Ergonomics Workplace Analysis
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Lecture – 03
Task Analysis

So, welcome you all again, this is the next class, and I will take you for one more tool or method for Ergonomic Workplace Evaluation, again I am here Urmi. So, today I will be talking about Task Analysis.

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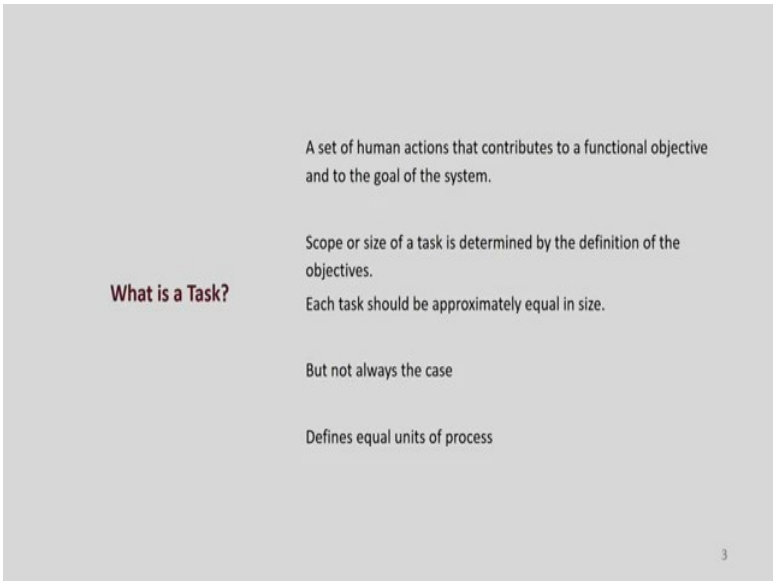

So, let us understand before going for details of the task analysis let us understand what is task? So, task we can confirm that a set of human action that contributes to a functional objective and that which will take you to a goal of a particular system. So, whenever we are talking about task so, for the whole job we have small-small elements which can be understood as a task and those are the very specific human operation or human action.

So, the scope or size of a task analysis we can determine by the definition of the objective of the whole task analysis and each task should be approximately equal in size, then it becomes easy for us to analyze it, but it is always it is not possible. So, whenever we are doing the task analysis we need to first define our task in the whole sequence of the job and defines equal units that is very important. So, units need to be equal otherwise it becomes very difficult at the end of the analysis to summarize the whole process.

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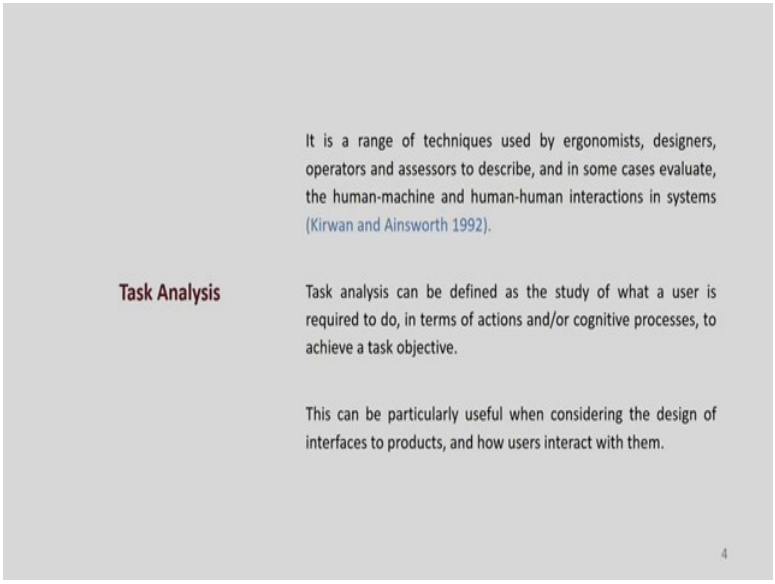

So, we have very specific definitions; I will take you for one. So, it is a range of techniques used by ergonomists, designers, operators, assessors to describe and in some cases evaluate the human-machine and human-human interaction in a whole system. So, when we are talking about task analysis we need to understand how we are interacting. In my earlier classes I tried to explain you the man-machine system. So, in that in man-machine environment system how two man are interacting or how one human being and the machine is interacting; if we understand those process it will help us to carry or evaluate through task analysis.

So, task analysis can be defined also as a study of what a user is required to do, in terms of action or cognitive process to achieve a task objective. What does this mean? It means that I supposed to perform or I supposed to do a particular or I supposed to achieve a particular goal; to achieve that particular goal what are the steps I am going to take. So, it may be physical, and it may be cognitive. So, understanding also a part of your task analysis. This can be particularly useful when considering the design of an interface of our product and how users interact with them.

So, when you have a product, you need to understand how the elements of that particular product are interacting with the human being. So, it depend how those elements are being operated or interacted with the human being and how those tasks can be evaluated or analyzed. So, once we start task analysis, first we need to define those small-small elements

which is very important. Now, before going to detail in the task analysis process or methodology or different techniques, I will tell why we do task analysis.

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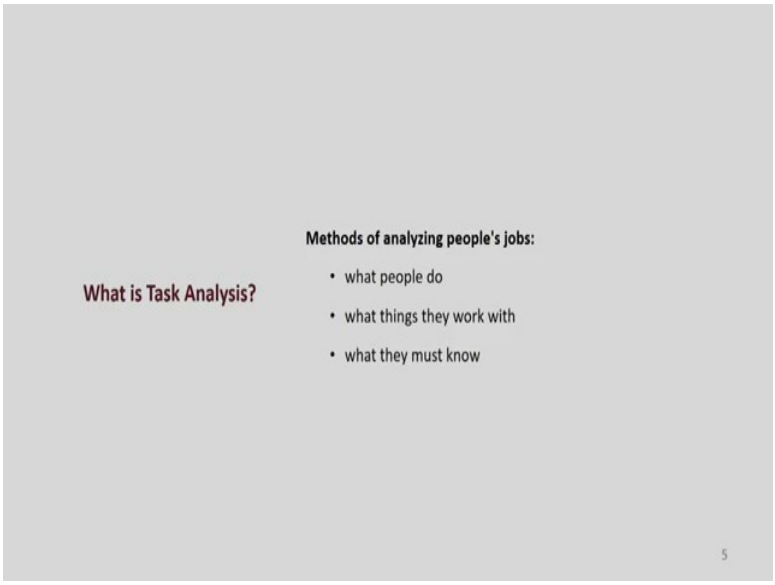

So, we do for people. So, what people are doing for that? What things they work with? So, those elements; machine, tools, objects. And what they must know? So, when they do that particular work or particular job or that particular task, what they should have that understanding. So, if we know all these three processes properly then only, we will be able to do a task analysis. I will take you for an example.

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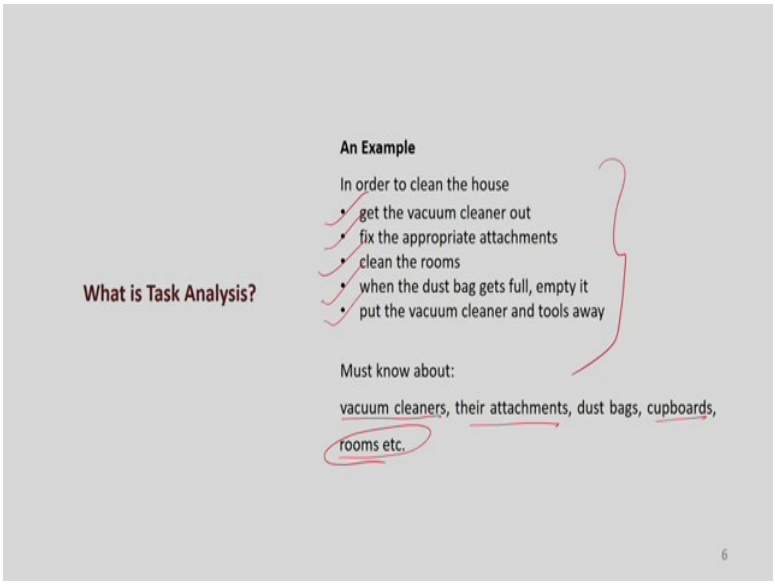

Here, I tried to mention suppose; we are doing a cleaning of a floor using a vacuum cleaner, you can take broom also; the process will be little changed. So, when I do a cleaning of a floor using a vacuum cleaner, first what I need to do is get a vacuum cleaner from the stored place right. Then fix all these operators whatever is required for this cleaning, then we clean that particular room.

And, once cleaning is done we understand yes cleaning is done here is again a cognition or inner understanding or sometimes it is kind of your own perception also. So, once I understand yes cleaning is done so, what I do is we take out the dust bag, empty it, clean it as per the requirement and put the vacuum cleaner back.

So, while doing this whole particular task what we need to understand? We should understand what is vacuum cleaner, how these vacuum cleaner works, their specific attachment; how the dust packs need to be open or operated cupboards, where these are to be kept. And, the particular room size, room position, and all those things where I should do the cleaning.

So, once I know all this process I will be able to do the particular job or particular task. So, once I do that task so, my goal is cleaning the room. So, to clean the room what I did? First, I get got the vacuum cleaner, then I fix the operator, then I clean the room, remove the dust, and I kept the vacuum cleaner in a place. You can repeat this or you can do this particular process using some other method also as I said, in the beginning, you can use broom, and you can do. So, this is one example.

