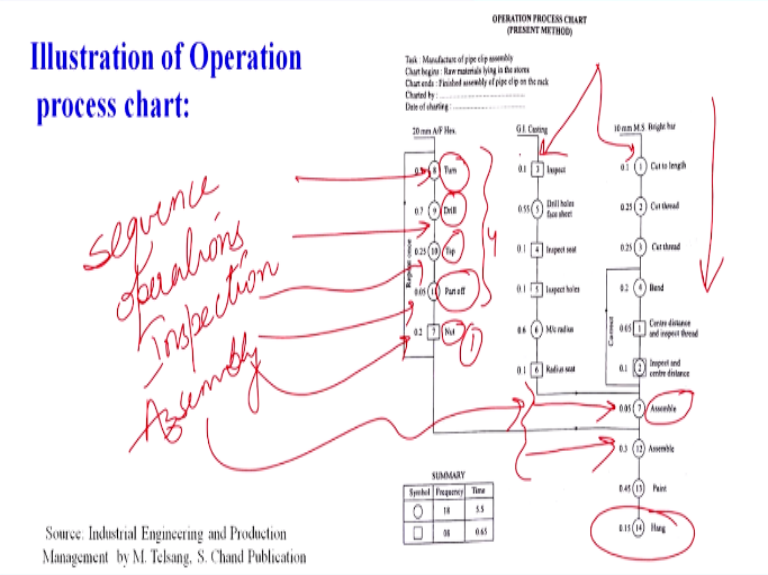

So here we can see this is an operation. This is also operation. So as was indicated we will write briefly the name of the operation so here it is Turn maybe turning then Drill again there is operation Tap then again operation Part off then there can be an Inspection that is Nut so you are inspecting there. So there are 4 operations taking place and one inspection taking place here. And as was indicated on this side we will write the time taken so the time here maybe in hours.

So this way we will see, this is one part this is our main as we have seen main trunk, now these are the 2 parts G.I C and 20 millimeter A/F Hex so these 2 parts are now coming this is being introduced at this place, it is you can see here it is written assembled and this is being introduced at this place and this is the final operation being done.

So if you see look at this operation process chart majorly there were 2 symbols only which are being used. Now these 2 symbols are one is related to inspection and another one is related to operation which has already been highlighted in the previous session that in operation process chart we are going to use these majorly 2 symbols-- these symbols are symbols of a operation and inspection, in this way we can see what all information is available here.

The sequence is clear. What are the various operations is being done is clear by looking at this and where the inspection is being done that is also clear and where the assembly is done is clear, where means that at what point we are doing the assembly? These 2 lines are indicating 2

different parts that are been produced there are operations there are inspections so 2 different parts are coming and getting assembled into the main part.

So this is the way operation process chart would look like. Now important points for preparation, so if you have understood what is OPC or Operation Process Chart quickly I will read it for you, what are the points to be taken care of. Already, we have discussed this.

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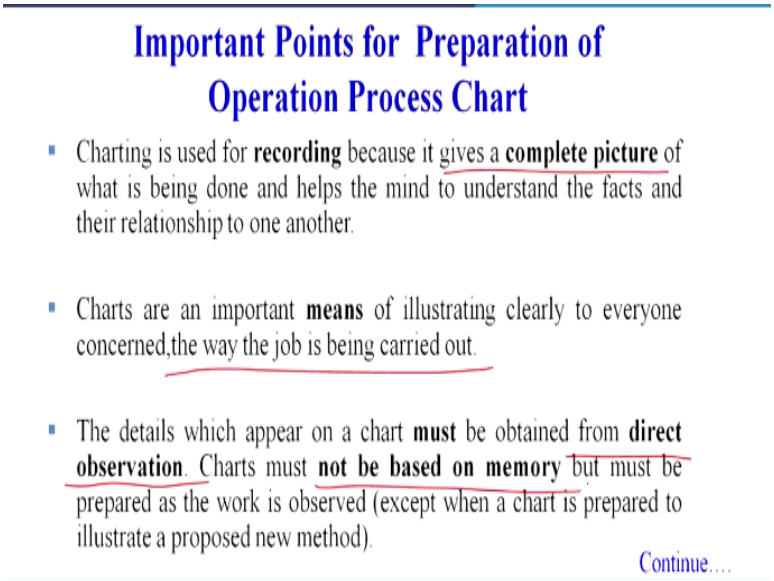

Charting is used for recording because it gives complete picture of what is begin done and helps the mind to understand the facts and their relationship to each other. So the relationship among the various activities that what is being done in terms of the various operations and inspection or the various activities and what is the relationship among them.

