Work System Design
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Lecture – 28
Micro-Motion Study

Hello friends, welcome to session 28 in our course on work system design. As you are aware that currently we are discussing method study and in method study we have learnt various graphical tools to represent the way we are conducting the work or the way we are performing the work. One important thing I would like to again emphasize today or revise today that the work is being done in the shop floor and the analysis for the overall work can be done at various levels.

This we have already seen that if we analyze the work on a broader scale that what is being done or what are the operations being done what are the sequence of operations being done in the factory. So, the factory level we have to analyze the work we will use different graphical tools maybe when we focus on one particular department we have to analyze the work we use different graphical tools

And when we go to the machine level when an operator is performing on a machine you may use a different graphical tool or we may use their different technique of analyzing the work or for recording the work or for comparing the different methods of doing the work. Today we have seen or we are going to see on your screen micro motion study. So, today we are going to go to the most elemental level of work classification.

That is when a person is performing the task manually on any given machine or using a particular equipment what are the basic very, very basic very, very fundamental a very, very micro level of motions that are done. For example, I have just know maybe put my hand here so this is one motion my hand moved from here and then I have just I had an itching feeling here so I have just rubbed my hand on my face like this.

So, going to that micro level of understanding micro level of examining why do we need to examine because of an overall objective or our target is to find out the best methods of doing the

work. What are the best methods that we have already seen in the introduction to method study? So, coming back again or refereeing back to the various graphical tools that we have studied we have seen operation process chart.

Or birds eye view or a broader picture of the work being done in the organization and then we have seen a flow process chart it gives more detail as compared to the operation process chart. Then we have seen a multi activity chart in multi activity chart how a man is operating for what period for what time man is working when he is idle or a single man is operating 2 machines for what % of the time person is working for what percentage of the time machine is working.

All that in man machine chart we can see then we have also seen 2 handed process charts that when the left hand is doing the work what is the right hand on a time scale we can plot. And we have seen an example in which we have tried to assemble a nut and a bolt. And we have used the process chart symbols to draw this 2 handed process chart. So, you may question or this may come to your mind that what can be the difference between a 2 handed process chart.

And the micro motions study because there also we are analyzing the movement or the activities being done by both the hands simultaneously. So, there has to be a difference between the 2 that is the operative 2 handed process chart is different from the micro motion study. In a way that micro motion study is even further detailed study all of the work being done. So, 2 handed process chart if you remember we use the process chart symbols there.

What are these symbols? These symbols are circle for operation then we have a symbol for the hold a symbol for transportation a symbol for inspection which is mostly avoided. So, in case of 2 handed process chart if I remember correctly we have already discussed that. So, these symbols are basically used for making the 2 handed process chart but in micro motion study we use a completely different set of symbols.

So, maybe one activity this is important that one that one activity that we depict in a 2 handed process chart may further boil down or may further ramify into 2 or 3 different symbols or 2 or 3 different micro motions. So, once again I reiterate that one activity of a 2 handed process chart

can be further divided into 2 or 3 basic motions and what are those motions those are called the micro motions and the study of the micro motions is called the micro motion study.

What is the objective of doing the micro motion study? we try to optimize economies the motions of the worker. the movement of his limbs or her limbs. We try to economize on that so that the work being performed is performed to the satisfactory level or as part of their desired specifications but causing minimum fatigue to the worker, worker feels fresh after doing his or her work.

So, that is basic purpose analyzing the motions or the elements of human motions at the micro level so that we are able to improve or provide the workers with a economized sequence of motions. So, that the work is enjoyable for the workers so in 6 th week of our discussion just to revise we have seen the basic concept of string diagrams which help us to design the layout in the most optimized manner.

In the previous session we have seen the principles of motion economy in which we have seen that 3 different types of principles do exist which we must follow in designing the work as well as in designing the work place. Today our target is micro motion studies so as i have already told that we have a discussion for several weeks on method study before we shift our attention to work measurement and finally on ergonomics.

