Ergonomics Research Techniques

Dr. Urmi R Salve

Department of Design, Indian Institute of Technology Guwahati

Week 8: Lec 28- Cognitive task analysis methods

Allocation of function methodology

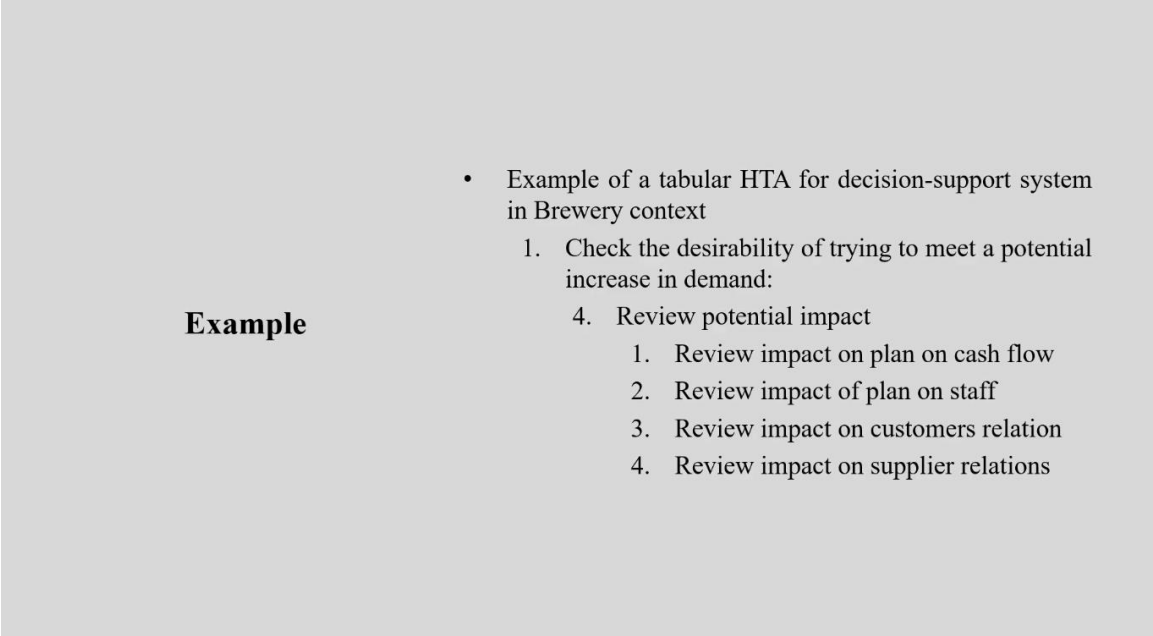
So, last time what we try to understand is the how the what is the total procedure of allocation of function. We remember that in allocation of function the initial stage is hierarchical task analysis. Now today what we will do we will try to understand through an example how these steps can be followed and how we can actually practice. So for today's example I have taken anyway it is taken from one already established example. In a brewery shop how the beers are being produced manufactured depending on the market. So when there is an extra demand in the market specially in different seasons like you know New Year or any celebration period. So how the demands increases, how the varieties can be increased or can be modified and how we can connect that to the different pubs or the delivery processes. Like you know different shops, different pubs or the outlets from where the beers can be sell out. Now here why this particular context because this context is very much dependent on the customers need. Now this need is not equal throughout the year. It keeps on varying. So depending on the demand, depending on the market requirement what we need to do is we need to plan our manpower, plan our production line, plan our delivery system, plan our warehouse or storage capacity and everything right. So this is very much connected to any live example that we can practice or that we come across in our research area. So let us understand the whole process.

Example

- Example of a tabular HTA for decision-support system in Brewery context
    1. Check the desirability of trying to meet a potential increase in demand:
        1. Forecast demand
            1. Review regular sales
            2. Review demand from pub
            3. Review potential demand from one-off events
        2. Produce provisional resource plan
            1. Calculate expected demand for each type of beer
            2. Make adjustment for production minima or maxima

Example

- Example of a tabular HTA for decision-support system in Brewery context
    1. Check the desirability of trying to meet a potential increase in demand:
        3. Check feasibility of plan
            1. Do materials explosion of ingredients
            2. Do materials explosion of casks and other packaging
            3. Check materials stocks
            4. Calculate materials required
            5. Negotiate with suppliers
            6. Check staff availability
            7. Check ability to deliver beer to customers



