Work System Design
Dr. Inderdeep Singh
Department of Mechanical & Industrial Engineering
Indian Institute of Technology – Roorkee

Lecture - 30
SIMO Chart

Namaskar friends, welcome to session number 30 in our course on work system design and I am bit excited and happy today that today we are going to finish 50% of our discussion on this topic. So today is the last session for week 6 and from next week our discussion will be towards the next 50% of our course on work system design. What we have understood in the first 50% of the course, we have tried to understand the concept of productivity.

We have tried to understand that we need to improve the productivity, what are the various reasons for low productivity, what are the causes of low productivity, how productivity can be increased or the productivity improvement techniques. So the first purpose is to find out that why we are studying this course, and we have established that a systematic work study or the design of the work system can definitely improve the productivity efficiency and effectiveness of any organisation.

Whether it is into manufacturing or it is into the banking or it is into the hotel or service industry, aviation industry. So these principles are relevant to each and every sector of business. Once we know that productivity can be improved, we have found out or we have discussed the techniques for improving the productivity, and in that the first thing is the method study. At each and every place I think I have taken this example 2-3 times that this recording activity that we are doing is also a kind of work that is being performed.

How it can be done in a better manner, apart from the content that is being discussed, there are other aspects also like the design of this studio, the lighting arrangement, the air-conditioning environment, the caustics of this room, the environment that the speaker is getting for recording the session, the type of equipment the person is or the speaker has been provided with for recording the session.

So this is also a kind of work that is done in how it can be improved further, we can always look for opportunities. So we have seen that work is being done in all spheres of our life, and

we can always try to improve the way we are doing our work. Since I am a mechanical engineer, so most of our examples are related to mechanical engineering only. But we have seen other examples as well.

If you can refer to the last session, we have taken an example, a micromotion study where a person is going to a wash room and he is going to shave. So how the micromotions can be used to depict the various activities that the person do, or the various micromotion that the person perform while doing the shaving operation. So it is not that all examples are from mechanical engineering, but we have tried to understand the concepts of method study with the help of various examples.

In method study, what we have covered? We have covered operation process chart, we have covered flow process chart, within flow process chart types of flow process charts, we have covered 2-handed process chart, we have covered multi-activity charts, we have covered flow diagrams, we have covered string diagrams, we have covered principles of motion economy. Then in the last session, we have studied therbligs.

We have tried to understand the basic concept of micromotion study. So all these techniques can be employed to improve the current way or method of doing the work. We have standard method of doing a work. For example, a lady at a house or in a country side does not have a washing machine, she is washing the clothes with her hands, manually washing her clothes, she may be doing it for years and years together and as she has been taught by her mother or mother-in-law, she is performing her task.

A potter is doing some work; he is using the potter wheel to make the pottery items. Some standard procedure or protocol the person is following in doing the task, and as he has been taught, he is doing the task in the similar manner. But as a work study analyst if we analyse how the work is being done, and scientifically try to examine it by questioning technique, that why the work is being done in this manner only? Can there be a better method of doing this work?

Can there be a better sequence of activities, which can help to economise the effort of this lady and the potter who is doing this pottery or who is trying to make the items out of clay. Certainly, there are scopes for improvement and today we are going to see the SIMO chart,

which is another technique which will help us to examine the work at the micromotion level. So whatever we are studying there are may be inputs, which can help us to improve the current method of doing the work.

So after method study, we will focus our attention on another important technique, which can help us to improve the productivity of our organisation and that is work measurement or time study. So first we are trying to find out better method of doing the work, then we will try to time this better method and find out the standard time for doing the work using the standard procedure, which is being established out of method study.

Now coming on to today's discussion, we have started our discussion from the broader or the bird's eye level. We have drawn operation process chart of the various operation processes being done in the industry. From operation process chart, we have gone to the more detailed flow process chart, then to the further detailing when a person is using both his hands to perform the work, we have gone to 2-handed process chart.

Then we have seen a man machine chart where man is operating the different machines, then we have jumped on to the string diagram, which can help us to economise the movement of the worker and material in shop floor or to redesign our layout. Then we have seen the principles of motion economy related to the use of human body, the design of the work place, the design of tools and equipment or the arrangement of the work place.