So, in todays session we will try to understand the basic concept of micro motion study. Now let us see the introduction to micro motion study if the discussion or what i have already tried to explain in the most simplistic manner if it is clear the sentence is easily will be comprehendible as well as understandable.

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Micro Motion Study: Introduction

- Micro motion study is the "technique of recording and analyzing the timing of basic elements of an operation with the objective of **achieving the best method** of **performing the operation**."
- Such respective short duration activities **involve quick movement of limbs** which cannot be accurately studied and timed using two handed process charts.

So, micro motion study is the technique of recording and analyzing the timing of basic motions, now what are these basic commotions or basic elements that we will see in the subsequent slides. So, this is a technique of recording and analyzing that i mean all basic elements of a operation with the objective off why do we need to examine why do we need to analyze these basic elements.

What is the objective? The objectivity is to achieve the best method and this is our target. We are trying to do the method study whatever we are discussing today that is micro motion study is one of the important techniques for method study and in method study, we are trying to find out one best method of doing the work of perform of performing the operation. So, maybe we are doing or we are performing the work.

It has been taught to us by way of our supervisor or as has been taught to us by the manager or whatever we have studied in the book. But there is always a scope of improvements if we analyze the work properly and whatever we have studied theoretically in the books many things may have changed number of equipments may have been devised or may be used in the industry which we may not have studied when we were studying our degree or for our diplomas.

So, things have changed so when things have changed the method of working must also change and when the method of working has to be changed we need to analyze we need to find out we

need to examine that whether the method which we are employing for doing the work is the best or the most optimal or there can be a better method and as suggested by the researchers there can be better method of doing the job.

And therefore we examine the work at various various levels we analyze the work at various levels and today our target is at the micro level how to analyze the work why to analyze the work and how it will help us to improve or to find out of the best method for performing the operations. So, such respective short duration activities involve quick movement of limbs which cannot be accurately studied and timed using 2 handed process charts.

So, this I have already explained in the introductory part today that in 2 handed process chart we use the basic process chart symbols and maybe one activity during the 2 handed process chart may be further subdivided into basic micro motions and therefore we need to understand that what can be the various basic micro motions which can be analyzed and that we will see today.

As well as maybe in the next session our target will be therbligs which are very fundamental basic micro motions so what we cannot achieve using 2 handed process chart that we can achieve using the micro motion study.

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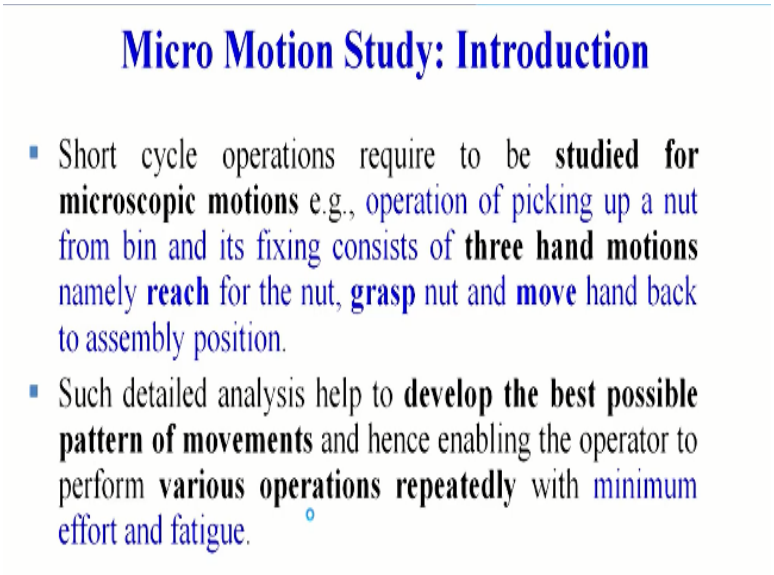

So, short cycle operations required to be studied for micro motions so short cycle so it is not

maybe we are not going to focus on a very long cycle a very long cycle means that suppose a person is doing the task which but he does not require very frequent movement of the hands. For example, he just switches on and of the conveyer belt. So, maybe it is just one motion only throughout the day.