Basically we will have as we mentioned in the procedure four steps, major steps. First is forecasting the demand, then produce the provisional resource plan, check the feasibility, feasibility of that particular plan. See we may forecast many thing. However we really need to check what is the kind of feasibility we have in the possibilities to execute that plan and then review the potential impact ok. So let us start with one by one. So when we are talking about now once we do all these thing then in allocation of function the major concept of allocation of function is we will be allocating all these steps either to human or to computer means machine or both where somewhere human is no more in control or in some cases computer or machine is in control ok. So first let us understand the you know all these steps and then we will allocate that function. So that is the major agenda for allocation of function. So when we are talking about forecast the demand especially for this particular example you know brewery context. So what we will do? We will understand the regular sales ok because throughout the year there is a pattern, there is a pattern of sales. So first we need to understand what are the minimum things are possible ok. When seasons comes definitely it will increase, but for basic understanding what is the regular sale? What is the kind of selling is happening in each outlet? Maybe it is retail, it may be pub, it may be some shop or something ok. Let us first understand that. Once we understand that we need to say that review the demand from different here I mentioned pub because in that particular example they deal with pub, but we can do for each separate outlet ok wherever the beers are being in on sale ok. And then review the potential demand from one off time event ok when there is nothing no celebration still there are something is going on right in a regular basis. So first we need to understand these three separate stages of what is the kind of sale is happening during the these three stages ok. So once we complete this particular reviewing process what we will do? We will do how do we manage our resources? How do we manage our

manpower? How do we plan our manpower? What is the kind of storage we require? What is the kind of supply we need to do? So all these provisional plan we need to work on from the resource point of view. So for that what we have to do two major stage, one is the calculation of the expected demand for each type of beer. So there are different categories right. It is not only beer maybe if you are talking about cosmetic, if you are talking about any other beverage or any other product you have to see there are different types right. If we are talking about face wash, face wash what we need to do? We need to so for dry skin, for maybe you know normal skin, so there are different varieties. So for each thing we need to understand for each category what is the expected demand. So these demand calculations, so this is very quantification right. So these things will come from my first portion that is the forecasting the demand. So that forecast the result of the forecasting the demand will be used to calculate the expected demand for each type, each variety. Once that is there then we need to do the adjustment for production, the what is the maximum possibility, what is the minimum possibility because as I mentioned these type of things are not equally demanding throughout the year right. So if it is not equally demanding throughout year what we have to do? We have to see when it demand is in the maximum level, when demand is at the minimum level. So accordingly we have to really plan how we can see the our resources to be handled. So once these two steps are you know complete then we need to see that how we can feasibly possibly we will be able to execute the plan that we are making. So to do so we have different steps. Now here I jotted down the major 7 steps ok. It may happen while working on for your particular case there will be some differences ok. So depending on the case to case maybe you can do some changes you can add or substract some more ok. So what how we are checking the feasibility? Do the materials explosion of ingredients are available or not. So what I did over here is the maximum possible things I included ok. It may happen for your case it will exactly match. However there are chances depending on the type of context that you are using there are changes that is why I mentioned it ok. So first one that how the materials are you know a material explosions of that particular ingredients are available or not. Then do materials explosion of you know casks and other packaging ok. So is there availability that that is available on because you know when we are talking about any kind of such production definitely packaging is an very important issue right. So then what is the kind of stock we have for all these materials. It's not only the the particular product but also associated accessories like you know packaging material other binding material and all those things. Then calculate the materials whole requirement what is the kind of so if we are talking about particular beverage to manufacture that to produce that what are the raw materials available. Once raw materials are there for that particular manufacturing you know then how do we store them how do we package them how do. So all varieties of material whatever the materials even the you know machineries parts requirements everything we need to calculate. So suppose a particular machine will work for 8 hours in a day and it will