Further we boiled down our discussion to the micromotions of the human body, then we have seen therbligs and from therbligs now we are trying to relate this therblig with time and try to find out that how the unnecessary body motions can be avoided. In today's session, we will try to understand the basic concepts of the SIMO chart, the definition of the SIMO chart, how to construct a SIMO chart and how it can be useful to us in economising the efforts of our worker.

So very quickly now I think the discussion part has been quite longer today, because I am feeling a bit happy reaching the 50% mark for our course, so I have just tried to revise what we have covered till now, because from next week our discussion will be towards the last 50%, so first 50% we have covered last 50% is remaining.

(Refer Slide Time: 08:43)

SIMO Chart: Introduction

- "SIMO" stands for Simultaneous Motion Cycle Chart.
- It is one of **micro-motion technique** devised by **Gilbreth** and it presents graphically the separable steps of each pertinent limb of the operator under study.
- The SIMO chart is the **micro-motion form** of the man type flow process chart.

So coming on to the discussion, that is a SIMO chart, SIMO stands for Simultaneous Motion Cycle Chart. So as we know that we are currently discussing micromotion study and it is used as you remember I think I will go to first that only, it is used for short cycle time activities only. I think it is not in this particular slide, but it will definitely come in today's discussion that it is used for short interval or short cycle time activity. So SIMO chart stands for simultaneous motion cycle chart.

So motions are micromotions and the cycles are short cycles and then we tried to identify the basic therbligs or the basic micromotions and try to plot them in the form of a chart. So simultaneous motion cycle, so cycle is basically related to the time domain, and the motion is related to the micromotions. So basically we will try to see or we will try to divide the work into the micromotions and we will try to plot this micromotions in the sequential manner and then in respect of the time taken for each micromotion in terms of winks.

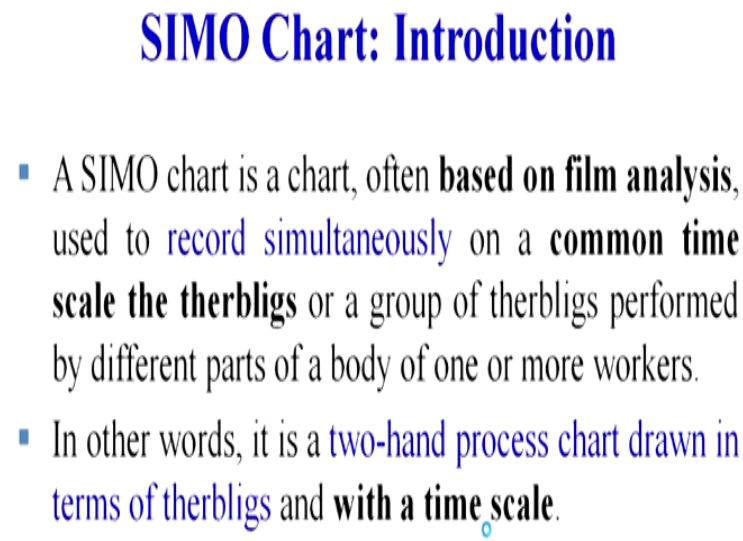
So it is one of the micromotion technique devised by Gilbreth, his name has come numerous times considered to be one of the leaders in the field or the developers of the time and motion study techniques. What is SIMO chart, this is related to Gilbreth one of important figures in time and motion study. It presents graphically the separable steps of each pertinent limb of the operator under study.

So the operator is performing his task, they are separable micromotions which he is doing, so we are trying to record those micromotions and plot them in the form of the SIMO chart. And these can be done for both the limbs, if you have left hand and right hand, if we are using our

feet also may be we can try to see that which of the therbligs or which of the micromotions are can be used for the other limbs as well.

But normally we see when the work is being done by hand, we use the left hand and right hand motions or micromotions only. The SIMO chart is the micromotion form of the man type of flow process chart, so usually we focus on the man in this case.

(Refer Slide Time: 11:18)



A SIMO chart is a chart often based on film analysis we have already seen that using therbligs or in micromotion study how do we perform the study. So first we have to film the whole operation or different cycles of the operation, different number of cycles for the operation. So first is film, then analysis of the film, then finding out or identifying the basic micromotions and then plotting them.

So this is the standard sequence of doing the analysis in micromotion study. A SIMO chart is a chart often based on the film analysis, so this is the foremost may be the input that goes into the construction of the SIMO chart. And film analysis, then it is used to record simultaneously on a common time scale the therbligs. So common time scale, this time scale is in terms of winks which we have already seen that what do we mean by this unit of time wink, 1 wink = 1/2000 of a minute.

