Ergonomics Research Techniques

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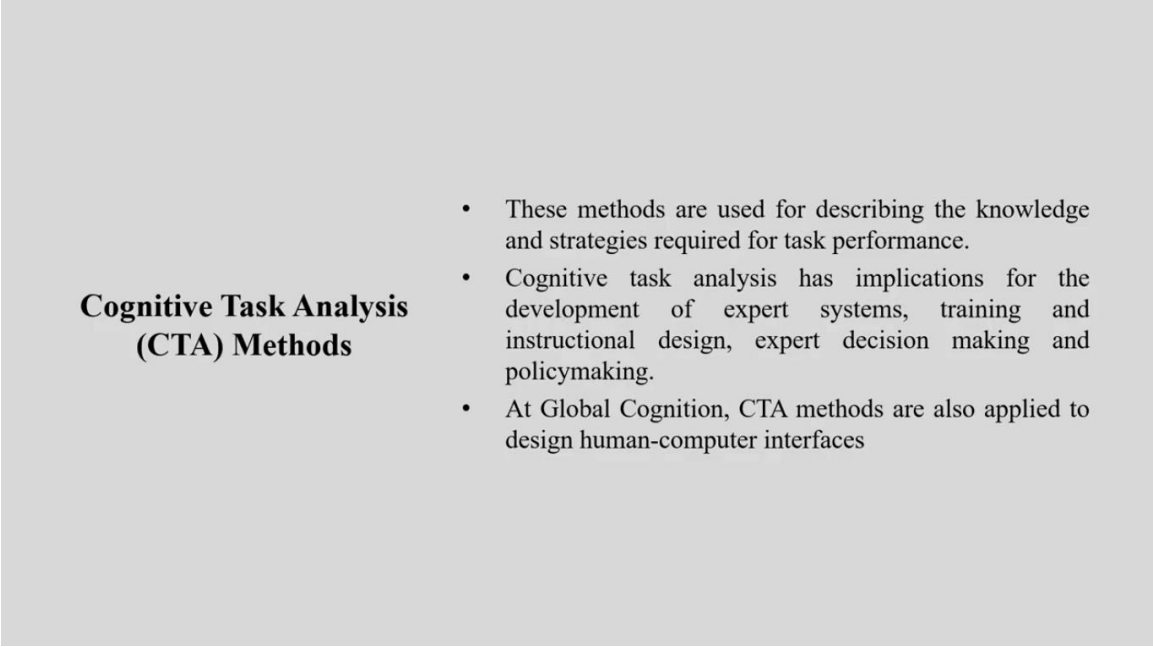
Week 8: Lec 26- Cognitive task analysis methods

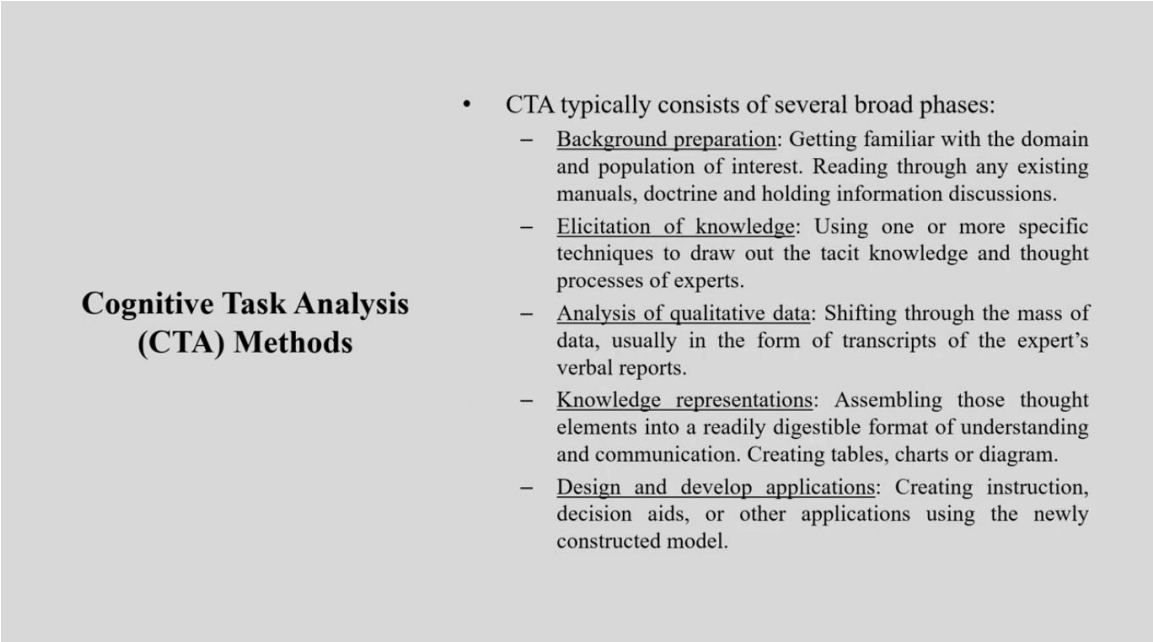
Hierarchical task analysis

Welcome back for today's class. Today we are going to take the next part of cognitive method. We will start with we discuss the general analysis method. Now from today onwards we will start the cognitive task analysis method ok. So, we have different method and we will discuss few of them over here.



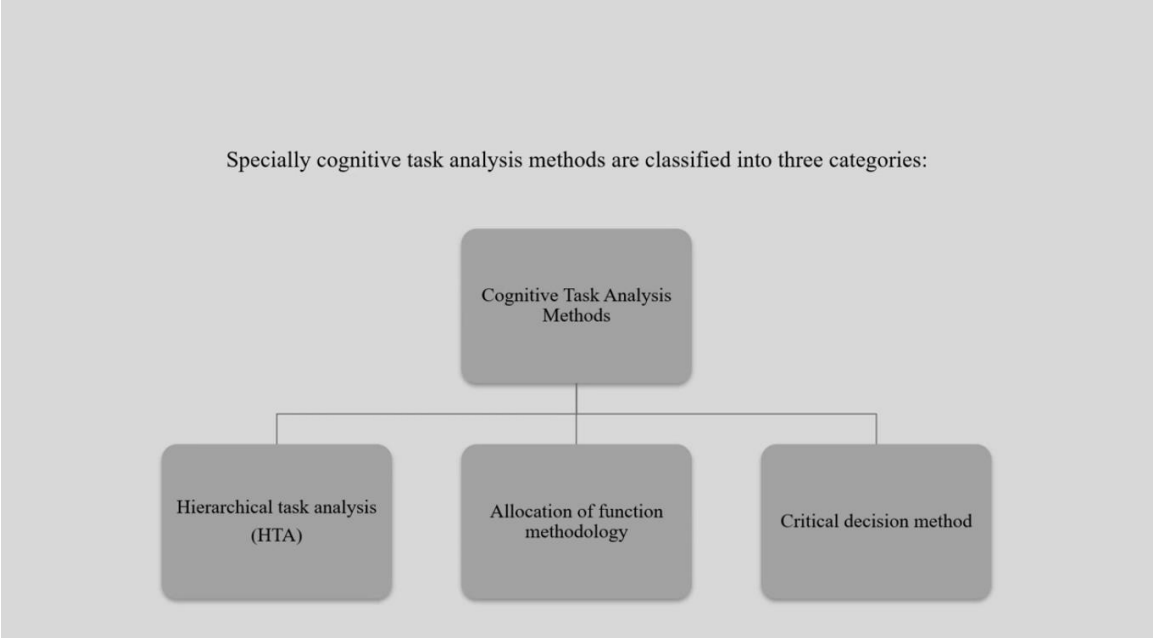
So, let us understand what is cognitive task analysis method. So, these methods are used for describing the knowledge and strategies which is required for understanding the task performance. So, here in the whole cognitive task analysis method whatever we were going to discuss here the point is task performance which is very very important. Whenever we are talking about task, we need to understand first what is task. So, in a whole job we we should have these definitions ready. We should identify the task that we are going to analyze for our this particular study and then we can take up any one of the method as per requirement and we can go ahead. So, if we talk about cognitive task analysis methods, we should understand what is task task, what is the kind of performance we are looking for, what is initial point of this task and this ending point of this task. So, input and output which is very very important whenever we are talking about this type of you know methods. Cognitive task analysis has implications for

development of various expert system, training and instructional design, expert decision making and policy making. See why all these? So whenever we are talking about task performance a person who is performing a particular task, so kind of job demand is there, kind of requirements are there and what is the performance level, what is the competency level. If we understand all these, then only it is possible for the designer, possible for the person who is doing the intervention to optimize the whole system. And once we try to do the optimization, there all these decision making, policy making will come into existence and of course new design, new design will come into existence. So whenever we are talking about cognitive task analysis, understanding the task performance at the end definitely what will happen using the output, using the interpretation of all these data, what we are going to do? We will understand where the lacuna is available in this particular system and where the intervention point can come, how the intervention can help to enhance the performance or productivity of the whole system. So whenever we are talking about this type of, these types of analysis we need to understand what is the system goal. So in our earlier MOOCs course we definitely discussed what is system, how the system function, what are the components of system. So whenever we are talking about task analysis of course that system understanding need to be there. So for more understanding about the system, you can refer the earlier MOOCs course that is ergonomics workplace analysis. So at global cognition cognition, cognitive task analysis methods are also applied to design the human computer interaction. Here human computer interaction does not mean only the literal computer, okay. So it is not that only desktop, laptop or something like that, no. So any system where the machine is present, how the interactions are happening, so that is going to be discussed or going to be analyzed in this particular cognitive task analysis method.