Charts are an important means of illustrating clearly to everyone concerned help us-- each one of us to understand the way the job is being carried out. The details which appear on a chart must be obtained from the direct observation, so then we want to draw the chart you must go observe and then draw the chart. Charts must not be based on memory because sometimes we may go wrong also, but must be prepared as the work is observed except one a chart is prepared to illustrate the purposed new method.

So when you are proposing a new method so then we have to use our imagination, we have to use our creativity, we have to use our creative skills to develop a new method, in that case we can draw it without going because we do not have that method of doing the work. But whenever there is a current method of doing the work we must go there, observe and then draw the chart instead of relying on our memory.

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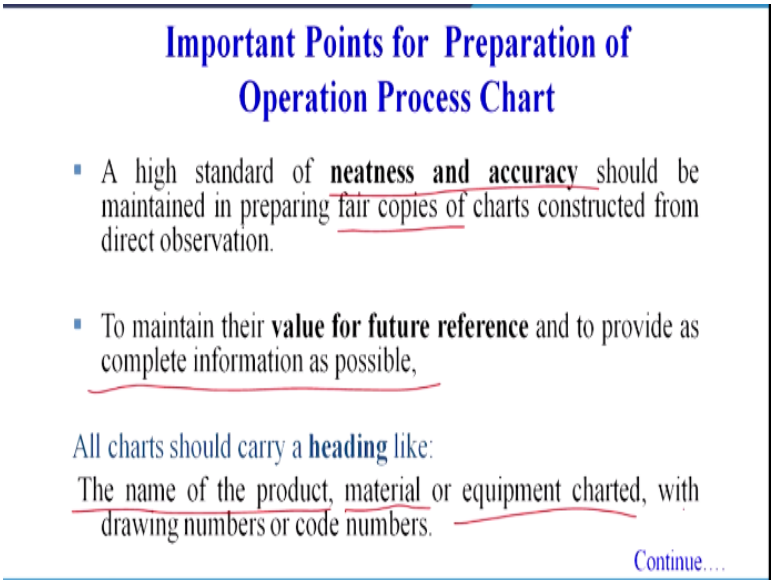

A high standard of neatness and accuracy should be maintained in preparing the fair copies of charts after direct observation. To maintain their value for future reference and to provide as complete information as possible. So we must try to produce as much as information or we must try to put as much information as possible on the chart or all charts must carry a heading like the name of the product.

So the heading, name of the product must be there, material or equipment must be listed there with drawing numbers or code numbers so which is also important. Finally, before leaving the chart check the following points.

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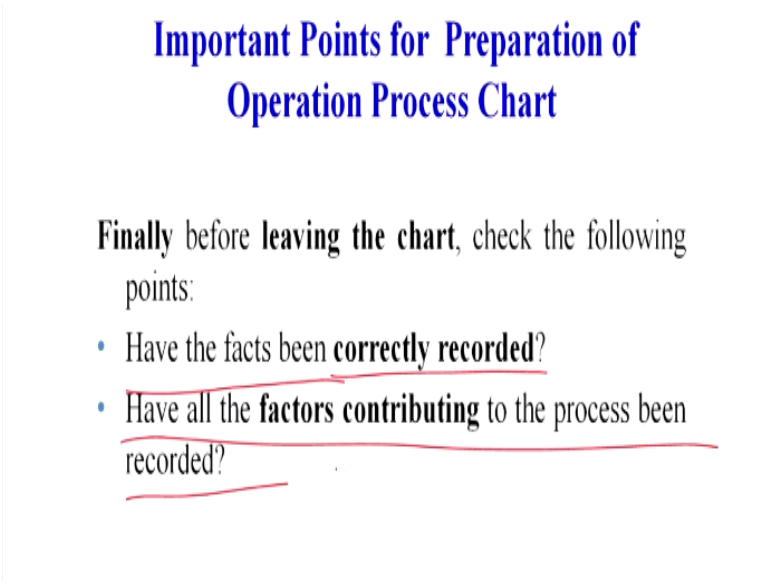