particular part will sustain for 3 months. Now if I need to plan for 1 year we have to see what is the kind of investment I need for that particular part for a year production right. So all these thing we need to understand because anyway whenever we are talking about all these thing money requirement or human availability everything is important right. So for that you need to calculate those material. Now once we understand ok these are the requirements what we need to do. We need to negotiate with our suppliers. So you know this is very much human dependent ok. So this we need to formulate how do we negotiate with the suppliers and at what time, at what rate, at what intense they will supply and how they will transport everything. For each and every component we need to make sure that we negotiate and we get this thing done this is very much human dependent ok. Now next is we are planning this is completely so it is in the planning stage so all the managerial level people will be involved fine. Once this is done then we need for execution executing this whole task major thing is this stuff right who will do this. It's not only the varieties of labour it's the whole process need to be maintained by some human being right. So how I am engaging my whole manpower in this whole job throughout my year this feasibility. So if I have 30 percent on role how I am going to allocate them for these jobs ok. So here job responsibilities ok will be defined. So once these job responsibilities so how do we recruit people. So depending on all these varieties we need to actually do this and all these thing I am saying that you know it's very much important we when we are at the initial stage of development. If it is established and there is not much drastic change in the market demand probably it will continue the same pattern will continue for some years. Of course business is not like that manufacturing process is not always same for years and years. There will be change in the market there will be change in the demand production line everything will change and these calculations you need to keep on doing you know on a regular basis. So once this is done that availability whatever the kind of manpower you have you calculate that then what you need to do that check the ability to deliver this produced beer to the customer. So how you are going to produce them. So again you have to talk about your logistics, ok, transport system who are the people will be involved, how do you connect to the outlets, how do you connect to the pubs; all those things you need to calculate. So all these are 4C ok. So you are actually calculating everything beforehand because if you do not have a pre assumption maybe there will be lot of difficulties when you are actually going to execute it. Yes of course it is not that if you are calculating and you know starting with something and there will be no change. Of course based on the immediate requirement there will be changes here and there. However the major component will be established beforehand ok. Now when everything is done you have to understand what is the kind of potential impact they have whatever we did and we have to review those impact. So major 3 review impact on the plan on cash flow which is actually very very important for this particular case for your case or your research depending on the context it may change. Plan on the staff so when do you recruit when

and what is the kind of terms and condition you are applying, what is the kind of job role you are assigning, what is the kind of job rotation you are planning, what is the break cycle you are planning for your staff everything. So this is very very crucial because anyway we are talking about human factors right. So if somebody is handling a particular activity depending on the capacity and capability of the human or the operator, you need to really understand which component of your task this person is going to execute right. So here the planning is very very important and reviewing that reviewing that is extremely important ok and this is not really very much quantitative. It depends on the asset knowledge ok. So a person why do we rely on experience? Here this experience comes and plays a major role ok for both the for all these reviewing cases. Asset knowledge is very very important because you know depending on the industry to industry depending on the varieties of people you know they are interacting and assessing these whole activity, the nature will keep on changing ok. So it is purely based on your of course there are structures however that is not only the thing so depending on the industry depending on the type the experience will be different knowledge base will be different and you can have different models you can build different models for that. Of course you need to work on the customer relation so for this particular case the customers are the pub people like who are actually buying your beverage ok and then suppliers relation so how all these activities so whatever you have planned in your earlier phase ok all these all these process ok how how these are going to impact on all these you know 4 component you have to really review on it. So if there is a problem with the cash flow, it may affect your staff plan, it may affect your relation with the customer also it may affect the relation with the supplier ok. So all are interdependent and how you are actually planning to handle it this critical part is very very important and you need to review it. It is real really important aspect.

Example

- Example of a tabular HTA for decision-support system in Brewery context (manufacturing of beer)
  - The analyst took into account stakeholder's needs to exercise craftsmanship and other specialists skills, their wish to maintain control of planning heuristics, and their need to promote cohesive team work.
  - The analyst opted for a high degree of allocation to the human.
  - A greater amount of computer support would have better addressed a need for quick recalculation of plans when under stress.
  - But this was in conflict with the needs most associated with the stakeholder's sources of job satisfaction.