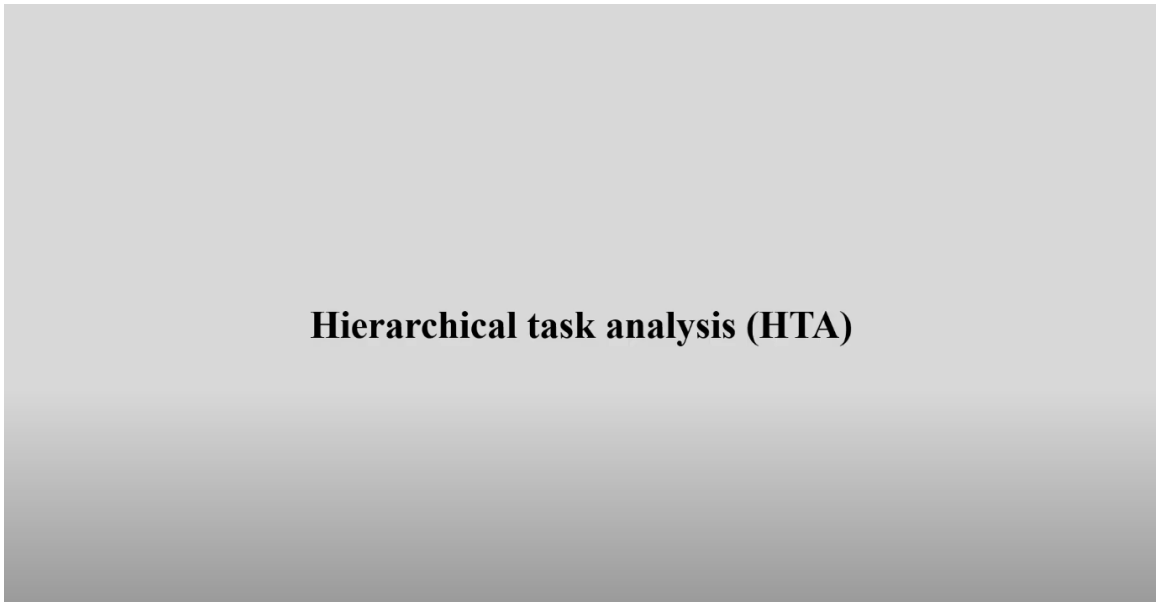
So let us understand what are the broad phases available, typically five. So what first is background preparation, then is elicitation of the knowledge, then qualitative data analysis, knowledge representation and design and develop that particular applications. So let us go one by one. So when we talk about background preparation what exactly it says? It says getting familiar with the domain and population of interest. So when we are talking about task analysis before we choose a method, okay there are several methods, right in cognitive task analysis. Before we go for a particular method what we need to understand? We need to understand what performance or what exactly we are going to study. So we have to be familiar with that particular area. Also the people who are actually involved in that particular job, in that particular task, we need to understand them very carefully. So population characteristics, so the age, the socioeconomic status, educational status, behavioral understanding, how they behave with each other, peer interaction. So depending on the type of task that you are going to analyze, we should understand the population very, very carefully. So before we select our sample we should understand the population characteristics, we should fix them very carefully. So whenever we are talking about population of course next stage is your sample, right. So before we select sample we should be very clear that what are the inclusion and exclusion criteria for that particular sample. So we should fix them before we go ahead with any kind of task analysis. So reading through the existing manuals whatever is available, doctrine or holding information discussion, so that is also possible. So whenever we are talking about that particular activity, so we of course we should understand what type of task that we are going to analyze. You should be very clear that what task I am going to analyze. So this understanding, I am emphasizing over here repeatedly because this part only we miss sometime. We just choose a task analysis method and we start working and once we get the data we realize okay this is not possible, like or maybe the data is not correct. There are many difficulties in the analysis stage. This only happen when we miss to understand the task at the initial level. Next is elicitation of knowledge. So using one or more specific techniques to draw out the tacit knowledge and thought process of the experts, okay. So it is very important as we are always talking about human, okay. Whenever we are talking about anything related to ergonomics, human is the main component, right. So understanding the tacit knowledge is very, very important because many things are not theoretically presented in book or in any journal papers or something. Whereas very specific tacit knowledge is very important whenever we are trying to understand that particular task background. So clear identification of those tacit knowledge specifically to that particular context is very important. So you can take up any one of the earlier method like observation or interview or focus group study and you can take information from there as the source of tacit knowledge. Of course, experts interviews always help you to understand this better. Next is analysis of the qualitative data because whenever we are in the initial stage we may not have any quantitative data for such cases. So analyzing those qualitative data is

very, very important. So shifting through the mass of data usually in the form of transcript of the experts verbal report. We can use content analysis, we can use focus group study data and we can of course interview, we can use and you can find out what is the exact scenario available in that particular context. It is very, very important. Next is knowledge representation. So assembling those thought whatever you are receiving from your earlier observation, earlier interview data elements into a readily designed digestible format. So here it is important what way you want to synthesize them. So if you are expert in that field of course you can derive your own. However, it is always advised for the new researchers you take help from the seniors, you take from the experts to derive how to derive these data. How the communication, extracting those information, how you are going to do that. So you take initial, at the initial stage take help from them. And the creating table chart or diagram whichever is suitable for your particular research. And the last step is the design and develop that particular application. So creating instruction, decision aids or other application using the newly constructed model. So after all at the end definitely we are going to design the particular model. We are going to construct that model and ultimately from all these information we are going to design it or construct it. So these are the basic five steps, phases basically that we should take up when we are talking about cognitive task analysis methods. Now we are going to discuss few of them not all, there are many varieties available. However, which are the broadly used methods that we are going to discuss.

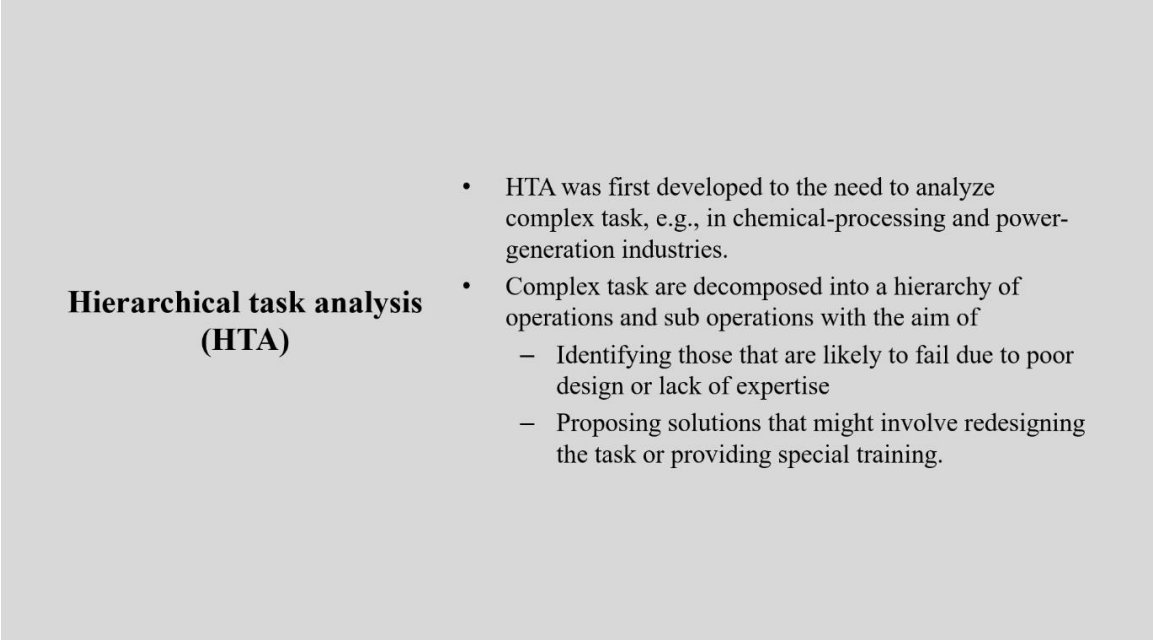


So mainly we are talking about hierarchical task analysis, because this is a method which is broadly used or majorly used in many domains. It is not only in the field of design, not only in the field of industrial engineering, in many you know subject, in many stream this particular method has been used for years and years. Then next is allocation of

function methodology and then critical decision method. So these three we will be discussing separately.

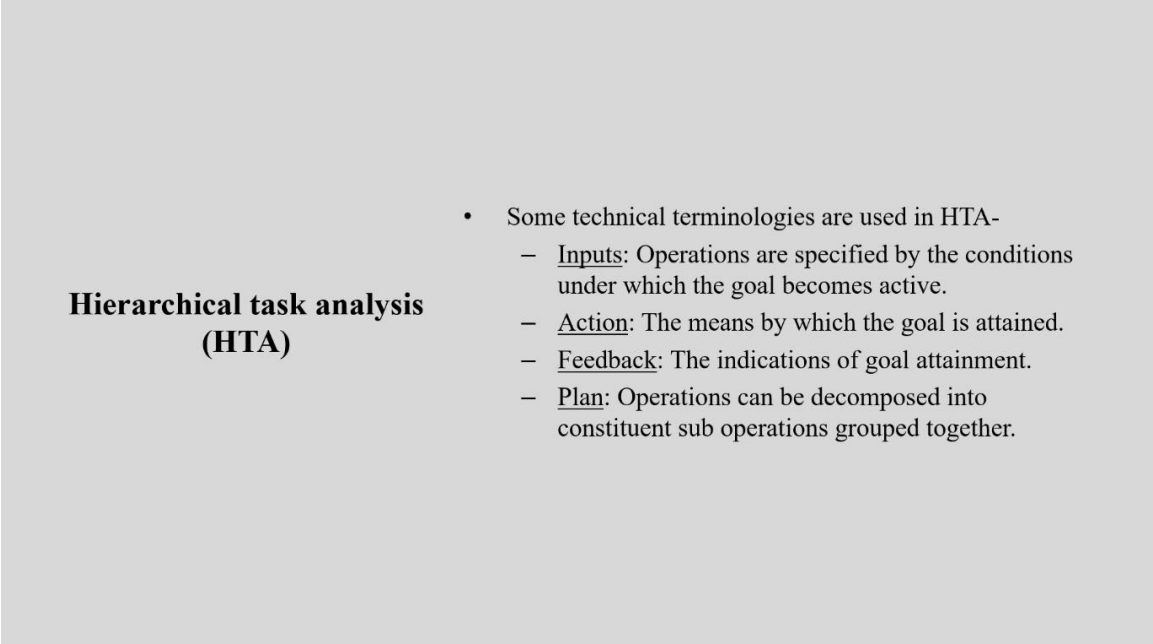


So let us start with hierarchical task analysis. In short, we call it as HTA. By nomenclature itself you understand how it will look like, what we are going to get from it. So hierarchy means we are developing an hierarchy based on the task that we are going to perform, the worker is going to perform. Now these I already mentioned in earlier classes that input can come from observation, mainly from the observational data. So whenever we are observing a particular task, observing a particular job in the workstation or workplace, you can take a video recording, you can get the observational data and you can give that as an input for the hierarchical task analysis.