So the time is also there, the micromotion is there in the form of therbligs, so these are the 2 input. So we need to record the time and first we need to know that what are the various therblig. So once we have recorded the film, we can analyse the film in a very slow motion

and try to identify that what are the basic motions being done by the worker. So these basic motions can be transport empty, transport loaded, search, select, find, use, there are position, pre-position.

So we will see all these therbligs, the time is also noted, and then we try to plot it in the form of a SIMO chart. But how we will get these therbligs or micromotions, these are done, these are taken from the film that we have already recorded. After the analysis of the film we will break down the total work into the micromotions. In other words, it is a 2-handed process chart in the terms of therbligs with the time scale.

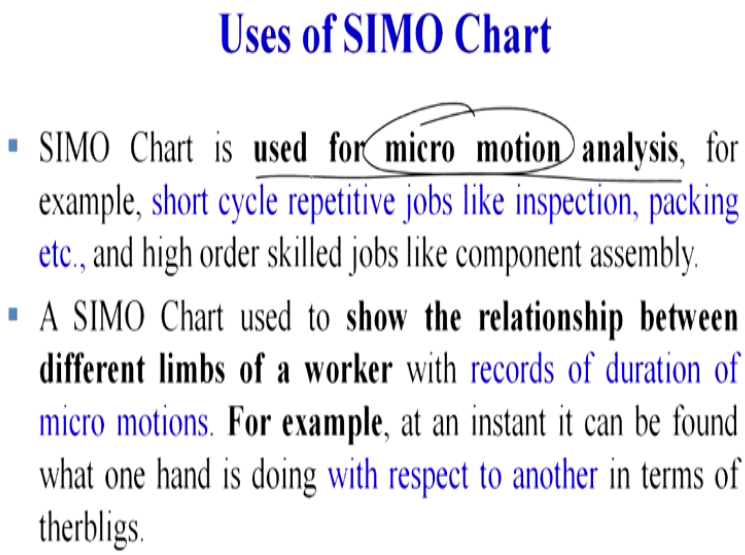
If you remember, refer back to our discussion on 2-handed process chart, in 2-handed process chart we have used the process chart symbols with a slightly modified definition in case of 2-handed process chart. Because the standard process chart symbols that we have used for constructing operation process chart, they have a meaning for each and every symbol. The circle stands for operation. The square stands for inspection.

The arrow sign stands for transportation. The inverted triangle stands for storage. So we have different process chart symbol, d stand for delay. So we have these process chart symbols and we use them for constructing operation process chart. But when we use a similar symbol for constructing a 2-handed process chart, there is a little bit of variation there, but those symbols are used for constructing a 2-handed process chart with little variation.

But here we are not going to use those symbols, we are going to use the symbols that we used for therbligs and please refer back to the previous session that we had, I have tried to explain to the best of my capability, each and every symbol that is used in therbligs or that is the therblig and that is used in the micromotion study. So those symbols will be used in constructing the SIMO chart and not the operation chart symbols that we have used earlier or the symbols that we have used for constructing the 2 handed process chart.

So in other words, our SIMO chart can be analogous to our 2-handed process chart, but the symbols will be different. In other words, the 2-handed process chart is drawn in terms of therbligs within the time scale. So we will draw it in the similar manner only but with different notations and different symbols. It will be drawn, the template may remain same as in case of 2-handed process chart, but the symbols will be different.

(Refer Slide Time: 15:43)



Uses of SIMO chart, I think this we have already, I have highlighted, SIMO chart is used for micromotion analysis, micromotions are the various therbligs. For example, this I have already told this is what is going to come in today's session, short cycle repetitive jobs. So usually micromotion study is conducted for short cycle repetitive jobs like inspection, packing, etc., and high order skilled job like component assembly.

So we have taken this example numerous time, assembly of nut and bolt and a washer, so such type of repetitive short cycle jobs are usually analysed using the SIMO charts. A SIMO chart is used to show the relationship between the different limbs of a worker with regards of duration of micro-motion. So duration is in terms of time and the relationship between the different limbs of a worker, so the different limbs are performing the various micromotion.