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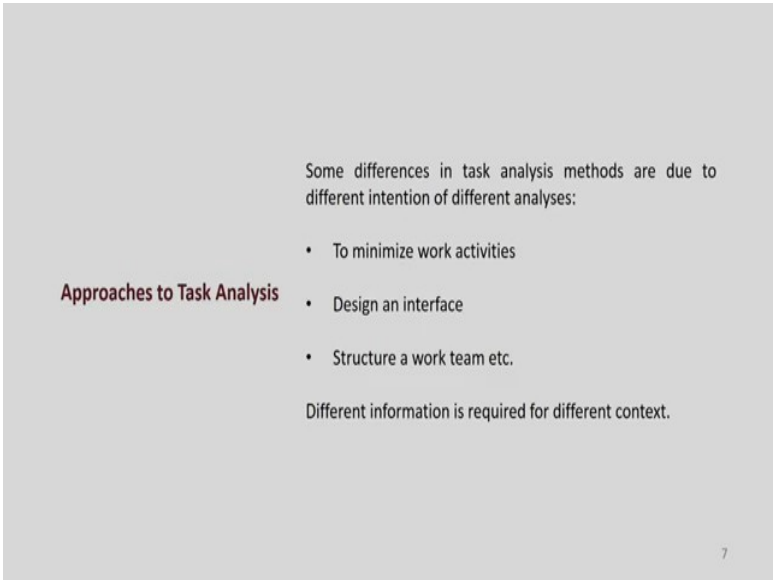

Now, here, I would like to mention why we should do and how we should do task analysis? So, we are doing to minimize the work activities, and later once we go for the techniques we will come to know how we minimize the work activities. Then we use this particular task analysis method to design the interface, also structure up work team.

So, maybe in a particular job or particular task we need 3 or 4 people to be operated in combination of 4 3 4 machines; how to make how to do that arrangement of that particular team? So, different techniques are available so, based on that we will be doing all this necessary goal. So, these are the kind of goal also why we should do task analysis. So, before I go into detail I should know how human performance is affected when somebody is doing a task. So, maybe operator's skills follow this all these points through the example what I gave earlier that cleaning the room using vacuum cleaner.

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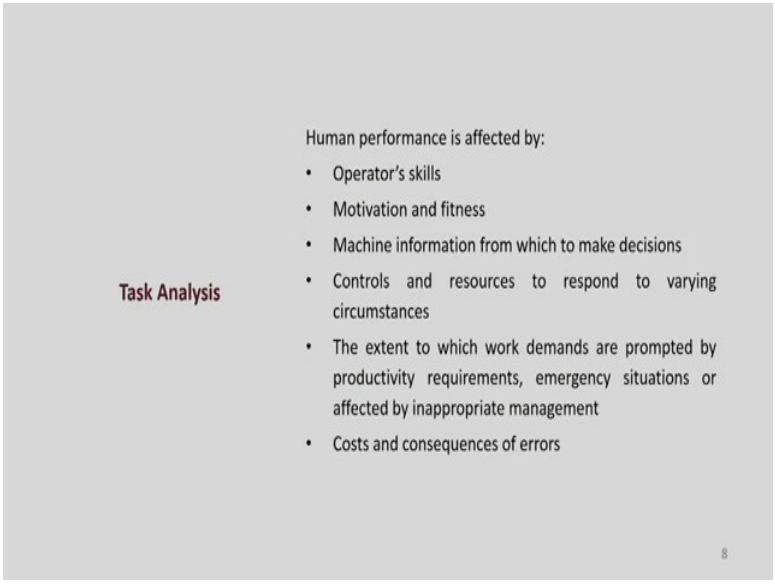

So, operator skill, motivation, and fitness, machine information from which to make our decision; do you understand how we are taking it? Now, controls and resources to respond to varying the circumstances, the extent to which work demands are prompted by productivity requirements, emergency situation or affected by inappropriate management; also cost and consequences of errors. Now, let us understand all this point with that particular example; So, when we are talking about vacuum cleaner and cleaning the room so, operator's skill. So, if I am a novice user I may a lot of time to do the arrangement or using that particular instrument.

So, if the skill is very important, based on this skill my task analysis will change. The process will get those elements in, will be different than motivation and fitness. Then machine information from which to make the decision, suppose there is a display it saying that dust bag is full or machine is on. So, how this information, so how the operator is perceiving those information and taking the level of cognition we are taking the decision. Controls and resources to respond to varying circumstances. So, if we have some certain uncertain things all of a sudden happens. So, I was cleaning the room maybe all of a sudden my water bottle fall on the floor.

So, what I supposed to do? So, control that; the extent to which work-demands are prompted by productivity requirements, an emergency situation or affected by inappropriate management. So, if I am not a person who understands the feats and gates and all those other elements, maybe I may do you know mismanagement. Suppose I am operating the vacuum

cleaner and I am simultaneously I am using the mobile phone so, there may be a problem. So, these things we need to understand when we are doing a task analysis.

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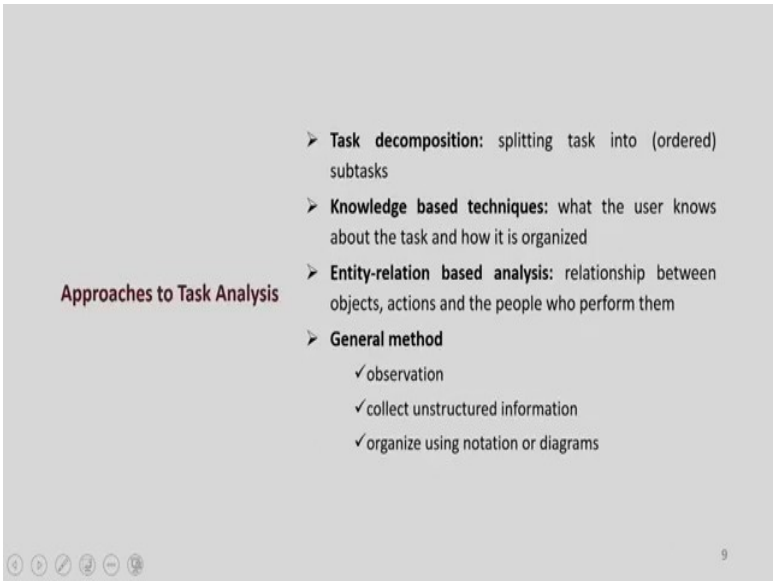

So, I will take you further for how, when we start the task analysis, what are the approaches we are doing one by one. So, first is task decomposition, by nomenclature itself you understand it splitting of the task in a sequence to small-small sub task. Then knowledge-based techniques so, when we understand this task to analyze the person, the researcher should understand the whole process in advance. If he or she is not aware of the whole process they will not be able to follow the whole task.

So, it is very important before you go for the task analysis you first understand that task properly. Entity relation based analysis, it helps you to understand the relationship between the objects, actions and the people who is performing that particular task and the final one is the general method. So, observation, collect information from the unstructured manner and organize using particular notation or diagrams. We will be describing all this information in the coming slides. So, this is the common or basic approach we should follow.

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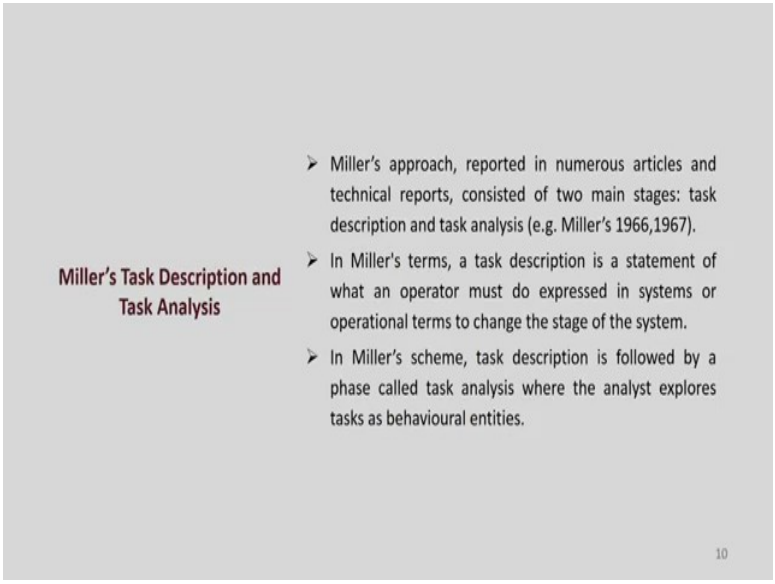

Now, I will take you very specific concept or description given by Professor Miller. So, in 1966 very early long back, in 1966 he tried to describe this task analysis. So, according to him he says that task description is a statement; task description is a statement of what an operator must do expressed in a system or operational terms to change the stage of the system. So, whatever we described everything is there, but it is his way to tell that what is task analysis.

So, in Miller's scheme task description is followed by a phase called task analysis where the analyst explores task as behavioral entities. So, how human being is expressing or interacting with those elements, so that is major concept or major aspect of Miller's task description. Now, I will take you one process which is cognitive task analysis; you must have heard about this particular method.

So, I will tell a little bit about this, and during the next few courses you may do your own activities at home, and you can submit, or you can enquire about this particular topic further. Also, you can read this from the textbook whatever I referred to you earlier.