Because this is particular thing is done for this particular example I what we did or what the author did they analyze the you know this particular analyst took into account the stakeholders need ok. So they they try to understand the stakeholders need to exercise the craftsmanship and other specialist skill that is why I was saying tacit knowledge is very important and their wish to maintain the control of planning heuristic and their need to promote you know cohesive team work. So this particular thing you need to understand so the analyst also may opt for a high degree of allocation to human. So depending on the type of activity you are doing the analyst can play here ok which one they more rely on the human, where they can more rely on the computer. So a greater amount of computer support would have better address to address a need for quick recalculation of plans when under stress ok. If some something is under stress so recalculation is very much possible if mostly things are controlled by computer whereas it may opposite if it is controlled by the human. So but this was in conflict with the needs most associated with the stakeholders sources of job satisfaction because when stakeholders have less control over the whole activity stakeholders majorly here will be the operator ok. If they have less control over the job there may create job stress or job dissatisfaction which in turn may cause the reduction in the performance or productivity ok. So here the optimization all these optimizations are very very important concept. So whenever third party wants to do all those things they need to work very closely with actual stakeholders specifically the operators, managers, supervisors ok the situations ok. So if they have all these correct information with them then these allocations will be very much correct.

Example

- Example of function allocations based on stakeholder analysis of the sociotechnical system
  1. Check the desirability
     1. Forecast demand **H**
        1. Review regular sales **H**
        2. Review demand from pub chains **H**.
        3. Review potential demand from one-off events **H**
     2. Produce provisional resource plan **H-C**
        1. Calculate expected demand for each type of beer **H-C**
        2. Make adjustment for production minima and maxima **C**

Now here for this particular example let us see how the analyst did the allocation. So H means human, C means computer, HC means both human and computer whereas human

has more control, CH computer and human both have function however computer has more control ok. Now here you can see for all these you know forecast demand it is completely based on human review ok. So human the person himself or herself need to do this task. So for this we really need specialist and they are employed for that particular job only. Now in the second case we can do some kind of calculation through computer also human input is required whereas in the adjustment cases minimum and maximum we can rely on the computer.

Example

- Example of a tabular HTA for decision-support system in Brewery context
  1. Check the desirability of trying to meet a potential increase in demand:
     3. Check feasibility of plan **H-C**
        1. Do materials explosion of ingredients **H-C**
        2. Do materials explosion of casks and other packaging **C**
        3. Check materials stocks **H-C**
        4. Calculate materials required **C**
        5. Negotiate with suppliers **H**
        6. Check staff availability **H**
        7. Check ability to deliver beer to customers **H**

Here also the feasibility plan checking of course human is more powerful to do the change in the permutation combination and for each cases like you know material explosion human computer where human is more material explosion for the cusks and other packaging we need to rely on the computer because the machine is going to work on this material stock material required. So material requirement definitely we need to depend on the machine because how much material is required for doing that particular packaging machine only can tell us. We cannot do any kind of changes over there whereas we can work on the stock part where human can be the major controlling power. Then suppliers availability of the stuff and the delivery feasibility all these three steps are majorly on the human. So if you check the whole process you can see human is more powerful over here.

Example

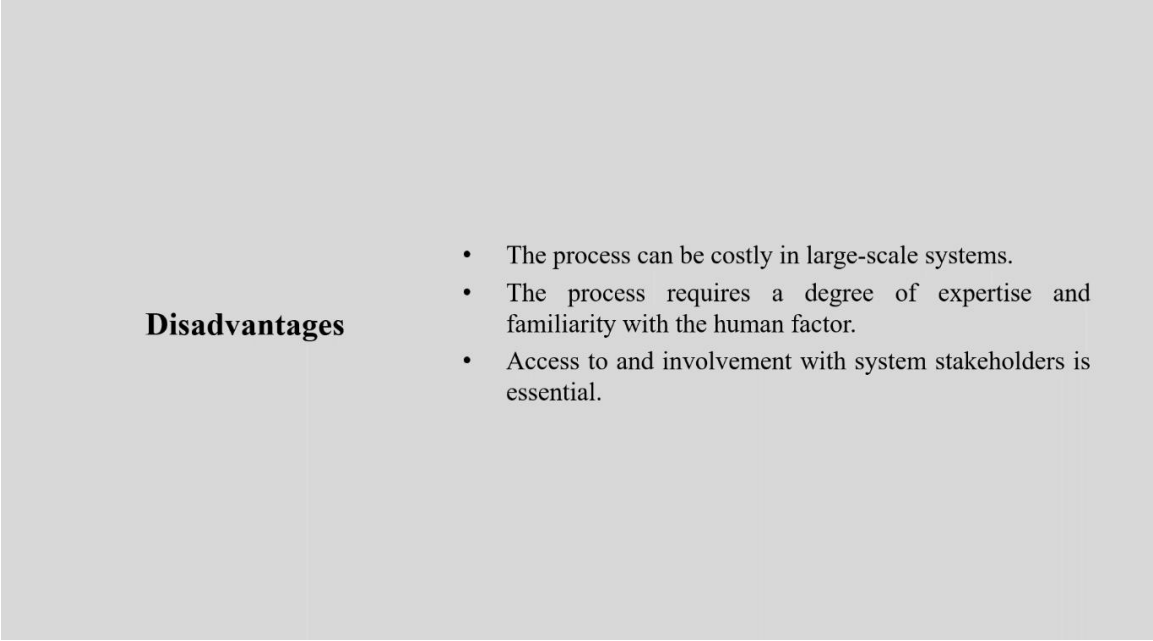
- Example of a tabular HTA for decision-support system in Brewery context
    1. Check the desirability of trying to meet a potential increase in demand:
        4. Review potential impact **H**
            1. Review impact on plan on cash flow **H**
            2. Review impact of plan on staff **H**
            3. Review impact on customers relation **H**
            4. Review impact on supplier relations **H**