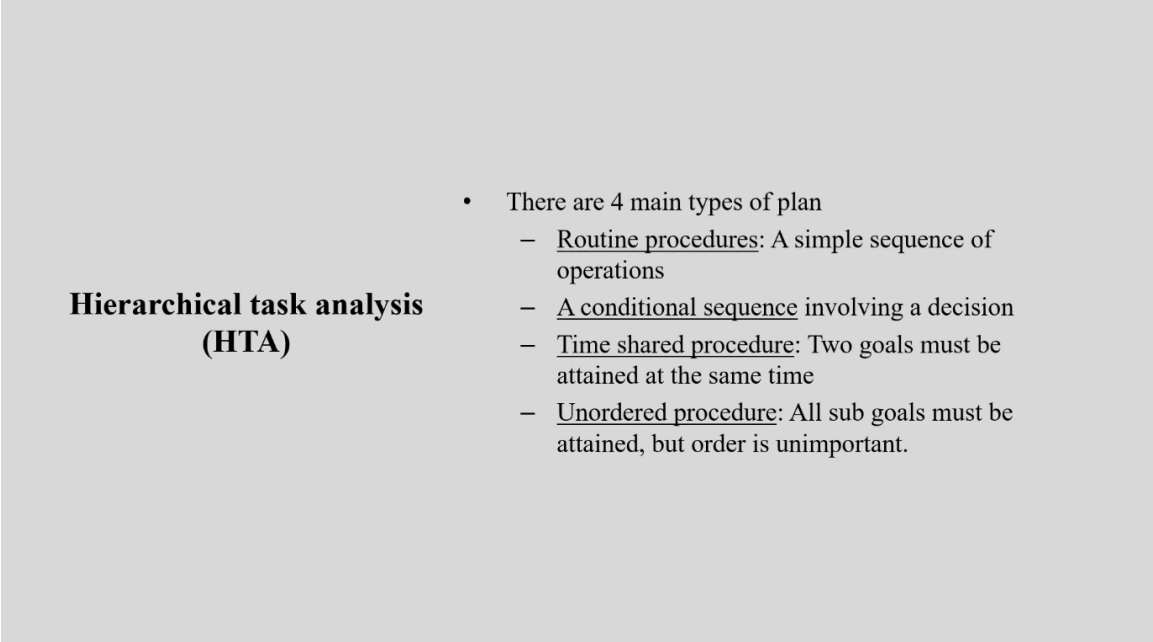
So let us understand it in detail. So HTA was first developed to the need to analyze complex task of course. Simple task it is very easy for us to understand, we can have a simple flow chart and we can understand the time taken or movements involved into it and we can understand where the interventions are required. However, in complex task where two, three components are connected with each other as a complex system. Do you remember that the systems, you know, man-machine system where we are talking about simple system and complex system. I will just give one more revision. Simple system means where one man, one machine and within a single environment they are interacting with each other. So there is no complexity. Whereas if any one of the component, any one of the component of the man-machine system changes like, you know, two man or three man or three machine or four machine. So if there is a change in the number of the man or machine, then it becomes complex in nature. So one component, the input from the output from the one component can act as the input of the other component and then it becomes an information flow and it creates a network. Okay. So when we have such kind of, we have such kind of complex system in place, then only we need this type of analysis to understand which one is coming prior, how the impact is flowing from one to other and where the interaction points are and which interaction point is causing the problem or which interaction point is having more gravity. Right? So whenever we are talking about hierarchical task analysis, we should remember it is a complex system. Okay. Example, initial days it started with the chemical processing unit, power generation industry for all these cases we used to go for the hierarchical task analysis. Later nowadays we are using it for many, many fields. So complex tasks are decomposed into a hierarchy of operation and suboperation with few aims. First, normally what we try to do is identify those are likely to fail due to poor design or lack of expertise. So here two major identifications are important. One is poor

design. Okay. Poor design and lack of expertise. So when we are talking about poor design, if we can really identify this poor design, what we can have? We can have direct indication that if we can improve that component, improve that particular design, of course my whole performance will go up. Whereas when we are talking about lack of expertise, what we need to do? We need to have some kind of training program, you know information and better system design so that there is less dependency on the experience, less dependency on the expertise. So then it becomes more easy for a new person to adopt the situation. Okay. This is one. And second is the, you know, we are going to propose the solution that might involve redesigning the task or providing special training. So it is connected with each other. Right? So that is very, very important.



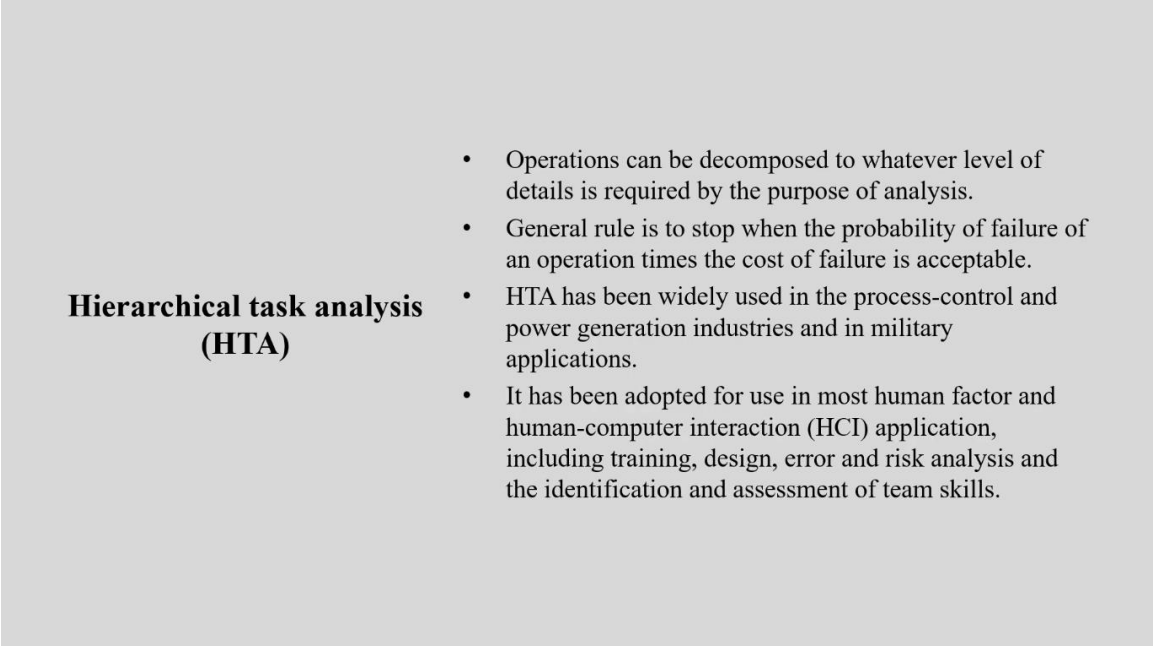
So whenever we are talking about hierarchical task analysis, one very important thing that we need to understand, we need to first understand what is the hierarchy present in that particular task. Okay. And how do we do that? We are going to explain it. Whenever we are talking about hierarchical task analysis, we should understand few terminology. First is input. We are talking this particular input many times. So operations are specified by the condition under which the goal becomes active. So that we will call as input. Okay. Second is action. Okay. That means by which the goal is attained. So you are doing some job. Okay. It is very easy to understand basically. Then third is feedback. So the indication of goal attainment. So whenever you are doing, performing an action, what will happen? There will be a result. And how you are receiving that information back. So contact between the end and the person who is operating it. So that kind of information. Okay. And of course the plan. So operations can be decomposed into constituent sub operations grouped together. Okay. That plan is very, very important. So

these four major terminology we should understand before we go ahead with the procedure of the hierarchical task analysis.