So, maybe it is not repetitive also after half an hour he has to just once press the button and he has to just analyze how the conveyer belt is moving the material. So, may be if there is some defective part he has to just pick it up and one defective is coming maybe after 2 hours of operation so that is not a very repetitive or a frequent movement of the limbs whereas there is another operation we had a person has to assemble 3 or 4 parts together.

And then drop the assembly in a box and then again take 3, 4 parts and drop the assembly in the final assembly in the box. So, this is quick movement of the limbs and then assembly and then dropping in those cases maybe we need to analyze the short cycle. So, short cycle operations to be studied for the microscopic motions there we can see there what is the movement of the limbs how the hands are moving.

How the feet are moving what is the basic motions that that are being done by the hands in those cases it is much more relevant because they are if we are able to economize we are able to optimize the motions in such a way that the effort is reduced the worker will be more productive or the labor productivity will be improved. So, the short cycle operations required to be studied for micro motions study.

For example, is given operation of picking up a nut from a bin and its fixing consists of 3 hand motions namely reach for the nut. So, suppose this is the nut which is lying here so first operation will be reach for the nut reach or sometimes as per the ILO specification in the book it is given we transport empty. So, I am reaching to the nut second is grasp i have to grasp it take hold of this nut and move the hand back to assemble.

So, it is a movement bringing it to the assembly and the left hand will also be doing something it may reach to the bolt then grasp the bolt move the bolt to the place of assembly and then finally

the assembly will take place. But this is short cycle and repetitive a person maybe doing hundreds of such micro motions in a day. So, in that case if we are able to economize it will save a lot of time and effort for the worker.

Grasp the nut and move the nut hand back to the assembly position that this may be for one hand of motion and then for the other hand also these similar motions may be there. So, that example i am reading it for you for a micro motions study what type of short cycle operations we can study using micro motions study operation of picking up a nut from the bin and fixing consists of 3 handed motions.

Namely reach for the nut, grasp the nut and move hand back to the assembly position such detailed analysis help to now why do we need to do such type of analyses they help to develop the best possible pattern of movements and hands enabling the operator to perform various operations repeatedly with a minimum effort and fatigue. So, minimum effort and fatigue are the 2 good thing that we want to achieve.

So, the operator will be happy if fatigue being caused because of the work is less and he is able to achieve much more work as was done by the current method., So, using the analyses using the basic motions if we are able to develop a better method a better sequence of operations or we try to help him by divide designing and developing assistive devices which can assist him for performing his what he will be the happy worker for the organization.

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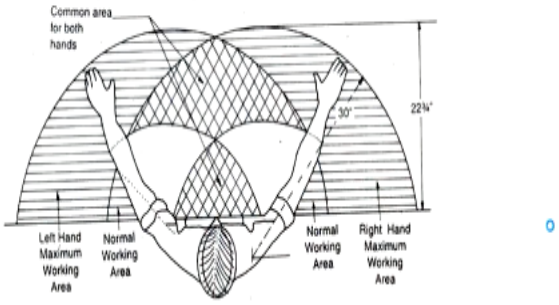
Micro Motion Study: Introduction

- Considerable **wastage of motions** and **idle time** can occur within an operation and the improvement is gained by reducing the operation cycle time.



Now this is another advantage considerable wastage of motions and idle time can occur within an operation and micro motions study will help us in the improvement but reducing the operation cycle time. So, if we are able to first record the current method of doing the job try to see what are the various micro motions being done or what are the various sequence of micro motion can we do it in a better manner.

Can we brainstorm can we find out using creativity or innovative design some proper or not some maybe we can say a better method of doing the same work. In that case it reduces the overall, overall operation cycle time. So, this is just a very standard diagram in most of the work science labs you see this diagram which shows the right hand maximum working area normal working area left hand maximum working area.