So basically a SIMO chart will show you the micromotions in terms of time, that what is the time taken for each micromotion. For example, at an instant it can be found what one hand is doing with respect to another in terms of the therbligs. So we will see with examples, may be with sentences the things may not be that clear, but once you see the actual SIMO chart you will see what left hand is doing, what right hand is doing, and what is the time scale in terms of winks.

(Refer Slide Time: 17:16)

Uses of SIMO Chart

- From the analysis shown about the motions of the two hands (or other body members) involved in doing an operation, **inefficient motion pattern can be identified** and **any violation of the principle of motion economy can be easily noticed**.
- The chart helps in **improving the method of doing an operation** so that balanced two-handed actions with coordinated foot and eye motions can be achieved and ineffective motions can be either reduced or eliminated.

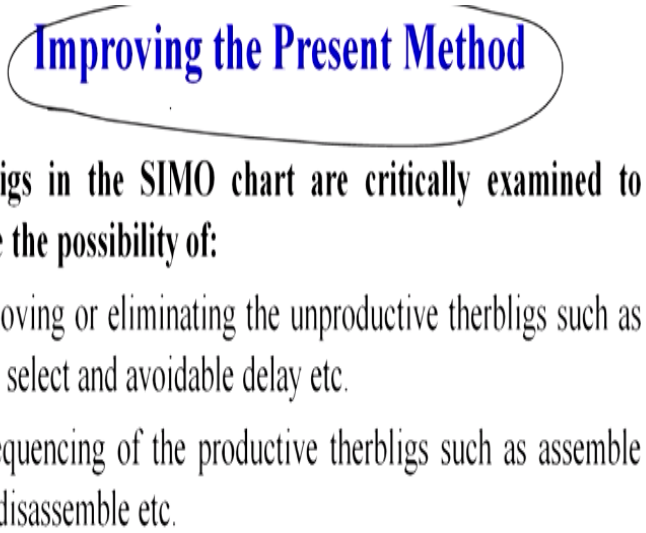
From the analysis shown above motions of the 2 hands or the other body, I have already told mostly it is with hands only, but are the other body members involved in doing an operation, inefficient motion pattern can be identified, very, very important, because we want to economise the effort of the worker. So where ever inefficiencies are there in terms of body movement that can be avoided and any violation of the principle of motion economy can easily be noticed.

So we can see that where we are not following the standard protocols, standard principles and wherever we are digressing or we are moving away from the standard protocol that can be easily identified with the help of the SIMO chart. The chart helps in improving the method of doing an operation, so that the balanced 2 hand action with coordinated foot and eye motions can be achieved and ineffective motions can either be reduced or eliminated.

So this ineffective motion we want to reduce, we want to eliminate, and only focus on improving the current method of doing the job. So our target use of SIMO chart is to identify the unnecessary micromotions that have crept up because of habits or because of the way we have been taught the things or taught to do the thing, those things we need to identify, we need to plot and then we need to eliminate.

And then design a better method or better sequence or pattern of this micromotion and then compare the 2 method, if the new method is better in terms of time saving, in terms of effort saving, we have to install and maintain the new method of doing the work, and SIMO chart will help us in this regard.

(Refer Slide Time: 19:14)

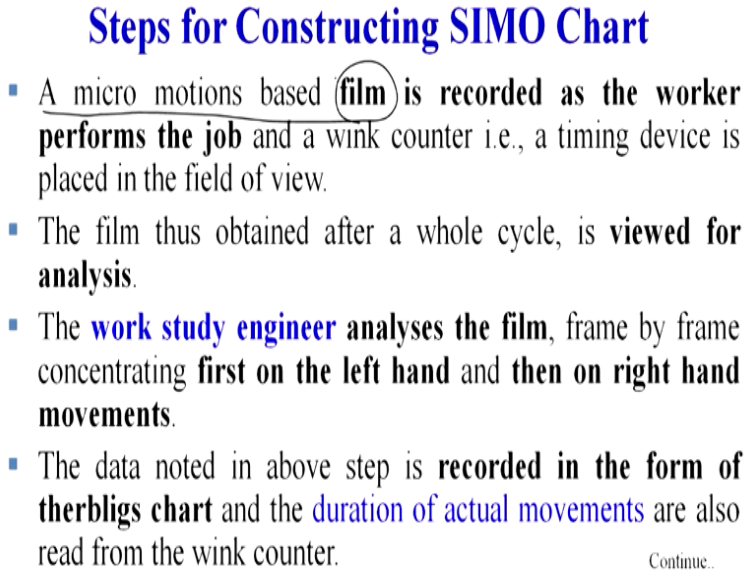


Now the most important slide, our target is improving the present method and SIMO chart will act as a technique for achieving that objective. Therbligs in the SIMO chart are critically examined to explore the possibilities of, how we will find out the better method. In the previous slide, we have seen that our target is to eliminate the unnecessary motion, so how we can identify them.