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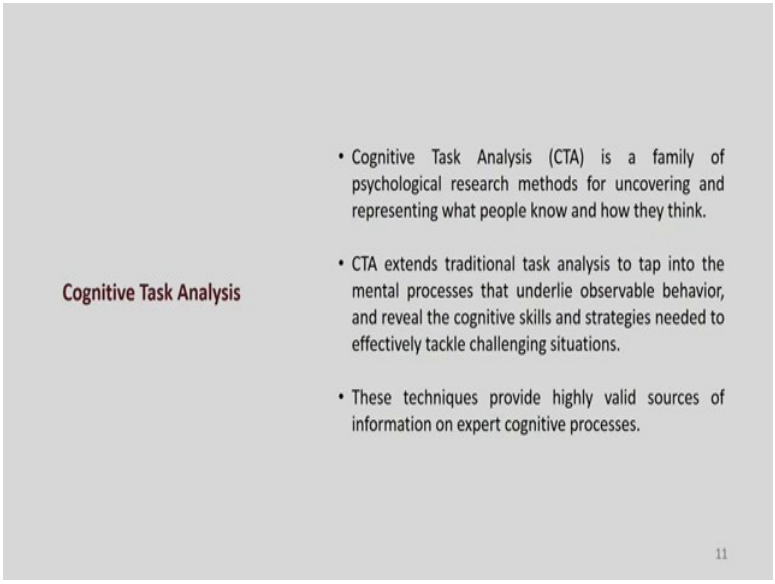

So, what is cognitive task analysis? Cognitive task analysis is a family of psychological research method. So, here it is very important, it is more of a psychological analysis for uncovering and representing what people know and how they think. Now, take the same example of vacuum cleaning, now when there is an indication that yes dust is full. So, I should recognize, I should understand yes it says that this color of light or this sound says that dust bag is full. So, once I understand that then I take decision to switch off the vacuum cleaner.

So, these understanding, what it says uncovering and representing what people know and how they think. So, I know if this beep sound or this red light is coming maybe dust bag is full I know this, maybe in other systems, whatever a vacuum cleaner I used earlier the representation is little bit different. But, I understand there will be something which will tell me that dust bag is full. So, if I see something unusual or something similar to that I will see, I will go back and check yo is it my is my desk back is full or not. So, I will take a decision.

So, this is the cognitive task analysis. So, cognitive task analysis extends traditional task analysis to tap into the mental process that underlie observable behavior and reveal the cognitive skills and strategies needed to effectively tackle challenging situation. So, these techniques provide highly valid sources of information on expert cognitive process. So, whenever we follow this type of cognitive tasks and there are various techniques available; if

we follow that we will come to know different you know very specific cognitive process information.

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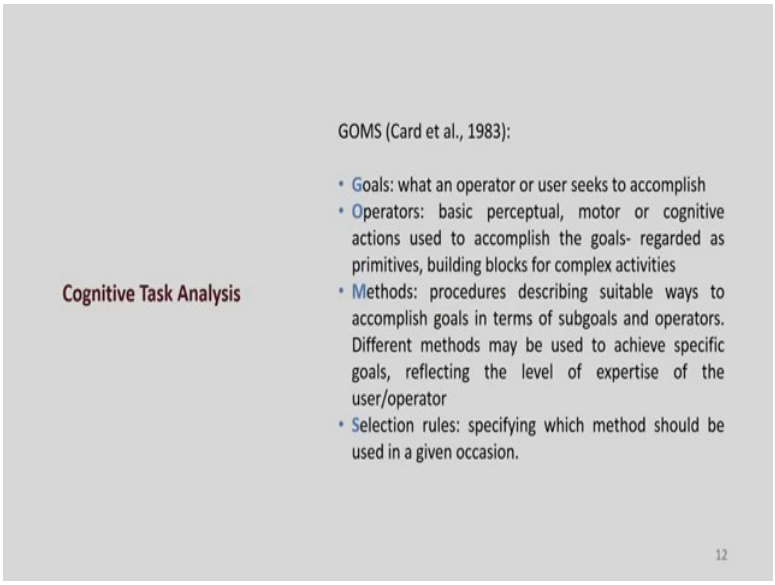

I will take one of the technique; we call it GOMS; it was developed by Card et al. in 1983. So, GOMS it refers to Goals, Operation, Methods, and Selection rules. So, what goals here? Goals means what an operator or users seeks to accomplish. So, before starting my task analysis, I should understand that the goal of that particular task.

Operators: basic perceptual, motor or cognitive action used to accomplish the goals regarded as primitive building blocks for complex activities. Then is method: procedures describing suitable ways to accomplish a goal in terms of sub-goals and operators.

So, going to the branches, different methods may be used to achieve specific goals reflecting the level of expertise of the users and operators. And finally, the selection rules specifying which method should be used in a given occasion. So, for each occasion we cannot use everything. So, depending on the requirement, depending on the context which is very important for any ergonomic workplace evaluation. So, whenever we are talking about the context based on that we will be selecting those rules. So, this is called a GOMS. Now, another kind of technique or a kind of information it is (Refer Time: 19:35).

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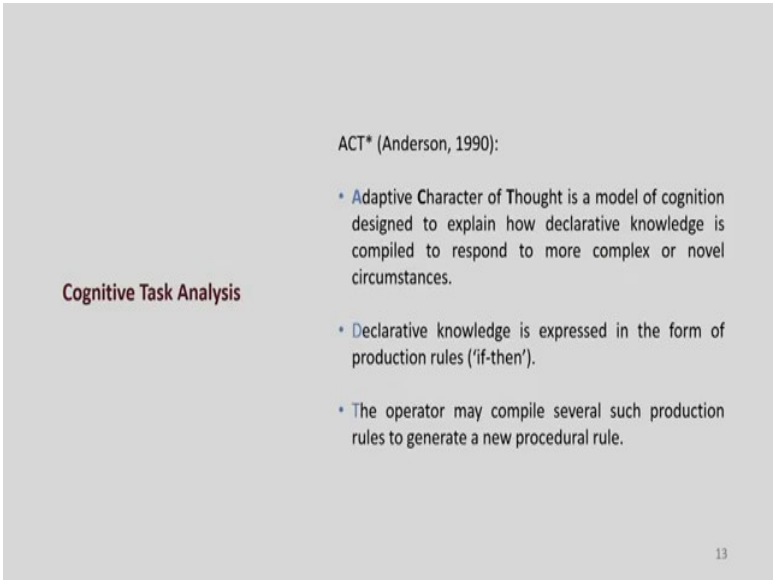

So, this one is very old 1983; this is also quite old; it is given by Anderson 1990. So, what it says? Adaptive character of thought is a model of cognition designed to explain how declarative knowledge is compiled to respond to more complex or novel circumstances. So, how those declarations are, how those explanations are so, that is very very important. Also it is a declarative process knowledge is expressed in the form of production rule.

So, here production is very important because finally, we will be talking about productivity. And, the operator may compile several such production rules to generate a new procedural approach or new procedural rule. So, once we understand these can be changed, these can be newly added and finally, we can modify it and go for different modification or different rule altogether.

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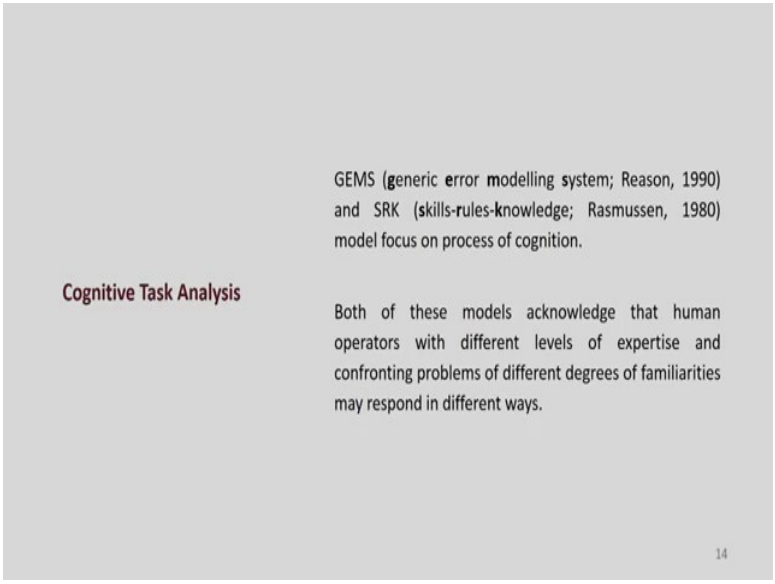

There are some many such; GEMS, SRK, etc. So, both of these models acknowledge that human operators with different levels of expertise and confronting problems of different degrees of formalities may respond in different ways. So, here you need to understand both are indifferent nature so, based on my context I will be using them.