So, this is very standard and depends upon the anthropometric data for the various areas of the various regions of the world may be this may slightly vary if we talk about European industry if we talk about Asian industry little bit of variation maybe there this is as per my personal perception. Because the maximum working area minimum working area is found out by taking maybe a shoulder and elbow as the rivet**.**

For maximum you can see the shoulder may be taken as rivet and for maybe a joint and for a minimum working area the elbow may be taken as a pivot point. So, this may vary because the

anthropometric data will vary across the world. So, that is maybe one important information that can be used when we are doing the micro motions study in the direct way or the indirect way.

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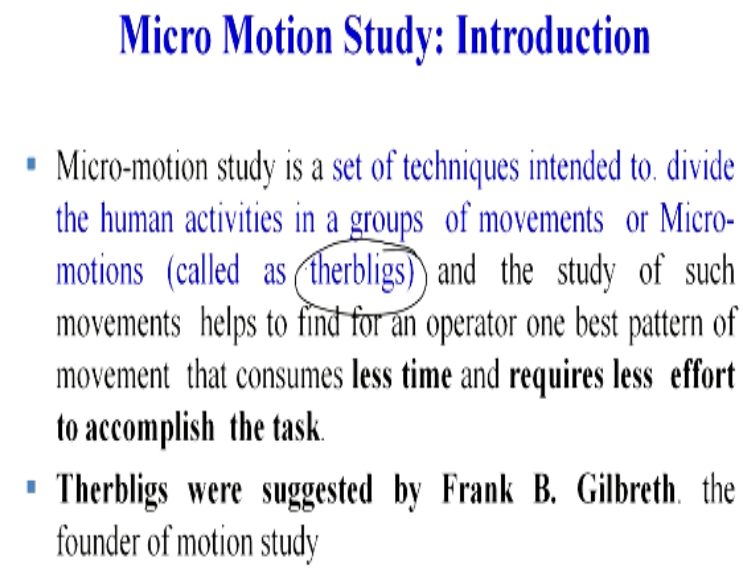

Now we are seeing one important term here which is therbligs on your screen. So, micro motions study now what is the study of what we have seen that we need to do the micro motions study to reduce the operation cycle time it will economize the effort of the worker the fatigue to the worker will be less if we are able to develop a better method of doing the work there is a current method we can analyze it going to the micro motion level.

The basic elemental motions can be studied observed recorded analyzed and a better method can be proposed which can be useful for the worker. So, all that is the basic understanding about the micro motion study. But what is micro motion study micro motion study is a set of techniques intended to divide the human activities in a groups of movements or micro motions called the therbligs.

So, this micro motions as a family as a group are usually called as the Therbligs and what are therbligs we will have a special session on therbligs. Maybe the next session will be on therbligs only but prior to going to the therbligs we need to understand that why do we need to conduct this micro motion study. So, this will help us in improving the way we are doing our work it will reduce the operations cycle time.

It will reduce the effort of the worker so this therbligs we will definitely study in the next session and the study of such movements this micro motions or therbligs helps to find for an operator one best pattern again and again. We are retreating this is our target which we want to hit one best pattern of movement that consumes less time one advantage requires less effort to accomplish the task.

So, it is time saving and it requires less effort for performing the task so we will try to understand what are these therbligs there are specific therbligs for specific micro motions. In the next session and what is the need to do this already I think 3 times in today's session I have highlighted that what is the importance of micro motion study. Therbligs were suggested by Frank B gilbreth the founder of motion study.

This name already we have seen one of the founders of the motion study principles. Again whatever we have covered till now in this session this is a summary of all that. That is purpose of micro motion study whatever introduction definition we have seen this is a summary I will not go into the detail of each and every sentence but will read these sentences for you.

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Purpose of Micro Motion Study

- To study the nature and path of movements for obtaining the elements of an operation.
- To **impart training to the workers** or **operators** regarding motion economy so that **unnecessary movements by the workers may be avoided.**
- To keep permanent record of the most efficient way of performing a task for future reference.
- To **obtain motion time data** for developing **synthetic time standards** for various elements.
- For carrying out **research** in the field of method and time study.