Now in the next part where the review comes all are human. So human has to take the major role. So any review any impact analysis has to be done by the human. So this way. Now once we understand so this whole process can be done and then based on the result whatever is coming you have to take the decision. So this way you can complete the allocation of function and from this allocation of function whatever like human, human computer, computer, computer human whatever the allocations you are doing based on your example you can take that for further review or further intervention. This way allocation of function this particular method will help you to understand the situation, understand that particular context ok.

Advantages

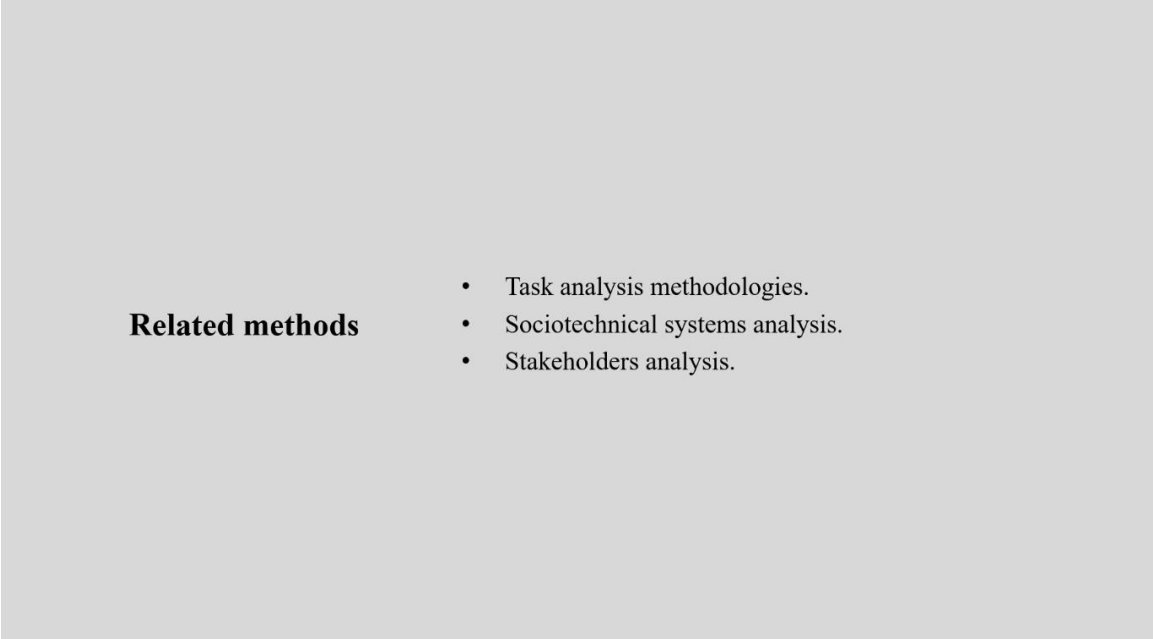
- The process provides a structure for automation decisions.
- The process ensures that automation decisions are traceable.
- The process helps ensure that the system user will not be inappropriately delegated the role of supervisor of automated systems.