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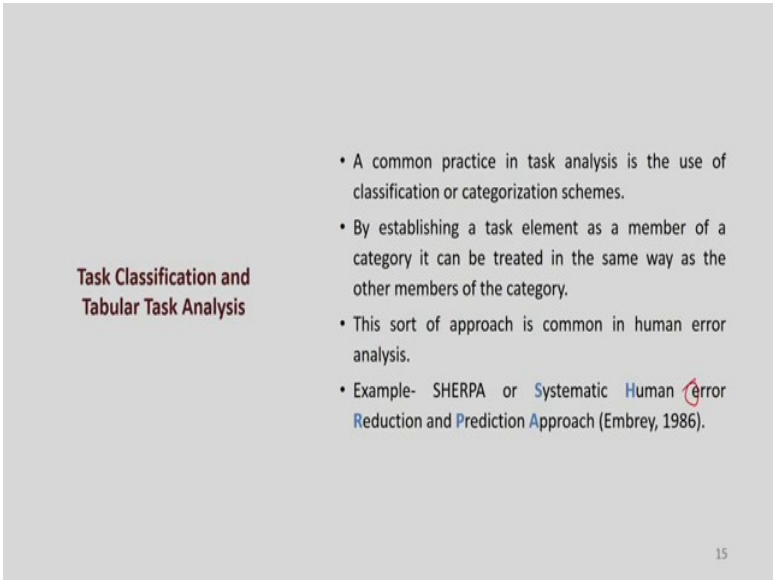

Once we understood the various approach and small part of cognitive task analysis, now I will take you to classification and tabular task analysis process. So, it is a common practice in task analysis the use of classification or categorization of the whole scheme. So, by

establishing a task element as a member of a category, it can be treated in the same way as the other members of the category. So, once we understand this is operation, this is transport so; accordingly we will categorize them, and we will combine them, and we will follow this.

So, this sort of approach is common in human error analysis as well example is SHERPA. So, SHERPA what it says? It says Systemic Human Error Reduction and Prediction Approach.

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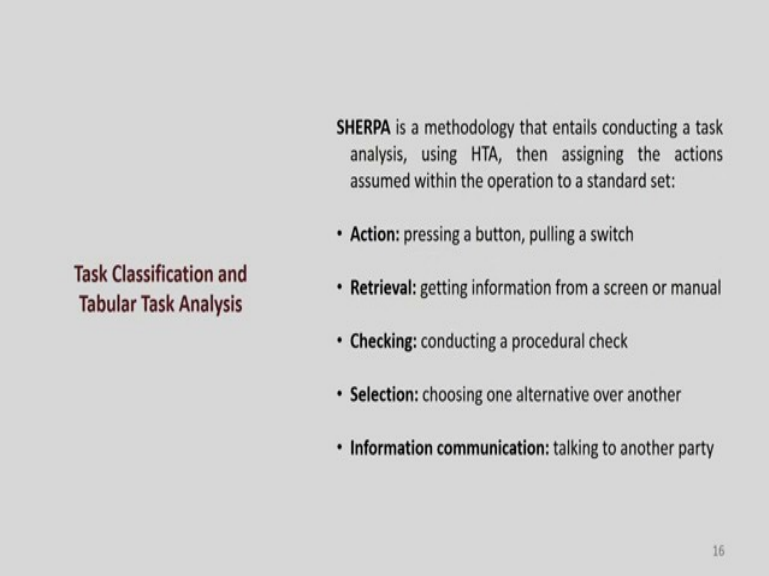

So, what it says? It has few steps; first is action, then retrieval, checking, selection, and information communication; again, we will take for hierarchical task analysis. This particular SHERPA uses hierarchical task analysis as a tool and does these categorizations. So, what action means?

The kind of activity or kind of operation human being is doing is action. Then retrieval: getting some information from any particular screen or manual or from any other sources. Checking is conducting a procedural check like you know if it is established process I need to know what it is so, I will do the check.

Then selection: choosing one alternative work over another. So, if you have I have two options, I will choose which one is best and the information communication talking to another operator or talking to another person who is responsible to do this particular job. So, these are the steps we should follow while doing the SHERPA. Now, as I mentioned in my

previous slide that the SHERPA can use hierarchical task analysis as a tool, I will take you to the hierarchical task analysis.

So, again this is quite old tool, it is developed in 1971, but till date it is very alive. So, most of the industrial engineer; ergonomist they use hierarchical task analysis. Yes, in the field of design maybe this particular task analysis is not that familiar, but also, but also many designers use this particular tool when they do the modification of the existing design or sometimes to understand the process of a particular new design.

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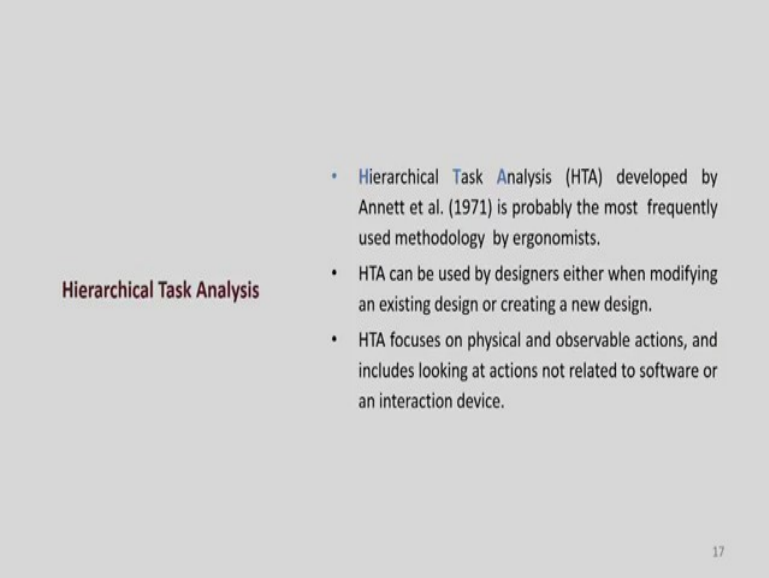

It's not that they do not use it, but there are limitations of hierarchical task analysis that's why use is limited by a designer. But of course, in the field of ergonomics, pure ergonomist they use extensively although it is an old tool, it has a lot of validity. So, it helps to understand the accident; it helps to understand the production rate, it helps to understand the productivity enhancement everything. So, it is very important.

So, hierarchical task analysis focuses on physical and observable actions and includes looking at action not related to software or an interaction device. So, it takes actions of the human being, it is very important. So, mainly, human operations can be evaluated very nicely.

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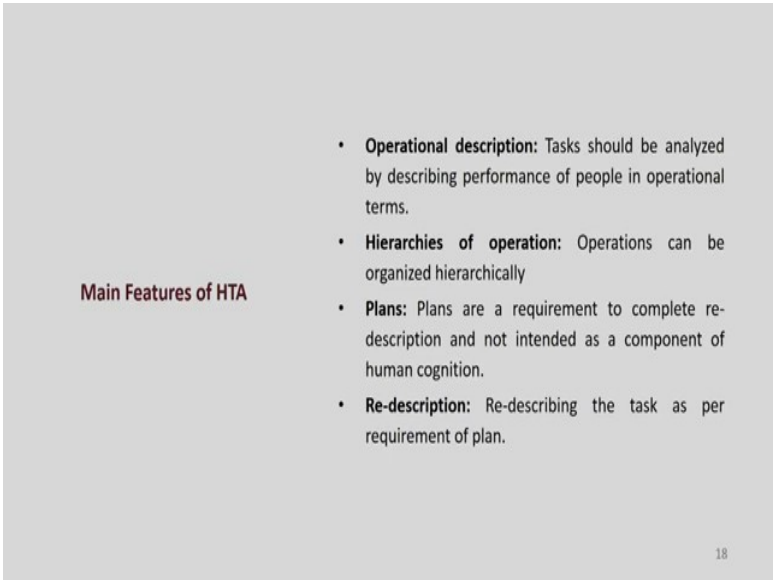

So, what are the main features of hierarchical task analysis? It describes the operation very nicely, it gives a hierarchy of the operation, it gives proper planning, also re-description of particular method or particular process. So, this way you can use it in various field.

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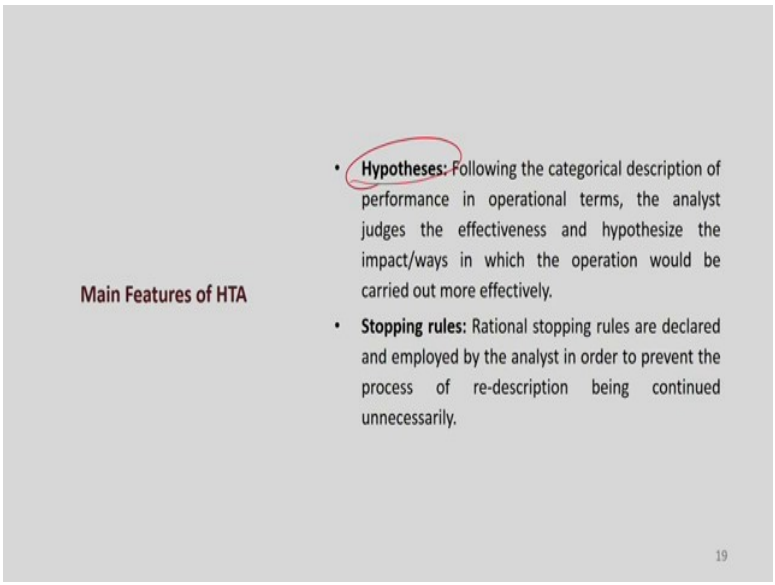

Also, it helps you to hypothesize some kind of event or some kind of operation which we really need to do during the process. So, the impact of some element on some others, how it is co-related. So, hierarchical task analysis always helps to hypothesize that, also it helps to define your stopping rules. Stopping rules means where exactly you need to complete your

task or you to give a full stop. So, it helps to take a rational decision that where the whole task can be can have a pause. So, these are the main features of hierarchical task analysis.