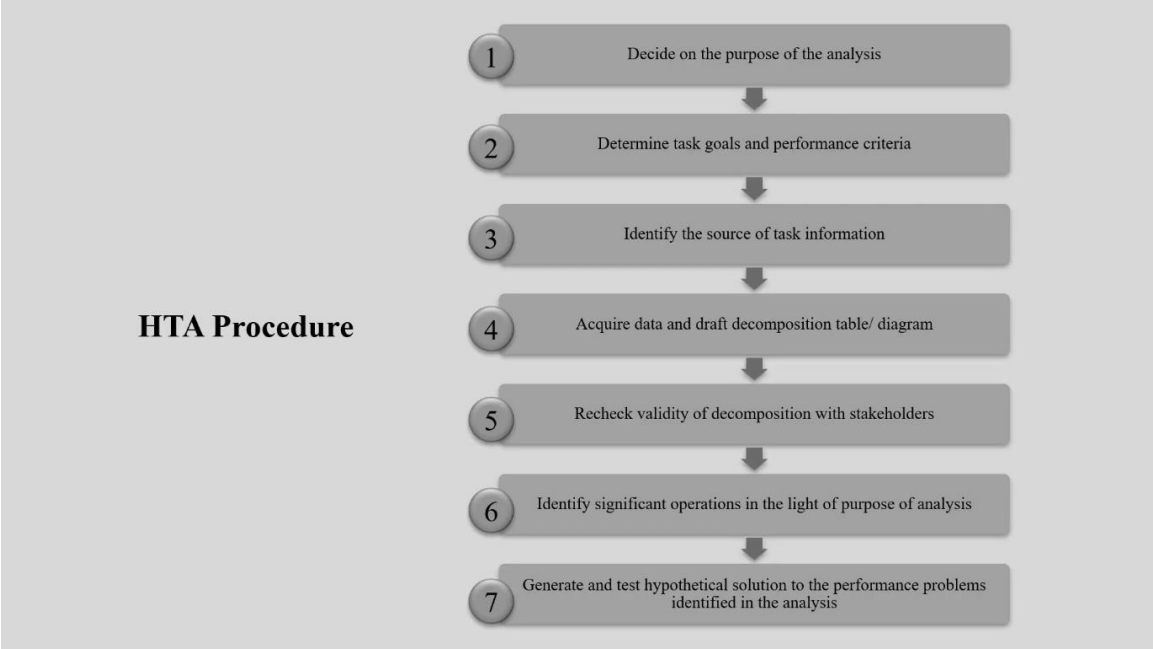
If we talk about plan, there are four major types. Apart from that we can have some more. However, these are the four major types that we normally practice. Okay. So first one is routine procedure. Then second is a conditional sequence, time-shared procedure and unordered which is not really in sequence such kind of procedures. So let us understand one by one. First is routine procedure. So what it is? A simple sequence of operation. So suppose I am talking about taking a class in a classroom. Simple process if we look at students arrive at class, teacher go to the class, pick up a particular topic, use blackboard, chalk and start taking the class. Now this is very broad divisions. Right? However, it is a very complex system if we go into detail like you know how students are arriving, how teacher is arriving at class, how they pick up the, every portion can go into more detail. Okay. So and each can have a simple sequence of it. So this is called the routine procedure. So when we are talking about understanding the sequence of operation, so step by step, 1, 2, 3, 4, something like that. Okay. The next is a conditional sequence where we are imposing some condition. So involving a particular decision. So if we go back to the previous example like teacher coming to the class and taking a particular class. Now if I am supposed to take a presentation and you know going ahead with the class, in that case condition is if laptop is present in function, if projector is present in function, so these are all the conditions we need to have. Okay. Sufficient illumination is there or not. So all these are condition. Then third is time shared procedure. So what it is? Two goals must be attained at the same time. So now when I am talking about, let us go back again to the same example. Two particular goal maybe we can set in that particular class. So in that what will happen? In a same class, two separate goal has to, you know

has to come out, like the result has to reflect. Okay. So then it is time shared procedure. So simultaneously it will go ahead. So read understanding and then writing or performing a particular job or something like that. Okay. And unordered procedure, all sub goals must be attained, but orders is not at all important. Okay. So maybe we can take up some, you know some product making or something, where we know this product need to be made and there are sub components of those, that particular product. I am not concerned that which part to be prepared first, second or third. However, I am only concerned the whole product should be ready, whole product should be ready as per the requirement. Okay. So that is the unordered procedure. There is no order is following. So maybe just for example, the whole product may have three components. Okay. Component 1, component 2, component 3. So I am not worried about that component 3 is prepared first or component 1 is prepared. At the end, whenever the component 1, 2 and 3 are ready, then only I am going to get my whole product. However, I am not really interested to understand or know that first is component 1, 2 or 3. So there is no order. Okay. So that is unordered procedure. So these are the four main types that we can have in the plan section.



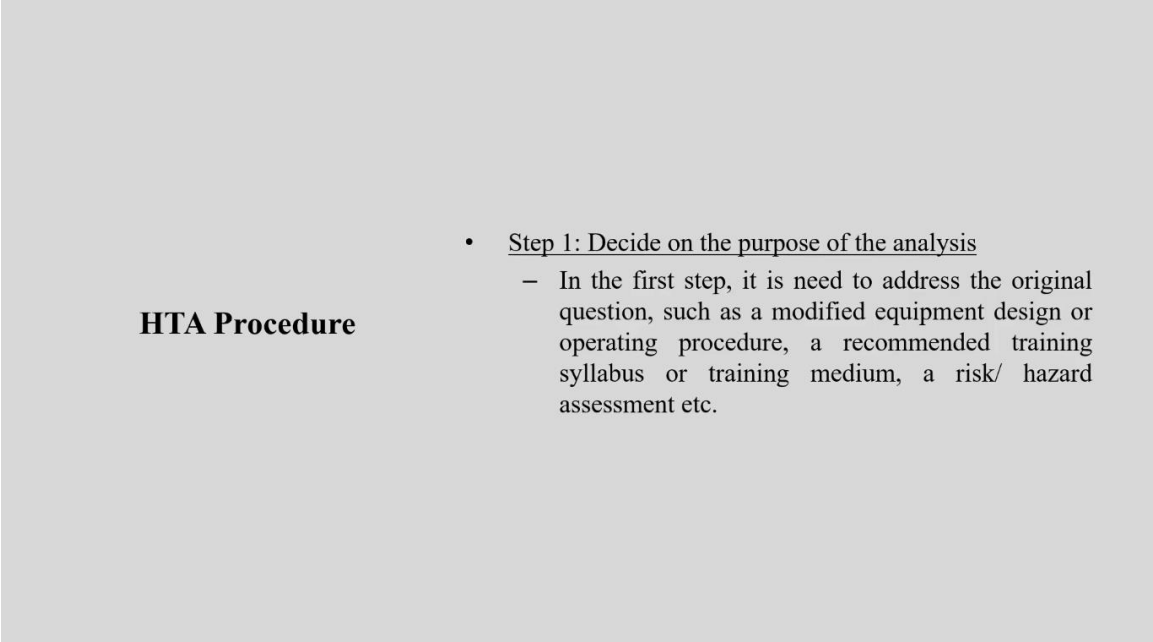
Little more about this hierarchical task analysis. So operations can be composed or to whatever level of the details is required by the purpose of analysis. So depending on the result that I am looking for, so objective, objective of my study, depending on that decomposition is possible. So you may decide at what level you want the decomposition. Okay. We will come about the procedure of decomposition definitely. So this decomposition depends on the objectives of the research. Okay. General rule is to stop when the probability of failure of an operation times the cost of failure is acceptable. So at that point, we may stop our decomposition. Hierarchical task analysis has been

widely used in the process control and power generation industry and in military application that we already mentioned. It has been adapted for use in most human factors and human computer interaction application including training, designing, error and risk analysis and the identification and assessment of the team skill. Okay. So how we are going to do that, all we are going to discuss later.



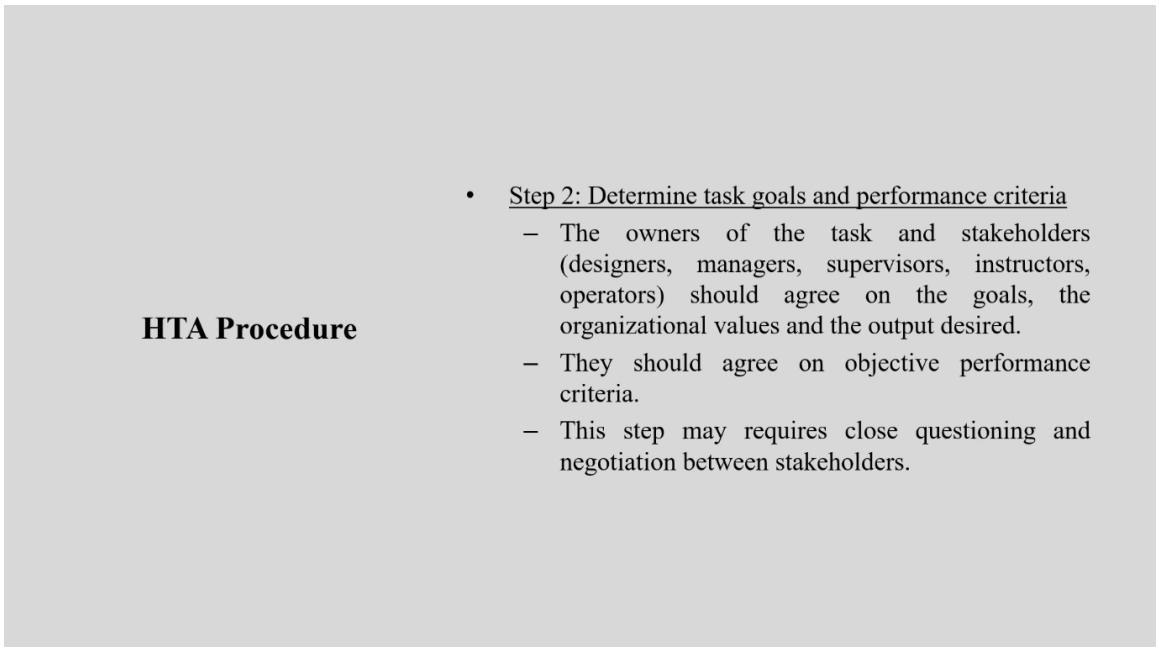
So if we go for the detailed procedure, in short it has these many steps. Each steps we are going to discuss. So first let us read out what are the steps one by one. So decide on the purpose of the analysis which is very important. If you are not clear about the purpose of the analysis, we will not be able to select that particular task. So when we know, when we understand at the end what I am looking for, so visualizing that is very, very important. Then determine the task goal and performance criteria. Third, identify the source of task information. Here it is very important, this task information. So if we do not understand what is the task information is available, then it becomes very difficult that to decompose those tasks further. So identifying the sources of task information is very, very important issue over here. Fourth is acquire data and draft a decomposition table that we are going to perform. Here it takes lot of time. You really need be very patient enough to draw that particular diagram. And it may happen you draw a particular decomposition diagram and later you found one more steps to be incorporated. Again you have to redraw that. So this is little tedious job. Reject the validity of the decomposition with the stakeholder. So it may happen that you decomposed it and later you take to the stakeholders and they inform, okay there is this step is missing or this decomposition is not correct, steps are little different, then again you can rewrite that particular table. So here it is a no feedback mechanism. The information come from here and after getting the feedback you can again redo the task, you can redo the table. Once

the table is ready, identify the significant operation in the light of purpose of analysis. So wherever, whatever is your objectives are based on that you identify the significant operations. According to the identification only you can go ahead and then generate and test the hypothetical solution to the performance problem and identified that particular like how you are going to take it further. So once whatever the problems are identified you then you take it for the further analysis, okay.