So our target is removing or eliminating the unproductive therbligs, and what are these unproductive therbligs such us find, select, avoidable delay. So we have seen that there are effective therbligs, there are ineffective therbligs or unproductive therbligs. So we can focus on the unproductive therbligs and try to eliminate them or reduce their frequency.

Resequencing of the productive therbligs such as assemble and disassemble. So we can try to locate, we can try to identify the therbligs or micromotions which are not adding efficiency into our operation and try to eliminate them and then we can try to re-sequence the therbligs in order to improve the overall operational efficiency.

(Refer Slide Time: 20:37)



Now steps for constructing the SIMO chart, let us quickly see these steps. A micromotion based film is recorded so first we need to have a film, in which we need to focus on the micromotions. So it is a film of a worker doing his task in a normal way, but we know that we have to focus on his or her micromotions so we must, when we are filming we must keep in mind that our target is to analyse the micromotions of the worker.

Therefore, in the beginning only we must be sure that the technique, or the cameras or the instruments or the equipment that we are using to record the worker is later on going to help us analyse the things frame by frame by frame. So that we are able to identify the various micromotions being done by the worker, so we need to identify our equipment judiciously. So micromotion based film is recorded as the worker performs the job.

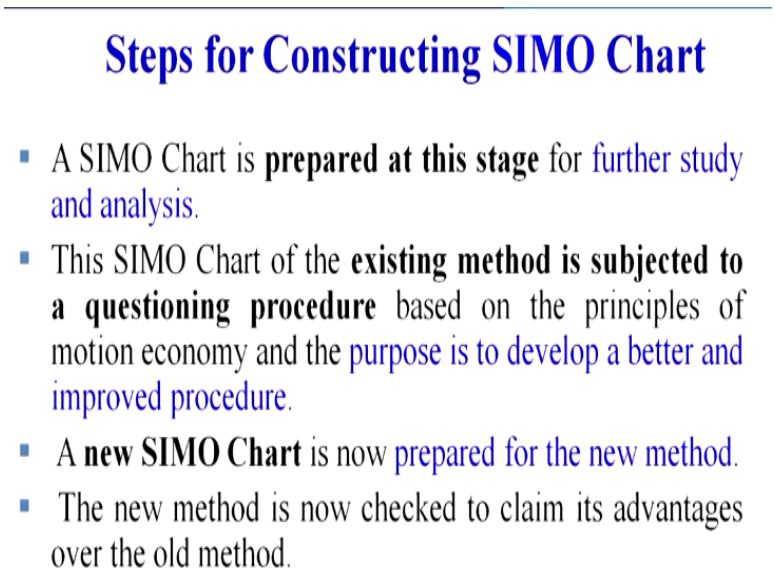
A wink counter that is a timing device is placed in the field of the view. So what are the 2 inputs for making a SIMO chart? These are the micromotions being done by the worker and the second one is the time. And both we are trying to get input, the micromotions we will get from the film and the time we will get from the timing device. The film thus obtained after the whole cycle is viewed for the analysis.

The work study engineer analysis film frame by frame, step by step, in a slow motion, concentrating first on the left hand and then on the right hand movements. So he will try to analyse the micromotions of the left hand and the right hand and then try to list them, may be transport empty, grasp, transport loaded, release, up to that level of micromotion he has to jolt

down or he has to write down or he has to list the various micromotions being done by the worker by analysing the film, which has been recorded of the worker performing the task.

The data noted in the above step is recorded in the form of a therbligs chart and the duration of the actual movement also read from the wink counter which is the timing device.

(Refer Slide Time: 23:01)



A SIMO chart is prepared at this stage for further study and analysis, how was SIMO chart will look like. We will quickly have few examples towards the end of today's session. This SIMO chart of the existing method is subjected to a questioning procedure, very, very important and we will discuss it detail with examples in our subsequent sessions. Based on the principles of motion economy.