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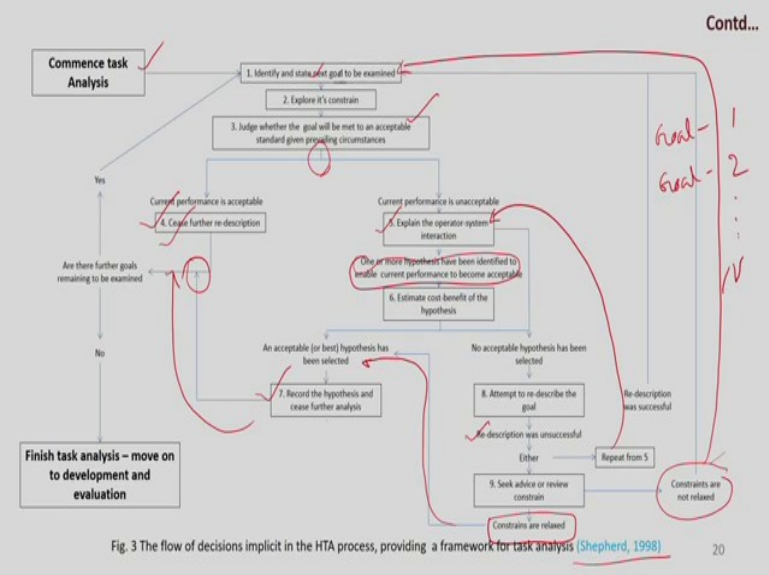

Now, take this example. So now, you thought of doing hierarchical task analysis. So, you start your job here. How? Identify the task, next goal to be examined and state next goal to be examined. First you identify that task and explain what is the goal, then explore its constraints. So, once you define this is the task to be done, and these are the goals of that particular task you try to explain the constraint of that. Then, judge whether the goal can be made to an acceptable standard given prevailing circumstances. So, if you have; you say or you identify current performance is acceptable, but if it is not acceptable then you need to go for further detailing.

So, once you find that performance is acceptable or it is absurd the standard or recommended rules so, use this further re-description. But, if it is not then what you do explain the operator system interaction. So, hierarchical task analysis in the beginning itself it does not say you keep on doing the analysis. So, once you find there is a problem, or there is a difference between the actual and the expectation, then you go for this fifth process that is the explain the operator system interaction. So, what you do here? One or more hypotheses have been identified, need to be identified and enable the current performance to become acceptable. So, as in this stage, I said it say helps you to develop the hypothesis. So, impact of some element on something else.

So, once we understand that part so, here also we hypothesize that; we hypothesize that, so, once we hypothesize hypothesis can is formulated then we try to see that it becomes acceptable or not. If once it is done then we try to see the hypothesis is cost-effective or not. Cost-effective means is it possible for us to implement within stipulated budget, budget includes your money, your other supplementary elements as well.

So, if it is like an acceptable or best hypothesis has been selected, then you go for the recording that hypothesis and come back. So that means, you reach the point where you need not do any further analysis. So, again you are seizing this particular process. So, if it is not acceptable, you found no whatever hypothesis we are formulating it is not acceptable then you try to redefine it once again.

So, again you do re-description of the unsuccessful items, once you redefine it then repeat it from again 5. So, here you found that there is a problem, it is not acceptable. So, you can go back from here again redefine, if you find hypothesis is successful again then you go back and seize. But still, if it is not seeking to advise or review of the constraint maybe those constraints it is not under your limit no capacity to define it.

So, you can redefine, you can take review, you can take experts comment, you can do further analysis. And finally, you relax those constraint means you are trying to minimize it; you try to fix it. Once it is done again it is going back it no it is going back here so that means 7; 7 means relaxing.

Relaxing means you are going back here again, you are seizing the analysis, but if it is not happening by any way you are not in a position to relax those constraints. So, what you have to do? Probably there is a problem in the beginning maybe you have not identified this particular task, or you have not stated those goals properly. So, again you start your process back. So, this is the common process what we follow during our hierarchical task analysis. So, here what I mentioned, if everything is done then you try to see this is one goal you defined, you did everything for one goal. Then go for goal 1, then goal 2 like that you go forward ‘n’ numbers right because, till the time you see the whole system is the constraints of the whole system is relaxed you continue for that.

So, goal identification is huge maybe for a small job you have 5, 6 tasks, but for a complex job you have ‘n’ number of tasks, and every task need to be analyzed in this way. So, you will get a lot of detailing of these elements, and for each detail or each step you need to freeze

it. This is explained by Shepherd in 1998. So, this is the way how he tried to explain hierarchical task analysis. Now, I will take one very small example; which is actually very difficult to identify such kind of simple examples. So, what here I would like to do is I want to go to library and issue a book as per my choice or as per my requirement.

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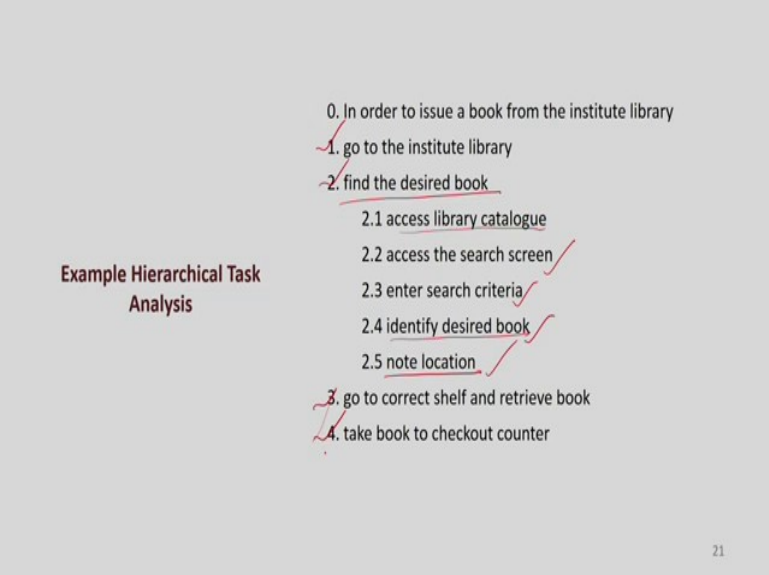

So, what I will do? I will go to my institute library, I will try to find out the desired book, I will go to the correct shelf, and retrieve that particular book, and take that book to check it out. So, 1, 2, 3, 4; these are the four process steps I will be following. Now, to find out the desired book there can be different issue. So, I will take it, or I will explain it in my next slide.

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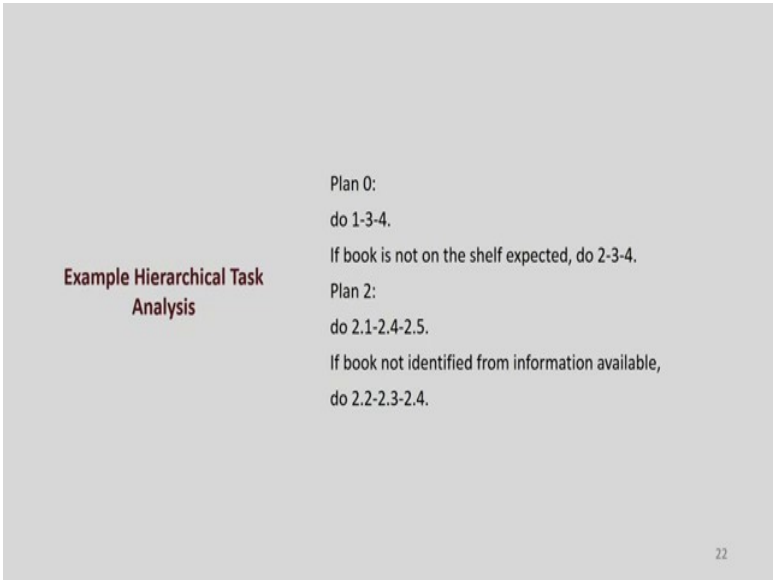

So, if the book is not in the shelf as expected. So, what am doing here? Find out the desired book right. So, if my book is not available on the expected shelf, what I will do? I will do 2, 3 and 4. And in plan 2 what I will do? 2.1 2.4 and 2.5. So, let me see access the library catalog, identify the desired book, and then note the location. Once I note the location, I will go to the correct shelf, and I will get that book.

But, if that book is not identified from the available catalog, then what I will do here? I will access the search screen; I will enter the search criteria, identify the desired book, note the location, then follow third and fourth night. So, this way I can do my task analysis for issuing a book from my own institute. So, this is very simple process. You will get very complex process when you do it in industry.

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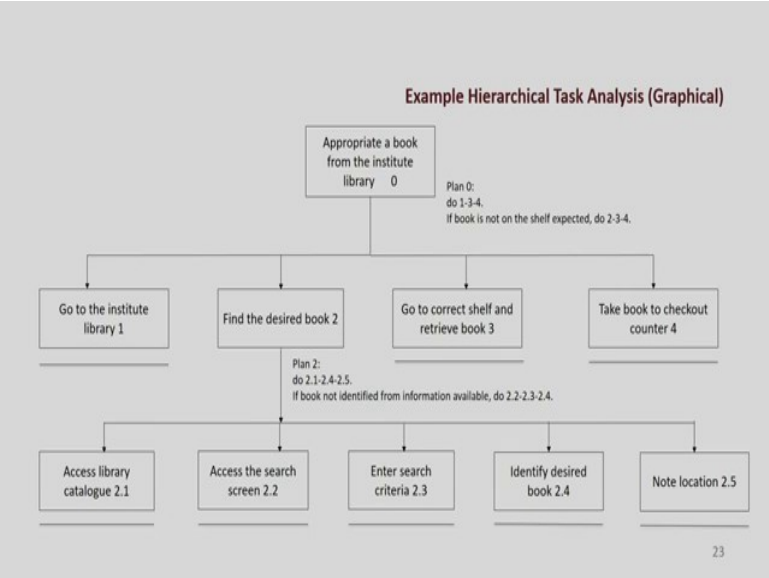

So, this is the tabular from form how you are performing the task analysis for issuing the book.