So let us detail it out in for each step. So first is the decide on the purpose of analysis.

In the very first step what you do it is need to address the original question. Now how this original question comes? So whenever we are looking at a particular task, looking at a particular job and we understand okay fine hierarchical task analysis need to be performed. We try to understand at the end of hierarchical task analysis what is the possible outcome, where I will land. So based on that question first original, first question we need to identify that particular task. Such as modified equipment design or operating procedure or recommended training syllabus or a training medium, many case, many thing is possible, okay. Simply if you want to design a particular tool what you will do? You will take it like what are the steps to be followed to use that particular tool. In that case how you can have this? So describe that particular purpose and you match it how you are going to do it. So decide the purpose of that analysis.



Second, the determine the task goal and performance criteria. Let us first read out what is there. So the owner of the task here it is very important who is going to perform it and the stakeholders, okay. Stakeholders of that whole task should agree on the goals and the organizational value and the output desired. First they should come into a particular point, okay. This is going to happen. So if there are differences then looking at the task, the perspectives will change, right. So before we start looking at the whole procedure we should be in a same platform. So they should agree on the objective of the performance criteria and this step may require close questioning and negotiation between the stakeholders. So we should be clear when we all stakeholders and the performance should be there in the on the same platform. There will be no differences in their opinion about that particular task. If differences of opinion are present then it may happen there will be a biasness, there will be missing of data and there will be many like wrong interpretation of the data will happen. So everybody should be there on the same understanding about the goal about the particular task.

HTA Procedure

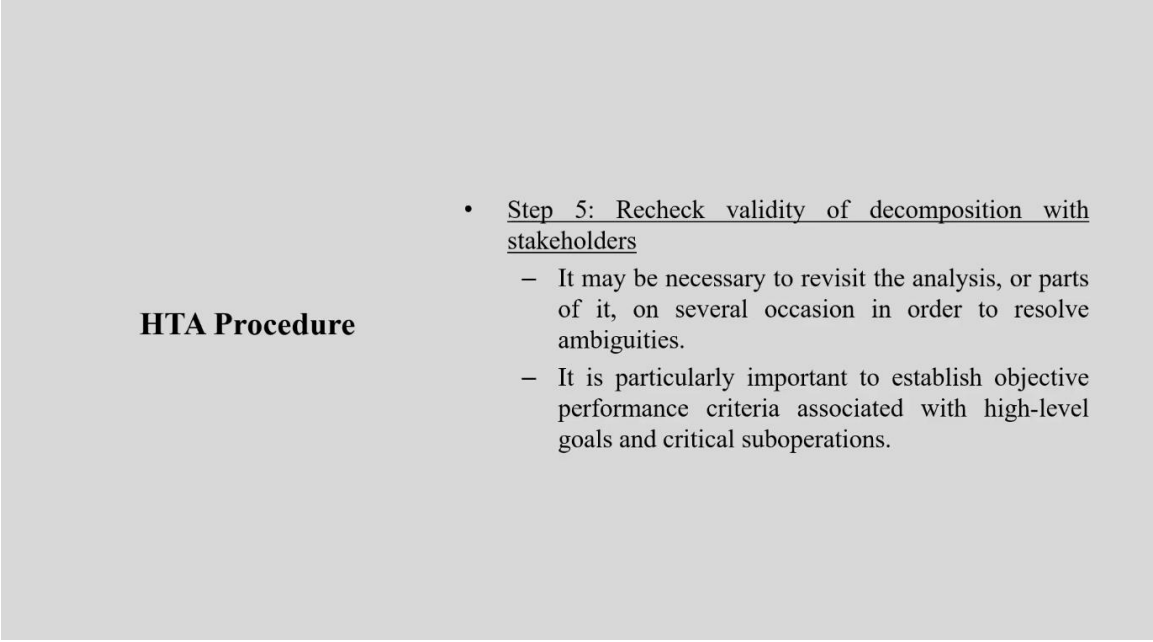
- Step 3: Identify sources of task information
  - This step includes documentation, such as drawing and manuals for maintenance and operating procedures; expert opinion from designers, managers, instructors and operators; and records of plant or operator performance (accident and maintenance data).
  - Direct observation is helpful for initial orientation and for checking opinion

So identify the source of task information. So as I mentioned, so here identifying that you know input source is very, very important. So this step includes the documentation such as drawings, manuals for maintenance and operation of procedure, experts opinion from the designer, managers, instruction and the instructors and the operators and the records of the plant and operator performance. So whatever informations are available regarding that particular task, so whatever the sources are there you are going to use it, you should identify them beforehand. So once the task is ready to analyze then you find out what are the sources available. Then direct observation is helpful for initial orientation and for checking the opinion.

HTA Procedure

- Step 4: Acquire data and draft decomposition table/ diagram
  - It is usually start with top-level goals, asking in turn how each subgoals is attained.
  - The decomposition table and diagram should reveal the overall structure of the task, including significant plans (long procedures, critical decision rules, dual tasks etc.)

Fourth step that acquire data and draft the decomposition table diagram as I mentioned it is a very tedious job, you should be very much careful when you do it. Basically what we try to do it is not that one particular person do this, we can have 3, 4 members of the team and they do it separately and they match with each other and then they go back to the stakeholders. Then it becomes very detailed, very precise and there will be less chance of error. So what exactly it does? It is usually, it starts usually with the top level goals asking in turn how each sub goals are attained. First is big, small, small, small, small like that they will derive it. So the decomposition table or diagram should reveal the overall structure of the task including significant plan. Whatever specific significant plans are involved in the whole task that has to be incorporated in this diagram. So long procedures, critical decision rule, if there are dual tasks to be performed everything has to be there very critically present and detailing, detailing is very, very important. So decomposing them at the minimum level that is very important over here. So it is a very critical portion and which you should do again and again so that you can arrive at better data, better decomposed table.



So once you derive it, so as I mentioned that you can do it for two members or three members team. So each member will have separate, then you combine them. If there is no major differences you can take anyone or if there are differences you would re-discuss and finally formulate your decomposition table. Once it is there, then you go back to the stakeholder and check them. So rechecking is very important. Once you recheck then what will happen the stakeholders or maybe the operator himself or herself. So they will have better understanding about that particular idea and they will clarify the process is whatever you have prepared is exactly the way they are doing it or not or there are some changes, there are some changes is required or not. So that they will mention or

they will clarify it. So that is very important. Once you get the clarification you can redo your decomposition table.

HTA Procedure

- Step 6: Identify significant operation in the light of purpose of the analysis
  - Operations can be decomposed to whatever level of detail is required by the purpose of the analysis.
  - A general rule is to stop when the probability of failure of an operation times the cost of failure (p×c) is acceptable.
  - The reason for failure may be obvious upon inspection of the details of the operations.
  - It is helpful to consider failures related to input, to action and plans, and to feedback.
  - Feedback essential to correct performance may suffer the problems of any other type of perceptual input, but may be especially disruptive if subject to delay.