First is to study the nature and tough movements for obtaining the elements of an operation this is related to recording or may be observing the current method of doing the work. Then it can be

used to impart training to the workers or operators regarding the motion economy. So, that the unnecessary movements by the workers may be avoided. So, unnecessary movements we want to avoid and it will help us.

The study of micro motion will help us to an avoid this unnecessary a movement. To keep permanent record of the most efficient way of performing the task for future reference. If we have found out best or the optimal sequence or optimal pattern of these basic movements or micro motions weekend recorded for future reference and that can become a standard method of doing the work.

To obtain the motion time data for developing synthetic time standards very very important synthetic time standards. So, this is very very relevant in case of work measurement and we will study this in detail event, we focus our attention on work measurement of these micro motions can be related to time taken for each micro motion and these can be useful when we want to find out the standard time for performing a task using the standard method of doing it.

So, this will be helpful using the synthetic data and it is one of the standard techniques of one of the important techniques of work measurement that we will study during the work measurement discussion. So, micro motion will also help us for carrying out research in the field of method time and study. So, maybe we can find out some we can trace or observe or locate some areas where improvement can be done with the help of micro motion study.

And then further we can do research in that area and try to economize the efforts of the worker. So, we can see that micro motions study is an important technique which will help us to economize the efforts of the worker and to find out best sequence or best pattern of micro motions or movements which can help us to improve efficiency and reduce the operation cycle timing.

Now what are the steps involved now we have understood that it is important it must be done what are the advantages I think in numerous time it has been listed in the previous slide some of you may even be feeling bored that the same thing is repeated 3 4 times. But it is important that

when we study micro motion we must know that why we are studying, what is the importance but how to do it is a standard approach.

I will not repeat it once I will not repeat it again and again once only we will see that what are the steps involved.

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Steps Involved in Micro Motion Study

- Filming the operation to be studied.
- Analysis of the data from the film.
- Making recording of the data (using SIMO chart)

First one is filling the operation to be studied then the analysis of the data from where from the film which is already recorded and the last is making that recording of the data using the SIMO chart. This is SIMO chart we will cover this in the last session of this week.

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1 Filming the Operation to be Studied

- Micro-motion study consists of **taking motion pictures** of the activity while being performed by an operator.
- Traditionally, the equipment required to **make a film or video tape** of the operation consists of 16 mm movie camera, 16 mm film, wink counter (micro-chronometer) and other usual photographic aids.
- Micro-chronometer (or wink counter) is a timing device placed in the field of view while filming and **time is recorded in winks** (1 wink =1/2000 of a minute).

Now first is filming the operation to be started all of us are very good at using the mobile phone cameras these days and making motion pictures videos can be recorded using the mobile phones so it is nothing new which can be taught to you all of you know how to make the movies, So first is filming the operation to be studied so on a shop floor when we want to do the micro motion study of a person operating a specific operating a specific machine.

Or performing a specialized task or performing a task. We can film the complete work cycle or film the complete cycle, so how we can do that micro motion study consists of taking in motion pictures of the activity while being while being performed by an operator. An operator is performing some task we will film it traditionally know this is important traditionally what was used in the books whatever is mentioned.

The equipment required to make a film or a video tape of an operation it consists of 16mm movie camera. 16mm film wink counter, wink it is explained in the last point here. Wink counter or a micro chronometer and other usual photographic aids. So, here I would like to add that this is from the theoretical book point of view. But these days there are latest techniques, high end camera, a very high resolution cameras are available.

Very high shutter speed cameras out available i think the younger generation the learners may be more acquainted with the latest type of cameras, latest types of video cameras that are available. To my knowledge i may not be an expert in that area but yes by frame by frame we can analyze how the worker is performing the task frame by frame if you see those of you who watch sports on television the cricket how clearly the slow motion is shown.

Even bat coming and hitting the ball at the center of the bat all that can even be captured even when in swimming there is sometimes photo finish so at a very slow very slow pace you can analyze who has finished the race first. So, that kind of cameras are available so when we have those type of cameras available it becomes far more easier for us to understand that how the worker is performing the task.