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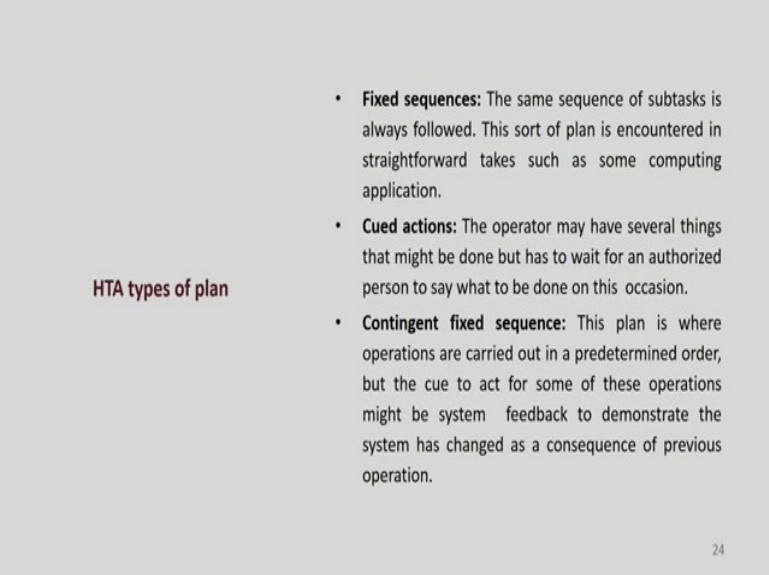

Now, I will explain to you what the types available for hierarchical task analysis plan are. So, something is called fixed sequences. What it is? It says the same sequence of subtask is always followed. This sort of plan is encountered in straightforward takes such as some computing application. Second is cued action: cued action by nomenclature says that some waiting. So, some action to be performed based on some other input. What it says? Operator

may have several things that might be done, but has to wait for an authorized person to say what to be done on this occasion.

So, I cannot take the decision, I am waiting for someone to say yes you do this or you do this or you do this. So, that is the cued like I am waiting for someone's comment. Then contingent fixed sequence, what it says? This plan is where operations are carried out in pre-determined order; order is predetermined, but the cued to act for some of these operations might be system feedback to demonstrate the system has changed as a consequence of previous operation. So, my whole system will tell me what happened in my earlier system, earlier process and based on that a decision I will be taking a decision that what to be done and what not to be done.

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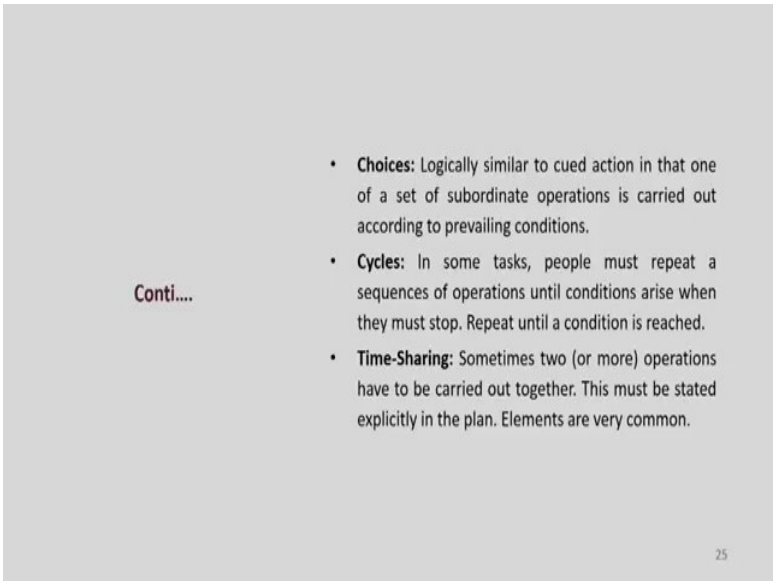

Again, one more it is choices so, logically similar to cued action in that one of a set of subordinate operation is carried out according to prevailing condition. Then cycles again nomenclature says everything, it says that in some tasks people must repeat a sequence of operation until conditions arise when they must stop. Repeat until a condition is reached. So, do these; do these; do these, take example from here know if it is not coming here you again go back and keep on doing it. So, this is a cycle.

So, this way you can do, then time-sharing someone sometimes two or more operators have to be carried out to the operation have to be carried out together, and this must be stated explicitly in the whole plan. So, elements are made be common right doing particular job is

very common. So, we need to explicitly say who is doing what. So, these are the types; now once we are doing task analysis specifically hierarchical task analysis we should know what should we do as a stopping rule.

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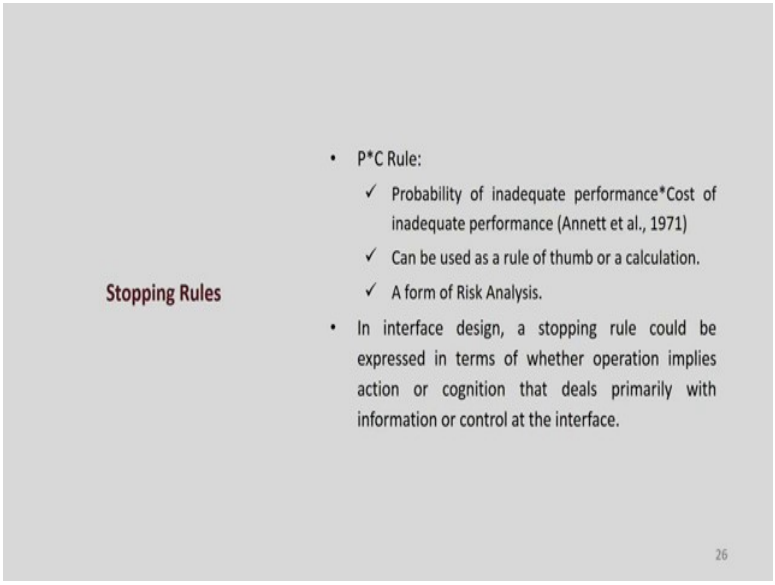

So, here we follow many times that P*C rule what it is? It says the probability of inadequate performance into cost of inadequate performance. So, probability of inadequate performance and cost of inadequate performance. So, if we are following these so, if my cost of inadequate performance is very high I always request, I always should stop that analysis or stop that process on that particular point. Or, I do not have any probability to enhance my performance; if I do further analysis or further rechecking then I should stop my process over there. So, that is called P*C rule.

It can be used as a rule of thumb; also, we use it for our return on investment calculation. So, how many times I do the analysis or how many times I should repeat the process, it helps to take that decision. Also a form of risk analysis, it helps to give you an understanding about the risk available in the current environment or current a task.

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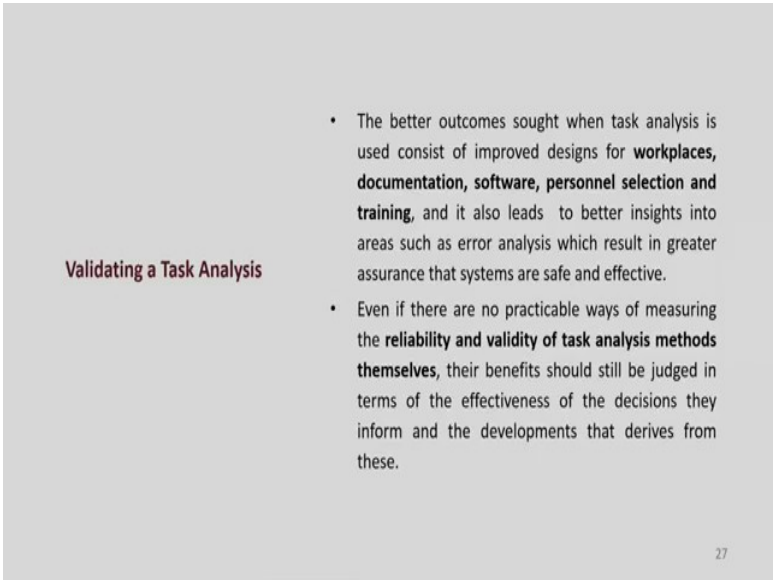

Now, of course, when we are talking about the particular technique or particular method we should understand what is validity of that particular task. In general we cannot taste validity of these task analysis, but yes what we can do reliability and validity of the task analysis method can be identified using their results. How the sensitive that result is, how sensitive that interpretation is. So, effectiveness of that particular decision, suppose I have taken a decision to change a small part of my job using task analysis data.

So, if I see the effect is huge or effect is really important for the whole task analysis, then I can tell you that task analysis is valid and it is reliable for this particular system. So, as such, we cannot test it, but yes through impact we can test the validity of the task analysis. Now, I will take you to one part which is very important always when we talk about task analysis that is the work-study because we are talking about the task, we are talking about that particular work or job.