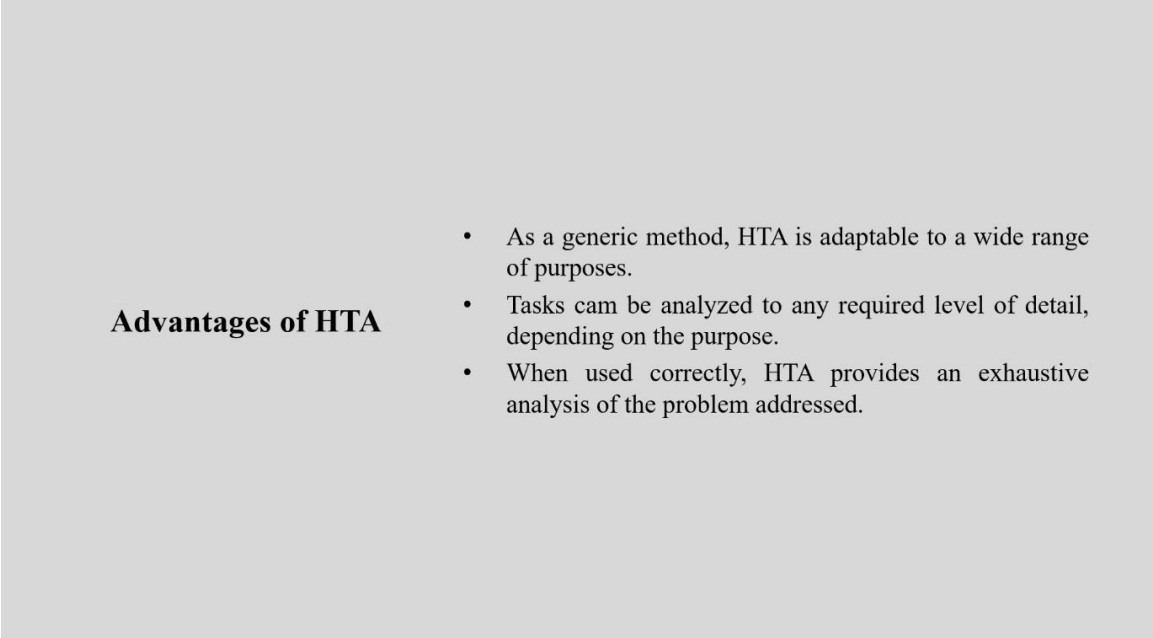
Then is your actual analysis. So identify the significant operation in the light of purpose of the analysis. So how do you do that? So operations can be decomposed to whatever level of detail is required by the purpose of analysis. So at what level you can fix it up. The general rule is to stop when probability of a failure of an operation time, the cost of failure is acceptable. So probability and the cost of failure. So these two things are this if it is at the level of acceptance you do at that level only. After that if it is not acceptable you do not go it further. So the reasons for failure may be obvious upon inspection of the details of the operation and it is helpful to consider failures related to input to action and plans and to the feedback. So this feedback is very essential to correct the performance and which may suffer the problems of any other type of perceptual input but may be especially disruptive if the subject the operator wants to delay it. So this is very very essential part how do you understand these feedbacks which is present in the whole decomposition table. So all these information you can gather if you follow these steps and then you can have your own data set ready for further analysis. Probably we take these for the statistical treatment or may be descriptive statistics.

HTA Procedure

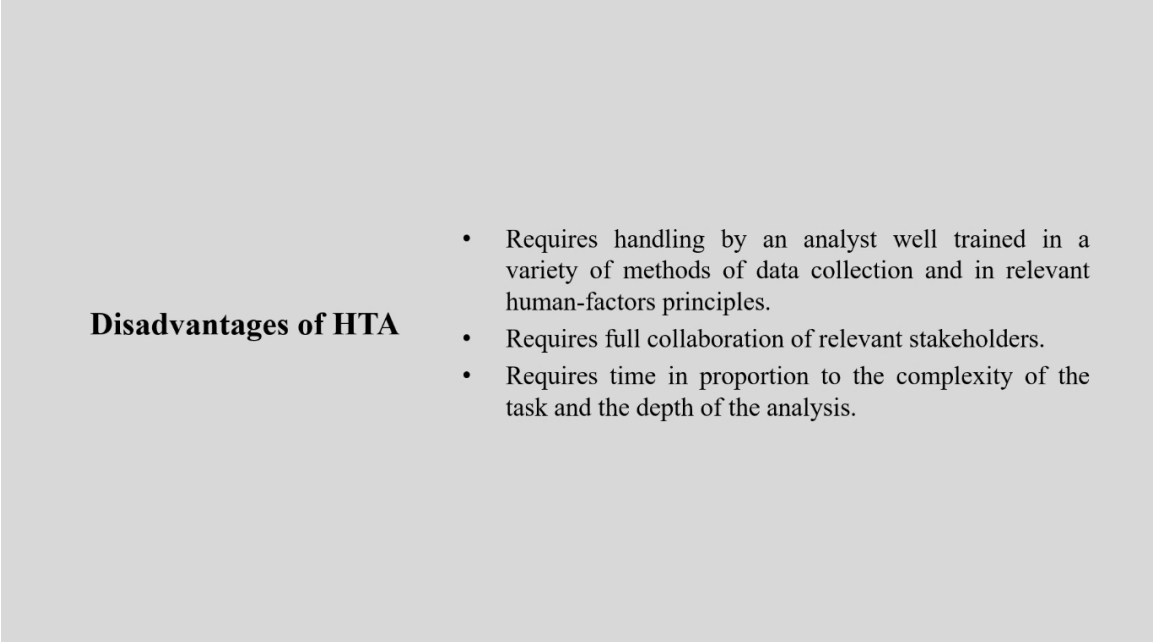
- Step 7: Generate and test hypothetical solutions to the performance problems identified in the analysis
  - Identifying the likely sources of unsatisfactory performance, plausible solutions, based on current theory and best practice are presented.
  - These may be related to the task design and the equipment, personnel use, procedures or training, and other forms of support, depending on the purpose of the analysis established in Step 1.
  - Usually the type of solution, e.g., to modify the design of the equipment or to construct a training syllabus is predetermined.
  - But the analysts should not refrain from drawing attention to alternative solutions where this may offer advantages.

Next is you generate and test the hypothetical solution to the performance problems which is being identified in that particular analysis. So what are the steps that we can do? So identifying the likely sources of unsatisfactory performance. It is very important. Here all these are decisions. So what you have to do? You have to identify the sources of unsatisfactory. So in the whole hierarchical table it may happen there are 4 unsatisfactory performance. Now why these unsatisfactory? So cause root analysis, root cause analysis. So you have to really go back and check that why these satisfactory performances are coming into in this particular stage. If we can understand that this is the root cause of these unsatisfactory then what we will do? We will start our intervention to that particular root. So this is very very important that you identify those sources. Of course it will give you a possible solution based on the current theory and best practices which is present in the industry. So you may refer the information from the literature, from the tacit knowledge present in that particular context and whatever the best practices available. Then you can derive the solution. So these may be related to the task design and the equipment and personal use, procedures or training and other forms of support depending on the purpose of the analysis which you have already decided at the very initial stage of hierarchical task analysis. So identifying what is your objective is very very important. So based on that this second step you can achieve. So normally what happen the type of solution example if you want to modify the design of the equipment or you want to construct a training syllabus whatever it is. It comes based on the whatever steps, whatever objective you had decided in the very initial stage that is very important. However the analyst should not reframe the drawing attention to alternative solution where this may offer a particular different advantage. So it happened that we decided something at the very initial stage. Based on that we conducted the

hierarchical task analysis. Now we have the decomposition table, we have the data with us. Of course we have the solution or the objective that we decided in the first step is being achieved. However once we decomposed that particular table it may happen that we are all of a sudden some new thing is coming up and that is the advantage that we were really unknown before we started this decomposition table, before we started this hierarchical task analysis. Now due to this table is ready we have some new idea, new source of information or new intervention point that you can go ahead with your next phase. So of course first definitely you are going to get the answer what you raised in the first step. Apart from that there are always a possibility that you can have more direction for further analysis or more direction for further intervention. So that is the critical part and it only happen when you look at the decomposition table very very critically. So it needs a skill, it needs experience. Of course the new researchers may not look into that detail. However when they discuss it with their seniors with the expertise or expert group of people of course some new area of intervention can come up from the same decomposition table. So it is very interesting over here.



So let us understand the advantages. So as a generic method HTA is adaptable to a wide range of purpose. So task can be analyzed to any required level of detail depending on the purpose. So as I mentioned that depending on the objective that you have chosen what you have to do you can decide that at what level you are going to decompose that particular task. So when you use it correctly HTA provides an exhaustive analysis of the problem that you are going to address. So it is very very important and detailed task and it may start from the observation.



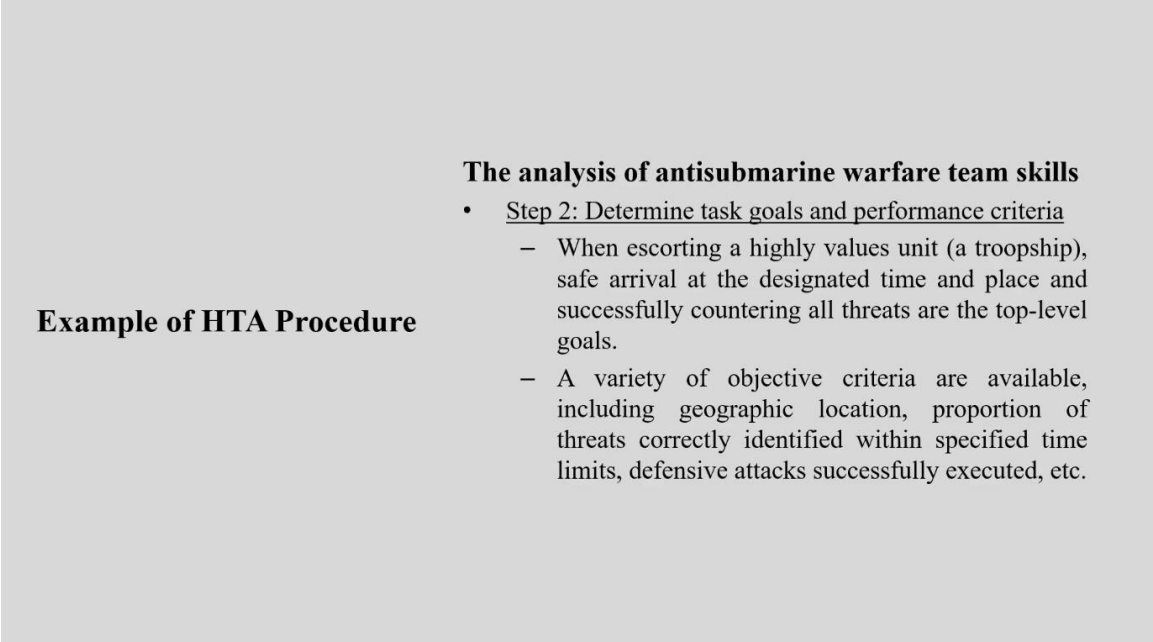
Of course it has some disadvantages. So it requires the handling by an analyst well trained in a variety of method of data collection and in relevant human factors principle. So as I mentioned it need experience, it needs a skill to collect data, analyze the data, looking at the perspective. It is very important. It requires full collaboration of relevant stakeholders as long you are not connected with these stakeholders, you will not be able to get good data. So that is why taking confidence and participation of each stakeholders are very very important. So if any one of the stakeholder is not really connected with that particular study, there is always a chance of biased data or no missing data that is possible. So it requires time in proportion to the complexity of the task as I mentioned if the task is complex time is more. So more complexity more time requirement. So it is absolutely if you have a very very complex task what you need to do normally that we try to do always in your data collection. We break them. We break them in phases. We break them as per the requirement and once we analyze each component separately then we merge them. So that way it becomes little simple or it becomes easy to handle such data. So time consumption is really very high when you are talking about formulating and analyzing the hierarchical task analysis.