So, this is a traditional method maybe maybe 15 20 years back maybe these days we have all the

latest equipment and cameras which can help us to record the sequence of micro motions being done by a worker while he or she is performing the task. Like micro chronometer or wink counter is a timing device placed in the field of view while filming and the time is recorded in winks. Now 1 wink=1/2000 times a minute.

Now is micro motion it is kind of a ballistic movement it is done in a very short interval of time therefore the units for time cannot be minutes or hours or to that matter second. It has to be milli seconds or micro seconds. So, accordingly we see that we are using another term that is called winks and 1 wink=1/2000 times a minute. So, first is filming what are the advantages of film.

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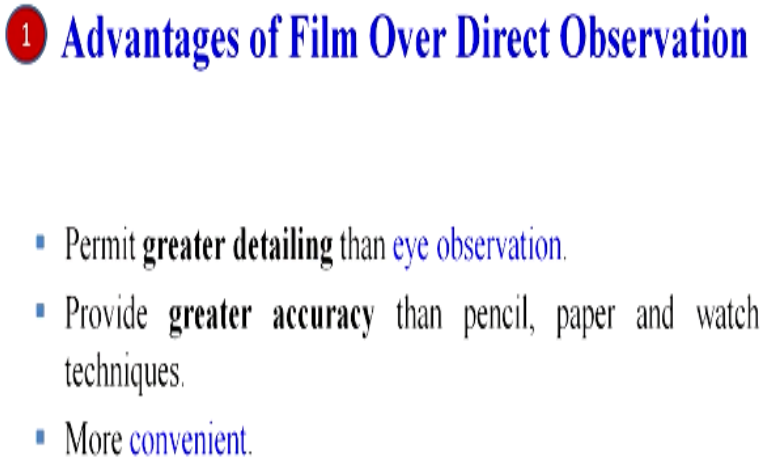

Direct observation permits greater detailing than eye observation as i have already told our eye has got capability beyond that we may not be able to analyze if the motions are very far but with films we can stop the film again and again reverse the film again and analyze that advantage is there. Provide greater accuracy than pencil paper and watch techniques and it is a more convenient.

And we can store it for later use also. Analyses of the data from the film once you have recorded the film we have to analyze the data.

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2 Analysis of the Data From the Film

Once the operation has been filmed and film is processed, then the film is viewed with help of projector for analysis of micro-motions. The film is analyzed in the **following way:**

- Film is run at normal speed so as to get familiar with the pattern of movement involved.
- A typical work cycle is selected from amongst the filmed cycles.
- Film is run at a very low speed and is usually stopped or reversed frequently to identify the motions (therbligs).
- Therbligs after identification are entered in analysis sheet.

Once the operation has been filmed and a film is processed then the film is viewed with the help of a projector for analysis of micro motion. The film is analyzed in the following way so these days the projectors are available you can have a bigger screen and analyze the way the work is being done. Films tis run at normal speed so as to get familiar with the pattern of movement involved.

A typical work cycle is selected from amongst the filmed cycles. You may you may film for 1 hour or a person may have done 100 cycles in those 1 hour in that 1 hour or may have done 10 cycles in that 1 hour. So, we will identify which 2 3 important cycles we want to for that analyze. So, since we are going to have short cycle times here so it is a continuous process worker is continuously working and the cycle time is shorter.

So, we have to identify that which frames we want to analyze. So, film is run at a very low speed and is usually stopped or reversed frequently to identify the motions. Now what are these motions these motions are the therbligs that we will cover in the next session. Therbligs after identification are entered in the analysis sheet. So, first thing is make a good movie using the most latest instrumentation or the cameras available or the video cameras available.

Then you analyze it frame by frame and then try to analyze that what are the basic motions being done by the person when he is performing the task then recording of the data.