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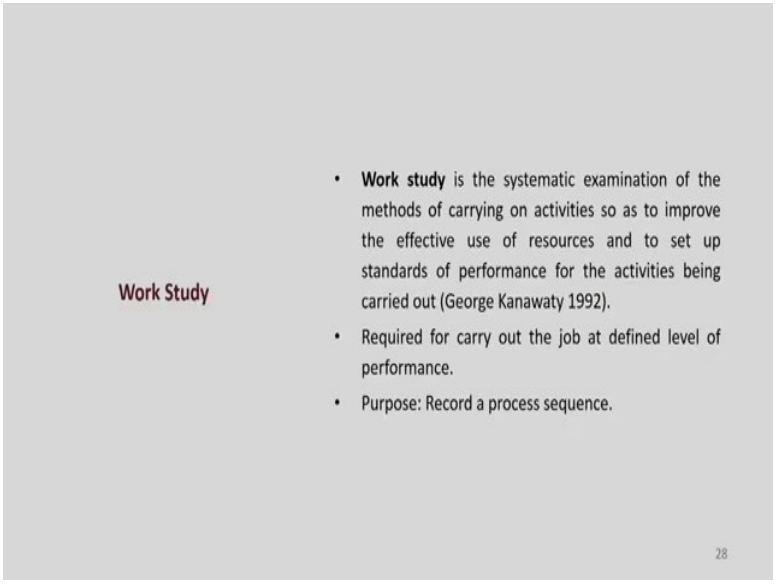

So, work-study is very important aspect, and majorly industrial engineers use this particular they are very much dependent on this type of system. Also designers, ergonomists they use these type of tools for their different evaluation purpose; also it helps in the many times in the rehabilitation. Because it explains the task, it helps you to redesign the workplace as well as workspace. So, it is extensively used by many personnel from the different-different field.

So, I will tell you about this work-study. So, work-study is a systemic examination of the methods of carrying out activities so, as to improve the effective use of resources and to set up standards of performance for carrying the activities being carried out. So, it is setting a particular standard. So, it is developed in 1992; it required for to carry out the job at defined level of performance. And why we do this? We record the process sequence with this work-study.

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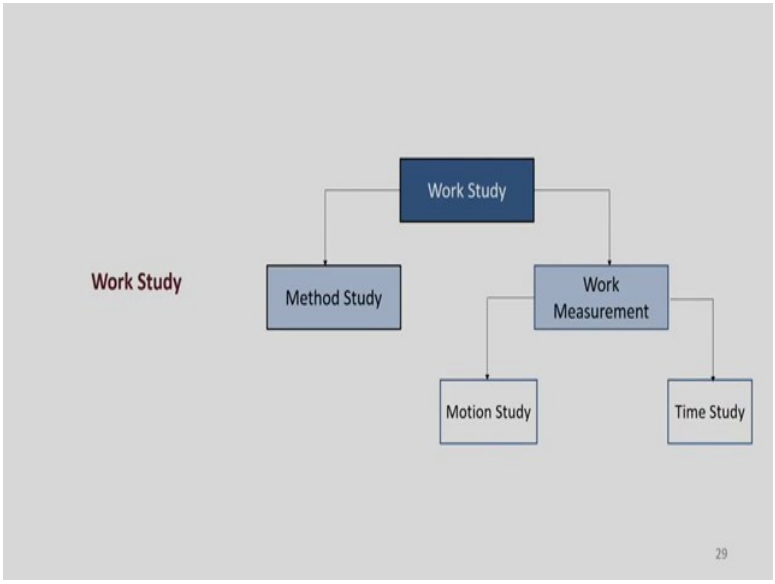

So, work-study can be divided into two major steps; that is the method study and work measurement. And, work measurement can be divided into two motion study and time study, I will take you to the definition of this.

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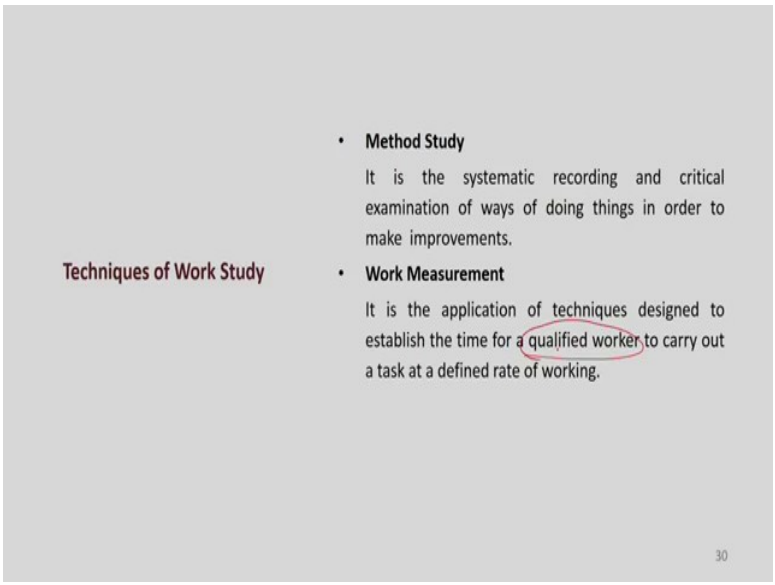

So, method study is a systemic recording and critical examination of ways of doing things in order to make improvements. And what is work measurement? It is the application of techniques designed to establish the time for a qualified worker to carry out a task at a

defined rate of working. Here this qualified worker is very important, and it is not that any person the reference can be any person, reference always should be a qualified worker.

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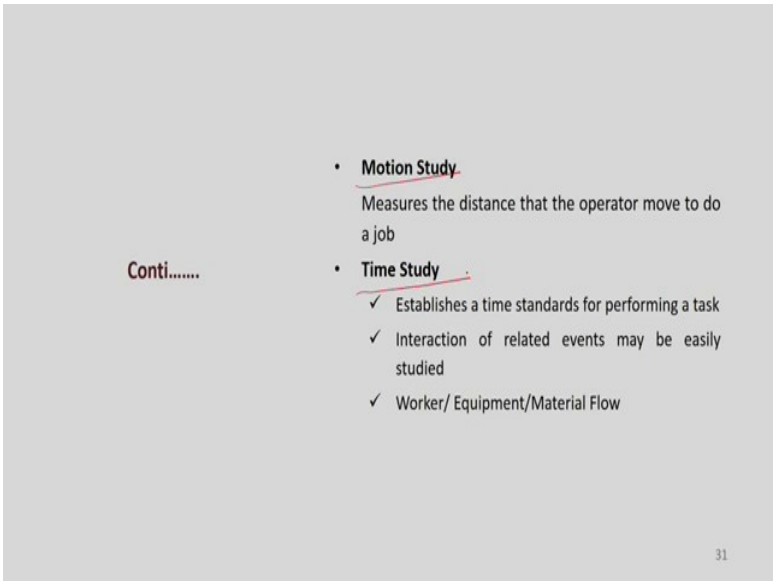

Motion study measures the distance that the operators move to do a particular job. And, time study it helps to establish a time standard for performing a task, interaction of related events may be easily studied and worker equipment and material flow. So, it is absolutely, motion is only the distance, time is time study talks about the time and time measurement.

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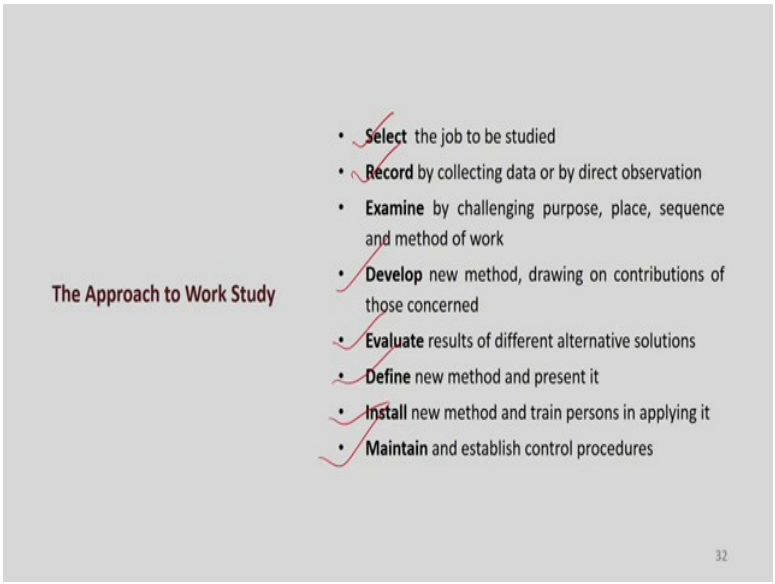

So, what are the approaches? First we select that particular job what we are going to be, what we are going to study, record by collecting data or by direct observation, examine by challenging purpose, place, sequence, and method of work. So, you need to examine that then develop the new method, and you can create a drawing on the contribution of those concerned. Evaluate the result, define the new method, and first you present, and then compare, install new method and train the person who is going to use that and maintain and establish it for control procedures. So, these are the approaches we follow in the work-study.