Example of HTA Procedure

The analysis of antisubmarine warfare team skills

- Step 1: Purpose of the analysis
  - Identification and measurement of team skills critical to successful antisubmarine warfare (ASW).
  - This analysis focuses on operations depending critically on team interaction.

So let us take some example. Here we are talking about anti-submarine warfare team and we are talking about the skill of them and how we are going to analyze the whole sequence. So here in the initial stage it is a task that is going to be performed and initial stage what we identified over here the purpose that identification of measurement of a team skill. What we are going to do over here? We are trying to measure the team skill critical to the successful anti-submarine warfare. So that we are going to do ASW. Anti-submarine warfare we are going to understand how successful they are when we are talking about the team skill of a critical anti-submarine warfare. So this analysis focuses on operations depending critically on the team interaction. So here each team how they are interacting with each other is very important.



The second once we understand what we are going to do so this is our purpose, we are going to understand the performance of that anti-submarine warfare team. So then let us understand that what we are going to do with this. So determining the task goal and performance criteria. So at the initial stage itself we are going to decide what are the performance criteria to be fulfilled. Once somebody is the whole thing is been done the whole performance is done what are the criteria's are there on which we are going to evaluate. So first let us decide on that. So what they have done in this particular example. So when they are going to escort a highly values unit so maybe a troopship. So safe arrival at the designated time and place and successfully countering all threats which are available at the top level goal. So this was the so first is safe arrival where at the designated time and place then successfully you have to counteract on the threats whatever threats available while operating. So these three things they are going to do. So based on this they are going to give the performance level. So they are going to understand the whole performance based on these criteria. So a variety of objective criteria are available including geographical location, proportion of threats correctly identified within specified time or not, defensive attack successfully executed or not. So all these can be we need to decide before we start this particular analysis. So in this particular stage what we have done not we the in that this particular example what they have done they have determined these few things. One is can they come back, can they rescue that troop on a specific time safely at the time that they have decided or at the place what have they have decided and is it possible for them to counteract successfully counteract all the threats whatever is available in that particular context. So that they have decided.

Example of HTA Procedure

The analysis of antisubmarine warfare team skills

- Step 3: Identify information sources
  - The primary source was a senior ASW instructor, supported by manuals specifying warfare doctrine and standard operating procedures.
  - The analyst was also able to observe teams operating in a simulator and to make use of electronic records of events occurring in exercise.
  - Video recordings were made of team operating in prearranged scenarios in a simulator.
  - These served as checks on the information provided by the expert and also as examples of data that could be used to measure team skills.

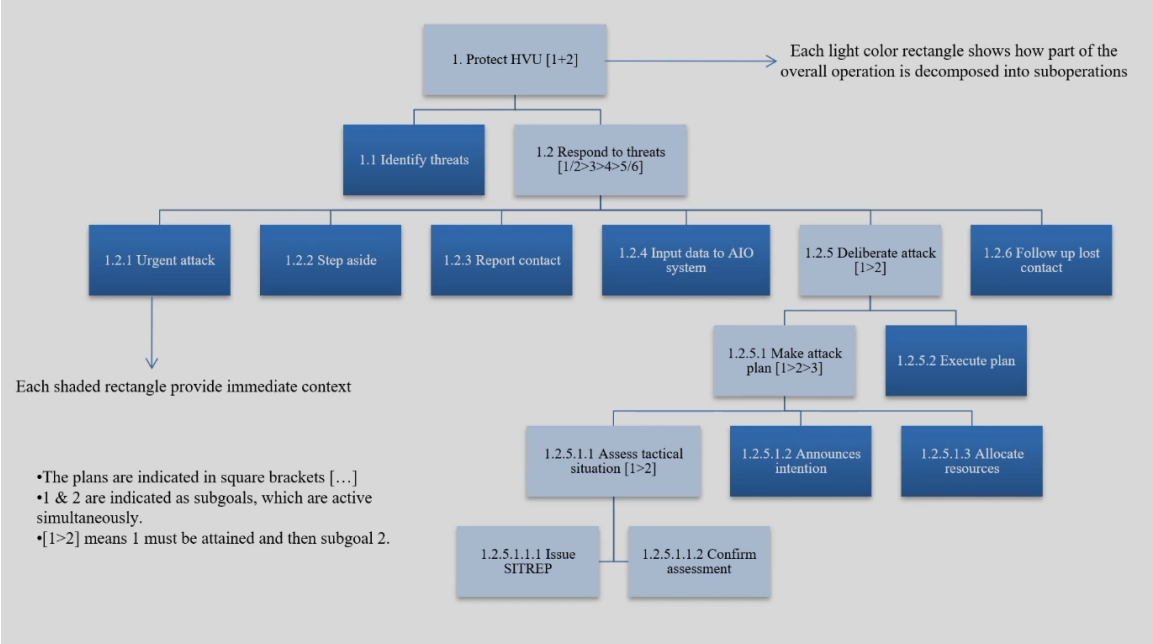
The next step identify the information sources which is very very important because these will help you to understand the decision making. This help will understand how the influences are there in critical path choose, chosen path. So that is why understanding the sources for information is very important. So what they have done over here the primary sources they identified as the senior ASW instructor. So there will be there supported by manuals specifying the warfare doctrine and standard operating procedure. So through SOP and through specific warfare doctrine, they are going to get these information to the senior ASW instructor. The analyst was also able to observe team operating in a simulator. So they have understood how exactly it is going to happen. So in a simulated condition they have observed it. So when it is in actual they can really understand or connect with the experience which they have received in the simulated condition to make use of electronic record of events occurring in the in that particular exercise. Of course video recording were made of team operating in prearranged scenario in a particular simulator. So these are all the sources of information. So these served as check on the information provided by the expert and also as an example of the data that could be used to measure the team skill. So these are all information they identified and they kept it with them for further analysis or further reference.

Example of HTA Procedure

The analysis of antisubmarine warfare team skills

- Step 4: Draft decomposition diagram/ table
  - The questioning of subject-matter experts focused on goals and failures.
  - Especially important are questions such as,
    - How would you know if 'x' had been correctly carried out?
  - A small section of the analysis is illustrated following:

Then they started with the decomposition diagram. The questioning of subject matter experts focused on the goals and the failures and especially important questions that were asked that how would you know if X have been correctly carried out or not. X means that particular step has been carried out or not.



A small section of analysis is illustrated. Suppose this is the diagram. Of course this is taken from the book. It is not that we have done it or we have carried out. So this way they can create the decomposition table. So it starts you know what was the point that they started. Step one is the protect the HVU and which is identified in 1 and 2. So 2 is

the second component. Here we are going to detail out the component 1 and then you can see all these steps are being carried out. So here what they are saying that each light color rectangle shows how the part of the overall operation is decomposed into sub operation. So all these 1, 2, here 3. So all the light color you know you are going further, further down. Whereas this deep color, so each shaded rectangle provide the immediate context. So each deep color means immediate action. So here, here, here you can understand these are the immediate actions to be done. So what it is just a representation. It is just a representation for your understanding how you can really derive your decomposition table. So what it says the plans are indicated in sequence bracket like you know like this type of dots. So that you can do and 1 and 2 are indicated as the sub goals of course and which are active simultaneously. So section 1 and section 2, they are going simultaneously and later maybe we can club them and we can have a bigger view or broad view of the whole system.

Tabular form of selected ASW team operations

Protect highly valued unit (HVU) [1+2]	Goal: Ensure safe and timely arrive of HVU Teamwork: Principle warfare officer (PWO) in unit gaining initial contact with threat assumes tactical command and follows standard operating procedures in this role Plan: Continues to monitor threat [1] while responding to identified threat Criterion measure: Safe and timely arrive of HVU
Respond to threats [1/2>3>4>5/6]	Goal: Respond to threat according to classification Teamwork: PWO selects response based on information provided by other team members Plan: If threat is immediate (torpedo) go to urgent attack [1.2.1], else execute 2, 3, 4, 5 or 6. Criterion measure: Appropriate response with minimal delay
1.2.5: Deliberate attack [1>2]	Goal: Get weapon in water within 6 min. Teamwork: See further breakdown below Plan: Make attack plan, then execute Criterion measure: Time elapsed since classification and/ or previous attack
1.2.5.1: Make attack plan [1>2>3]	Goal: Plan understood and accepted by team Teamwork: Information regarding tactical situation and resources available from team members to PWO Plan: Assess tactical situation, announce intentions; allocate resources Criterion measure: Accurate information provided

You can create this type of blocks or flow diagram or you can go ahead with this type of table. It is same thing, similar thing. So that you can have and then here it is very good that you have all the verbal description. So it becomes more easy for someone to understand. So you can understand what is the plan for this step, what is the plan for this step like that you can have more clarity if you are going to analyze this or read this out later.