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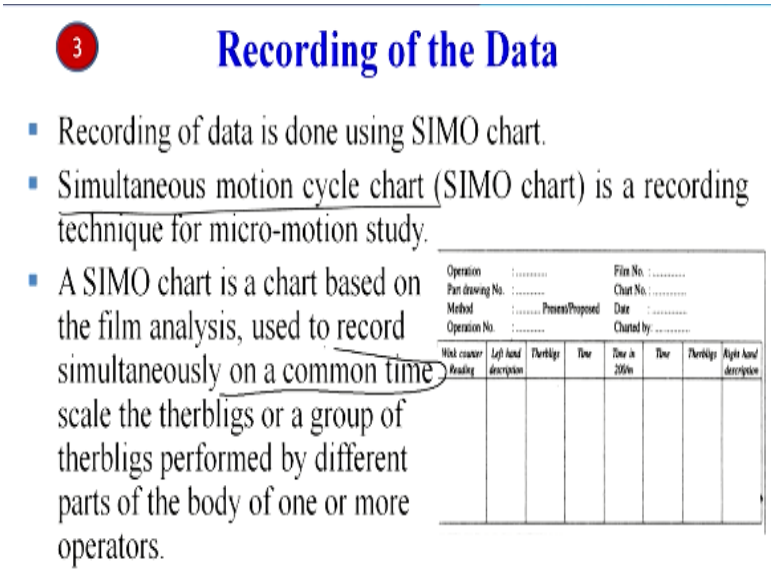

Recording of the data is done using SIMO chart. What is a SIMO chart? It is simultaneous motion cycle chart it is a recording technique for micro motion study. We will cover SIMO chart in the last session of this week that is week number 6. SIMO chart is a chart based on the film analysis used to record simultaneously on a common time scale. So, it will the micro motions will be recorded on a common time scale and the micro motion ae called therbligs.

Therbligs or a group of therbligs performed by different parts of the body of 1 or more operators. So, basically the 2 things are important here one is the time in terms of winks and another is therbligs or the micro motions that the worker or a group of workers are doing for performing the task or while performing the task.

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Advantages of Micro Motion Study

- It provides a **permanent record** of **motion study** on films.
- A large number of operators can see the **procedure at any time** even after the completion of motion study work.
- Films can easily reveal the **difference between the present** and **the proposed technique**.
- Films can be demonstrated to **large work force** at any desired speed.
- It provides **accurate time** for each operation or motion in comparison to stop watch time study.

Now what are the advantages of micro motion study is you can see it provides a permanent record of motion study on films. So, now may be five years down the line if you again want to see that what was the method that was followed 5 years ago for performing this task. We can just take out the film and see how it was being done. So, it provides a permanent record of motion study.

A large number of operators can see the procedure at any time even after completion of the motions study but that is also important it becomes a teaching aid also you have a feeling you have a recorded it at particular time when a person is not doing the work in the correct manner we can depict at that particular time teach or maybe we can train our people in such a way that this is the place we have normally where the people go wrong.

So, here you must avoid you must follow the specified pattern of movements in order to be right so our micro motion films can be later used as training aids also. It can be shown to a large number of people the films can easily reveal the difference between the present and the proposed technique. So, we can identify in the present that this is the place where the problem is there and then we can show what is the right method of doing the work.

Or what is the right pattern or sequence of motions that must be adopted by the worker. Films can be demonstrated to a large work force at their desired speed. So, if we have the feeling you

can show it at frame by frame by frame and train our workers accordingly. It provides accurate time for each operation or motion in comparison to stop watch time study. So, this point I am not emphasizing right now.

Because first we need to understand what do we mean by stop watch time study and then compare it with the following technique or the time provided by the film. So, when we go to work measurement there we will try to understand that what is a stop watch time study technique and how it is different from the filming technique that what can be their differences. So, with this we conclude the todays session on micro motion study.

I think to summarize we have understood that why do we need to do the micro motion study and what are the steps to be followed in performing a micro motion study. And 2 things have come out from todays session that is the therbligs which are the basic micro motion and the SIMO chart on which we record the therbligs using the time scale. So, both these things the therbligs and the SIMO chart we will be covering in our subsequent sessions. Thank you.