And the purpose is why we are analysing and subjecting the current method to the questioning technique, with a purpose to develop a better and an improved procedure. Then once we have found out, we have eliminated the unnecessary sequence of motions we have re-sequenced, we have eliminated the unnecessary therbligs or ineffective therbligs, we have now developed a new method.

So a new SIMO chart is now prepared for the new method, the method is checked to claim its advantages over the old method. So new method may claim that it is time saving, it is effort saving, so we will compare both the current method and the new method by using the SIMO chart.

(Refer Slide Time: 24:12)

1 Example: SIMO Chart

SIMO CHART

Operation..... Date.....
Name of the worker..... Film No.....
Component, Name..... Operation No.....
Method:Present/Proposed

Left hand description	*Symbol*	*Time (winks)*	*Symbol*	*Right hand description*
Grasp chisel	*G*	0	*G*	Grasp hammer
		10		
To job	*TL*	20	*TL*	To job
Position	*P*	30	*AD*	Idle
		40		
Hold	*H*	50	*U*	Use

http://www.businessmanagementideas.com/production-management

This is an example of the SIMO chart on your screen, you can see it is SIMO chart, what is the work being done, grasp the chisel, symbol is G, to the job, because the chisel is now in hand, it is transport loaded TL, then position P, then hold H, this is the description of the left hand. Then for the right hand simultaneously what is being done, grasp the hammer G, to job so transport loaded, idle the left hand is positioning the chisel, right hand is holding the hammer.

While the left hand is positioning right hand is idle, then it is holding the chisel and with the hammer, you are using the hammer for chiselling the wood. Now you can see in case of 2 handed process chart this 4 micromotions could have easily been plotted with 1 or 2 symbols only. But here we have gone to an elemental level, a level below and we have tried to identify the basic or the micromotions, that is grasping.

What are the therbligs here, grasp, then transport loaded, position, hold, all these are the therbligs. So from where we will get this therbligs, these therbligs have been recorded from the film or have been jotted down, or written down from the film after analysing the film. This is the time, from where we have got the time, the time has come from the device or the timing device, and left hand and right hand we have analysed from the films that what the left hand is doing and what the right hand is doing.

So this is a simple description of a SIMO chart.

(Refer Slide Time: 26:15)

2 Example: SIMO Chart

Operation: Finish hand filing of copper work piece.

S.No.	Left hand description	Therblig	Time	Therblig	Right hand
1.	Searching and lifting	SH,H	0.2		
2.			0.4	U	Opening the vice
3.	Clamping workpiece	PP	0.8	PP	clamping work piece in the vice piece in the vice.
4.			1.0	TL	Take the file
5.	Do the hand filling operation.	U	2.0	U	Do the hand filing Operation.
6.			2.2	TL	Taking the micrometer
7.	Check the dimension	I	3.0	I	Check the dimension
8.			3.2	U	Open the vice
9.	Remove the work piece	TL		3.4	

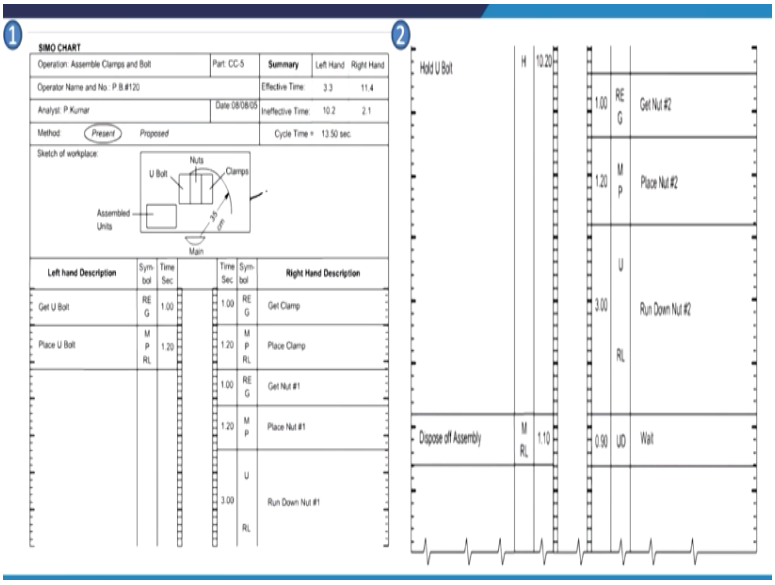
http://www.yourarticlelibrary.com/ergonomics

Then we can see another type of a chart, finish hand filing of copper work piece. So we have a copper work piece, and hand filing has to be done, finish hand filing. So here also we can see there is a left hand description, there is a right hand description and the therbligs are given, the symbols are given. Just I will read for you left hand, first is searching and lifting with left hand, clamping the work piece, do the hand filing operation, check the dimension, remove the work piece.