Tabular form of selected ASW team operations	
1.2.5.1.1: Assess tactical situation [1>2]	Goal: Arrive at correct assessment of tactical situation Teamwork: PWO must gather all relevant information by up-to-date status reports from own team and sensors and other friendly forces Plan: Issue situation report (SITREP), then confirm assessment Criterion measure: Correct assessment; time to make an assessment
1.2.5.1.1.1: Issue SITREP	Goal: To ensure whole team is aware of threat situation and to provide an opportunity to other team members to check my omissions or errors in tactical appreciations Teamwork: PWO issues SITREP at appropriate time; all team members check against information they hold. Criterion measure: All team members have accurate tactical information
1.2.5.1.1.2: Confirm tactical assessment	Goal: Construct an accurate assessment of the threat and of resources available to meet it. Teamwork: Final responsibility lies with the PWO, but the information provided by and discussions with other team members are essential to identify and resolve any inconsistencies Criterion measure: Accurate assessment in light of information and resources available.

That is possible though no details of our previous table.

Example of HTA Procedure

The analysis of antisubmarine warfare team skills

- Step 5: Recheck validity of decomposition with stakeholders
  - At least two iterations of the decompositions were required before the stakeholders, and the analyst, were satisfied that this was an accurate representation of the task goals and the various means of attaining them.

Now once you finish that particular step that you know you have drawn the sub identified the goals, sub goals and you created that hierarchical structure, hierarchy structure then you check. So whatever you have achieved over here what you can go? You can go back to the experts, you can go to the each stakeholder and you can get the validity of this decomposition table. So here what they have done? At least two interactions of the decompositions were required before they go to the stakeholder and the analyst were satisfied that this was an accurate representation of the task that they have chosen and the

various means of attending them. So they have really done it well in this particular example. It is from a publication so of course it is already printed.

Example of HTA Procedure

The analysis of antisubmarine warfare team skills

- Step 6: Identify significant operations
  - Referring to step 1, the aim of the analysis was to identify and measure team skills critical to successful team performance.
  - The depth of the analysis was therefore determined by the lowest level at which various team activities could be associated with critically important team products.
  - Example: Operation 1.2.5.1.1.1 (Table) where discussion between team members, each of whom whole partial information on the nature of the threat, is a highly desirable means of minimizing ambiguity of interpretation of the tactical situation.

So now in the last stage what they have done that identifying the significant operation. So referring to the step 1 like what is the aim? Aim of this analysis was to identify and measure the team skill, critical to successful team performance. That was the objective. That was the that is why they started this. So the depth of the analysis was therefore determined by the lowest level at which various team activities could be associated with critically important team products. That way they have achieved it.

Tabular form of selected ASW team operations

1.2.5.1.1: Assess tactical situation [1>2]	Goal: Arrive at correct assessment of tactical situation Teamwork: PWO must gather all relevant information by up-to-date status reports from own team and sensors and other friendly forces Plan: Issue situation report (SITREP), then confirm assessment Criterion measure: Correct assessment; time to make an assessment
1.2.5.1.1.1: Issue SITREP	Goal: To ensure whole team is aware of threat situation and to provide an opportunity to other team members to check my omissions or errors in tactical appreciations Teamwork: PWO issues SITREP at appropriate time; all team members check against information they hold. Criterion measure: All team members have accurate tactical information
1.2.5.1.1.2: Confirm tactical assessment	Goal: Construct an accurate assessment of the threat and of resources available to meet it. Teamwork: Final responsibility lies with the PWO, but the information provided by and discussions with other team members are essential to identify and resolve any inconsistencies Criterion measure: Accurate assessment in light of information and resources available.

So for example in this particular case let us go back again here. So what they have done? What goal? They have the what kind of teamwork they have done and the criteria of measures they have identified and they have clearly mentioned it. So it becomes very easy for the researcher to take up the decision.

Example of HTA Procedure

The analysis of antisubmarine warfare team skills

- Step 7: Generate and test hypothetical solutions to performance problem
  - The analysis identified a number of critical operations in which various type of team interaction could be lead to failure to achieve team goals.
  - Five types of critical team behavior were identified: send information, receive information, discuss, collaborate and synchronize.
  - The performance of ASW teams was observed during a standard exercise and scored as the percentage of satisfactorily execute team operations in each of the five categories.

Now in the last step so what they have done? Generate and test the hypothetical solution to the performance problem. So whatever problems they have identified they have to develop the hypothetical solution of it. So the analysis identified a number of critical operation at which various type of team interaction could be related to failure to achieve this team goal. So there are possibilities that these interaction may create problem and the whole performance, the rescue operation may fail. So they identified that. So 5 types of critical team behavior were identified. So first was sending information from one source to other source. Then receiving information. So one person is sending information from one place to other person and maybe sending is also a problem, maybe a problem or receiving also maybe a problem. There are possibilities that discussion may go into wrong direction. How they collaborate, how they will act upon there may be some problem and synchronization the whole activity. So these are the major 5 areas that they identified after they derived this particular hierarchical chart. So the performance of ASW team was observed during a standard exercise and scored as the percentage of satisfactorily executed team operation in each of the 5 categories. So these 5 categories send information, receive information, discuss, collaborate and synchronize. So what they have done, they have categorized them and they have what they have done, they have given the percentage of it and then only they decided which one will take first, second and third and fourth like that.

Related methods to HTA

- HTA has been used as a basis for the investigation of a variety of problems.
- As the first step in the TAFEI (Task analysis for the error identification) method for hazard and risk assessment
- In SHERPA (Systemic human error reduction and prediction approach) for predicting human error
- In MUSA (Method for usability engineering) usability assessment, the sub-goal template (SGT) method for specification of information requirements
- In TAKD (Task analysis for knowledge-based descriptions) method for the capture of task knowledge requirements in HCL

So as I mentioned, it is not only an individual method, it is connected to many other methods. So what are these? Maybe Sherpa, maybe Musa, all these methods are connected. So what it says that HTA has been used as a basis of the investigation of a variety of problem. So TAFEI, Sherpa, Musa and task analysis for knowledge based description, these all are related method.

Standards & Regulations

- HTA does not purport to provide any standard measure and has not, as yet been incorporated into specific standard.

So I will take you to the standard and regulation. It does not have any specific standard measure. Only thing over here is that how you are decomposing that, how you are creating the decomposing table is very important to you. So that you need to maintain.

Reliability & Validity

- Reliability depends principally on the care taken in data collection.
- Attention is drawn especially to cross-checking of information in Step 5.
- Validity depends on whether the analyst correctly addresses the question asked in Step 1 and provides effective solutions in Step 7.

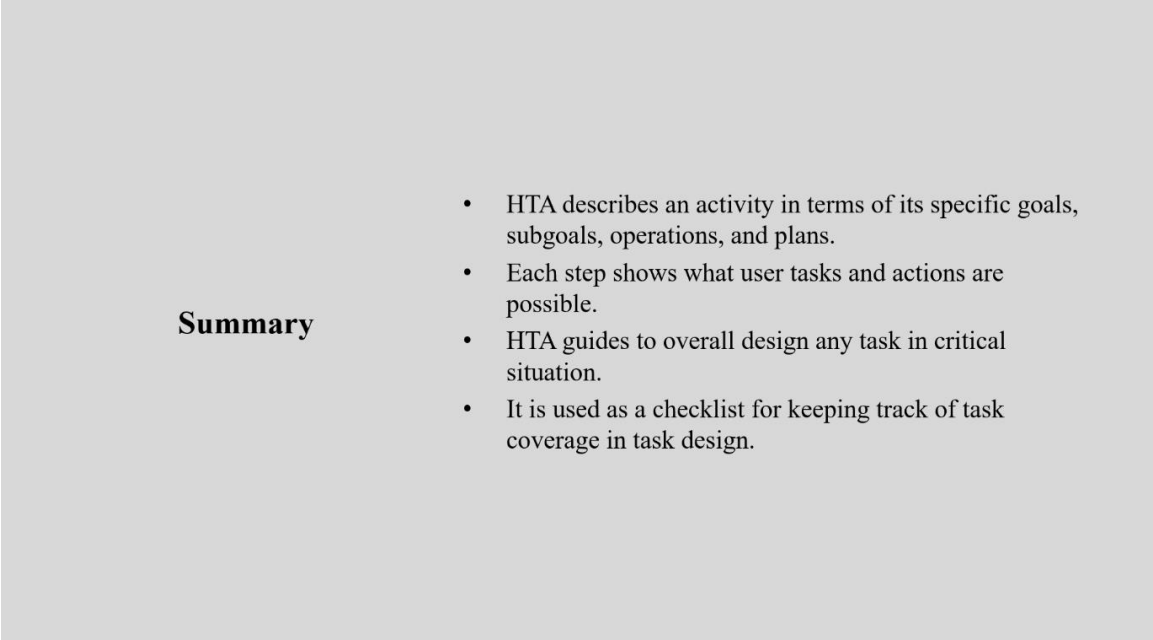
Reliability and validity, so no reliability depends principally on the care that you have taken in the data collection. Specifically when you are formulating your table, so step 5 and step 7 is very, very important. So you should take care of them very critically, you should understand it very detail and then only you take the decision. Based on those two steps, you know your reliability and validity depends.

Tools needed

- HTA can be carried out using only pen or pencil and paper.
- Interviews are tape recorded and the diagrammatic and tabular forms were constructed on a laptop computer using a general purpose software idea development and planning tool called, Inspiration™.
- Video recording is used in Step 7 for sampling team behavior in critical operations.

What do you actually need? HTA can be carried out using only pen and paper method. However, it is always better you have a video recording so that you can redo the exercise

at the latter stage also. Also the observational record you can take up using video and audio. Okay, that is possible.



So in summary, we can say HTA is an activity that describe in terms of its specific goal, subgoals, operations and plans. Each step shows what user, task and actions are possible. HTA guides to overall design any task in critical situation and also it is used as a checklist for keeping track of a task coverage in the task design. Okay, so from next day we will go for some other tool. Till now we discussed this hierarchical task analysis and we will start with the other method in the next class. Thank you. .