Have the facts been correctly recorded? This we have to check and have all the factors contributing to the process has been recorded. So basically, we must see that as much information you can put in the chart we must take into account all the information. So lastly, we can see what are the advantages of the operation process charts.

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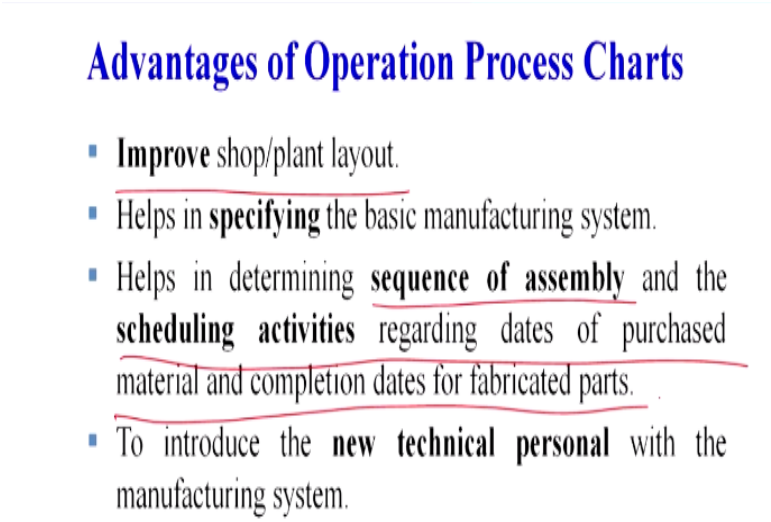

So they can be used to improve the shop and plant layout where we have the bird's eye view. We have depicted the whole operations inspections and activities happening in the factory with the help of the process chart symbols. We can look at the chart and try to see that there is a unnecessary movement of material or there can be a combination of processes or operations at one place.

There can be a elimination of certain operation, so all that will help us to improve the layout and we will save in terms of the man hours; we can also say our effort also, we can say that the time taken for the performing the task, so the benefits can be numerous and varied. But overall the operation process chart can be used to improve the shop and plant layout.

So when we change the layout we will see with the help of example and case study that when you change the layout you derive different types of benefits. Helps in specifying the basic manufacturing system, so we are now not required to go to each and every section maybe at one place only we can have a data which will be able to depict the overall manufacturing system on a piece of paper in the form of operation process chart.

Helps in determining the sequence of assembly and the scheduling activities regarding dates of purchased material and completed, dates for fabricated parts. So it helps in determining the sequence of a assembly that when we look the example we have taken all sequence of operations and inspections was clearly earmarked and based on that we can have a overall picture clear to us then also it will help us in scheduling the activities regarding dates of purchased materials.

Now suppose somewhere we are introducing a Buyout into the system, so we can very easily see that Buyouts will be required, what is the quantity required and can help us schedule our procurement process also. To introduce the new technical personal with the manufacturing system.

Now suppose there is a group of engineers or there is a group of workers who have joined the organization, so instead of taking them around that must also be done, we can give them a copy of the operation process chart very easily if they know the symbols that is the circle represents an operation and the square represents in inspection and the arrow represents the transportation.

If they have basic information about the symbol just at looking at the operation process chart they will be clearly able to understand that what is being done, what is a sequence of operations, where the inspections are being carried out, so they will be able to understand the complete

picture the complete detail of the work being done or the sequence of operations being carried out in the industry or the factory.

So with this we conclude the today's session. In next session, we will try to understand the operation process chart or the applications of the operation process chart with the help of an example. Thank you.