So therblig inspection, checking the dimension, which we have seen in the previous session, do the hand filing operation use, U is used here. Clamping the work piece, may be position, clamping the work piece again there is position, transport loaded, inspection by right hand also, so you can see that this is the time that is being depicted here. So here you can see that left hand description, right hand description and the time as well as the symbols of therbligs are used.

We will not read each one of these, but the main point is to emphasise that how a SIMO chart can be depicted. Now let us see there is an important point to understand that what is the difference between a 2 handed process chart, because in the previous 2 examples of SIMO charts, we have seen that there is a left hand description, there is a right hand description and then we are putting the therblig symbols there as well as the time, a common time scale we are using.

(Refer Slide Time: 27:58)



So what can be the difference, so here we have seen a sample of clamps and bolts in this case, this is a layout also is shown here, this is the layout. here we have the clamps in this box we have a U bolt here and these are the nuts in the central position, this is the main point assemble units have to be placed here. What is the job, assemble of clamps and bolts, so effective time, left hand, right hand is given, ineffective time for left hand and right hand is given, the total cycle time is also mentioned.

So here you see the left hand description, the right hand description, so get to the bolt, even in case of for example, for a 2 handed process chart get to the bolt we may depict by transportation, but here the symbol used is RE and G, that is reach and grasp, or transport empty and grasp, so maybe that is one thing. Place U bolt, so here we have 3 therbligs are coming into picture, that is M position and RL.

So in case of 2 handed process chart only we have major work elements or activities, but in case micromotion analysis we use the therbligs symbols here, and similarly the time also you see is given in seconds here, time is given in seconds. Similarly, for right hand you can see get the clamp, so for getting the clamp 2 micromotions are there, for placing the lamp there are 3 micromotions here, M, P and RL.

So from here right continues, hold the bolt H symbol is there which is a therblig, time is also mentioned that for 10.20 seconds we have to hold the bolt and then the right hand is performing different tasks during that time, when the left hand is holding the bolt, the right

hand is doing other activities and for that also therbligs are mentioned here, these are the therbligs.

So we can see that disposing of the assembly is done by the left hand, so we can now compare the 2, that in case of 2 handed process chart, we use the broader definition of the work elements. In case of SIMO chart, we go to the micromotion level, 2 handed process chart higher level depiction or higher level definition of the work elements, as is given in get to the bolt or get U bolt.

But in micromotion analysis using a SIMO chart we use in terms of therbligs as the time is given in terms of winks. So there is a difference between the 2, that the 2 handed process chart and the SIMO chart. So basically it depends when we have to select a particular recording technique or when we have to select method study techniques, in that case we have to be very, very sure that what we want to analyse.

Now suppose we want to analyse at the micromotion level, we will draw SIMO chart, if you want to do at a normal level of analysis, we want to find out at a broader scale we may use a 2 handed process chart. If we want to analyse the complete organisation or we want to need to have a bird's eye view of the whole organisation, we are not interested in how the worker is doing the job, we want to just see how the various sequence of operations or processes are being conducted in the organisation, we may go for an operation process chart.

So depending upon the level of our analysis, we will select our recording technique, we will select our analysis technique, or we will in broader sense we can say we will select the technique that we are going to use for conducting the method study. So with this we conclude the today's session, in next session we will focus, or in next week we will focus our attention on the standard steps that we need to follow for developing the better method.

Although for each technique we have tried to see that what is the current method and what is the better or the best method. But now we will see with the help of examples or by the questioning technique how we can develop systematically a better method of doing the job. So the technique can be any technique but the standard procedure remains the same.

So let us see that how much we can cover in next week related to method study, it will be followed by work measurement and finally we will finish the course with discussion on ergonomics. Thank you.