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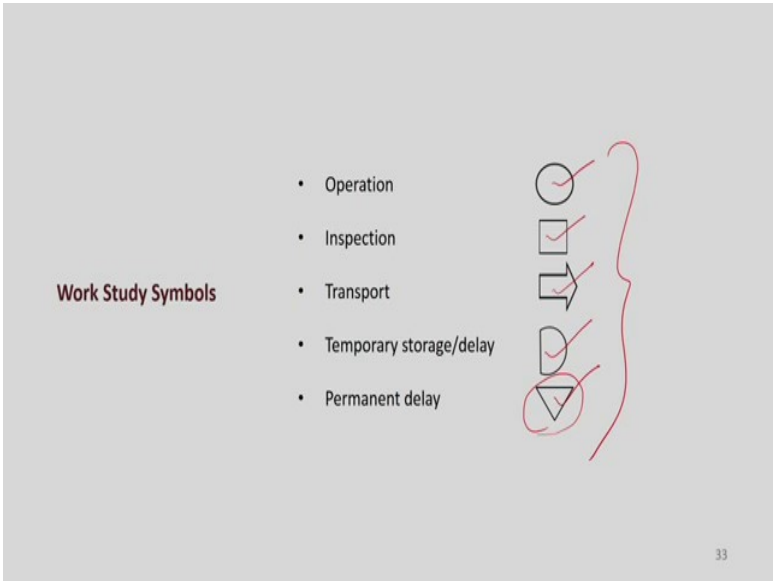

Very important when we are talking about work-study symbols, this is called operation, this is called inspection, transportation, delay or storage and this is permanent delay. So, permanent delay maybe we can consider some machine break down, no in inadequate amount of material so, those things. The temporary delay means I may be waiting for someone to give a command or I just get these elements over here, and somebody will take it and do the operation, so these are. Now, these all symbols are very specific, you cannot do the changes over here you need to follow these symbols as it is.

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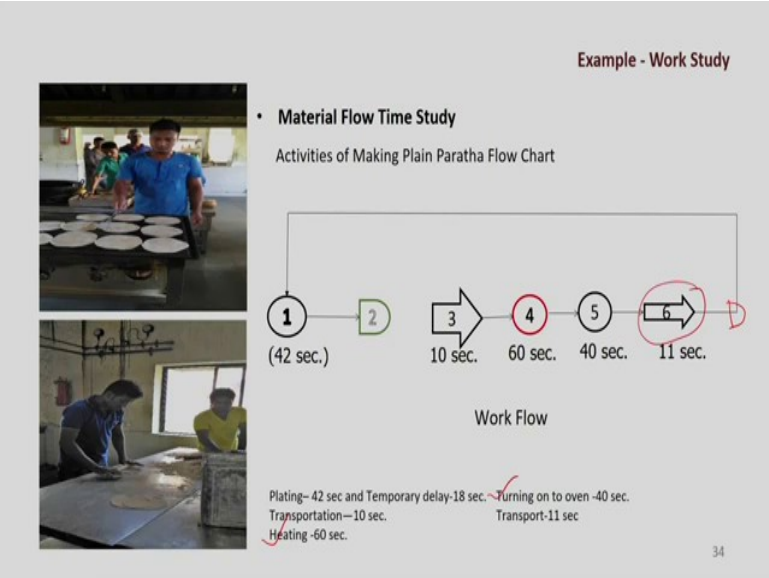

Now, take an example here. So, here am trying to give you an example; a chapatti, or paratha making at our hostel mess. So, what very simple here only material flow we try to explain. So, first is the plating, we plate it for 40 seconds, and there is a temporary delay that we wait that to be heated, then we do the transportation, then heating.

We heat it one side, then we turn it to the oven for another side and then we do the transportation. We keep it for a temporary store them maybe here you can do temporary storage, maybe here you can do temporary storage and can go back to the other like you repeat the process. So, this can be done.

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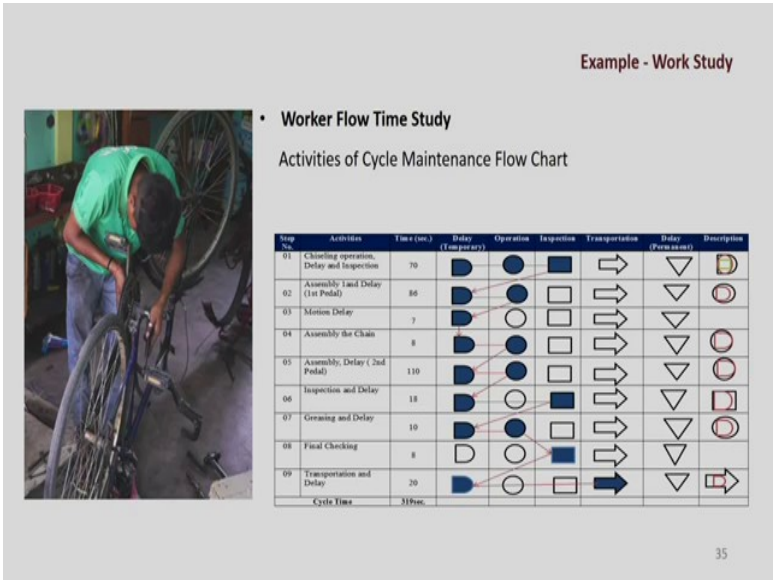

Now, again here, I tried to explain the worker flow time study. So, here it is material flow, here it is workers flow. So, we can create this chart like this. So, what work-study actually does? Work-study tries to talk about productivity. So, what is productivity? Per unit input what is your output. So, doing your work-study in terms of method study or motion study or you know time study whatever you do finally, you try to explain the productivity.

So, if there is a change in productivity as expected or change means in the reduce it is being reduced, then we really need to see the process. So, we will study those process, and we will do the task analysis, and we will find out where the critical aspect is. And, we will do the maybe different types of intervention maybe mechanical, maybe design, some other elements, or maybe managerial decisions.

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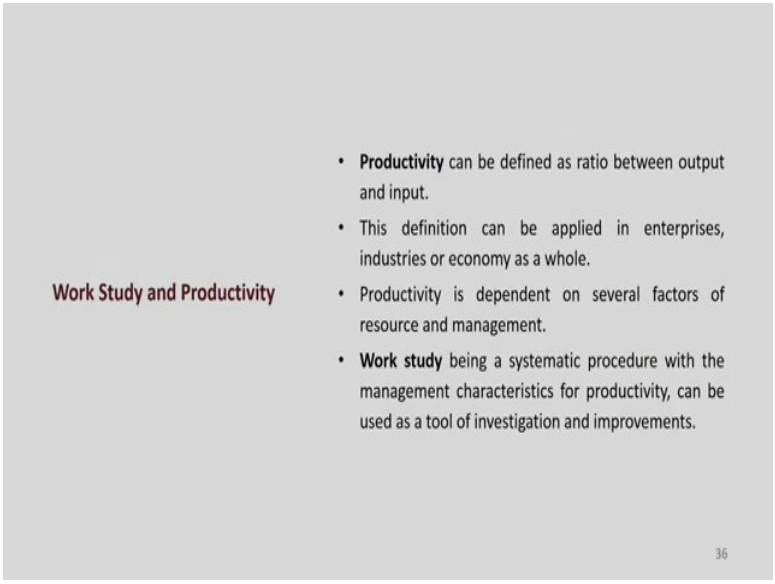

So, that way, we can use these all methods like the whole task analysis different techniques we can use to identify that. So, this definition can be applied in enterprises, industries, or economy as a whole. So, that is very important and work-study being a systematic procedure with the management characteristics of for productivity, can be used as a tool of investigation and improvement what I explained earlier right.

So, using these particular different work-study tool also with the help of task analysis techniques and tools what we will do, we will understand the whole system. And, it is a part of the workplace analysis because you are going to answer that how your workplace is performing in response to a particular goal. So, once we do that we will achieve our goal. So, this much I thought today I will be talking.

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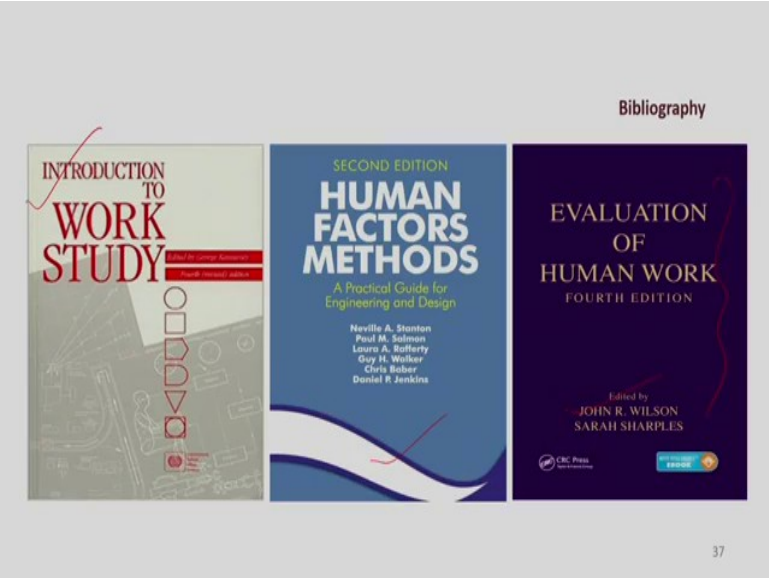

And these are the books, this book is very important if you talk about the work-study. Also these two books you can follow for other purposes like task analysis, here you will get a lot of techniques you know which can be explained as you know tools of task analysis. So, here I would like to conclude today's class and I will meet you in the next class for other topic.

Thank you.