Now let us understand the advantages whatever we get for this particular process. So this particular process provides a structure for automation decision. So wherever computer is more powerful we can easily go for automation whereas human is more powerful we really need to think where to do the automation ok. So based on the allocations we need to we need to plan how we can introduce automation in the whole process ok. This process actually ensures the automation decision where exactly so decision making ok so that is important and the process of course helps to ensure the system user will not be inappropriately delegated the role of supervisors of the automation system. So very clearly they will mention where the supervision is required, how it is required, when it is required. So all these steps are very very clear if we use this particular you know allocation of function method. So latter once it is established one it is verified for a particular system ok. Later it will be very easy for the intervention who is going to do the intervention to take a decision where to start ok. So these are the advantages.



However there are different disadvantages. Majorly this process can be very costly in you know large scale system. This is a very small system that I described however if it is a very large system you know nuclear power or you know big automobile industry or manufacturing of something very big for those cases it is very very costly because each steps you need to really look into. So initial cost of you know doing this particular process or assessment will be very costly and the process requires a degree of expertise of course as I mentioned tacit knowledge is very very important in the whole process ok. And understanding what is human factor, how do we consider human factor that familiarity is very much important. So it is a skill ok. Maybe if you first time you are you know doing this you will not be able to decide which one human, which one you know computer there may be some ambiguity. Whereas if you keep on practicing with

the help of some experts you will gain that knowledge and you will understand because you will be able to do it very perfectly ok. So the expertise is very important. And access to and involvement with the system stakeholder is very essential because if you do not have access to the stakeholder like you know talking to the manager, talking to the supervisor or understanding the role of operator if these are not accessible to you, you will not be able to do the allocation properly ok. So these are the disadvantage. So you need to rely on the stakeholders view. If there is an obligation you know there is an obstruction to contact or connect to the stakeholders you will not be able to map the whole process or you will not be able to allocate the whole process correctly ok.



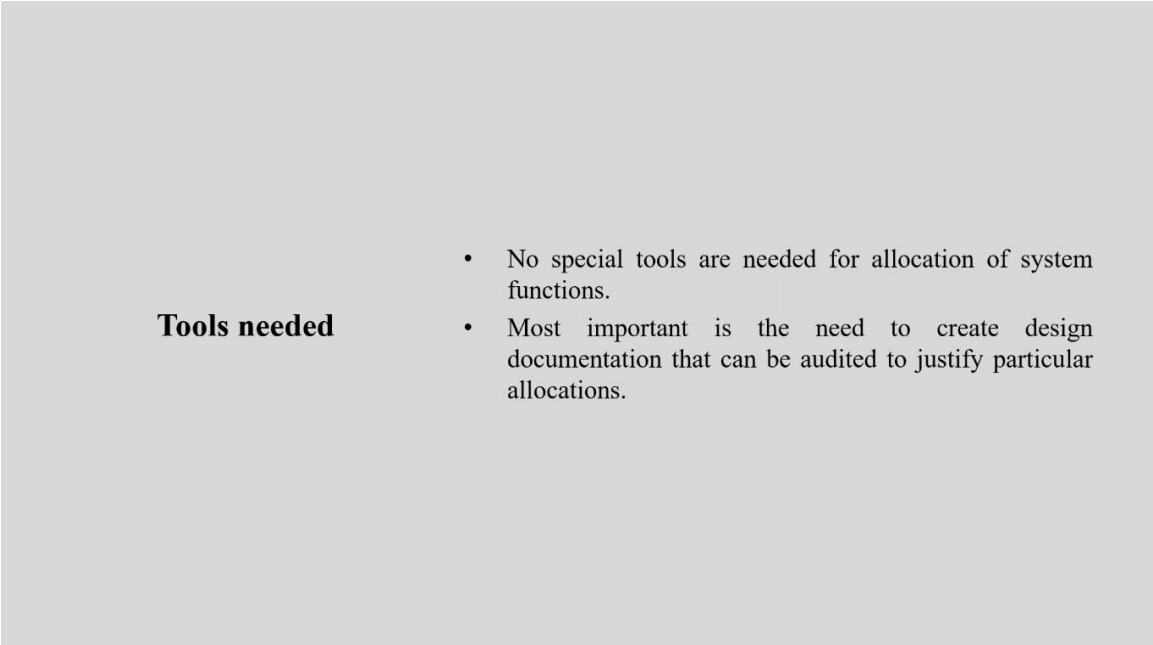
So these are the advantages and of course, connected methods are task analysis because without task analysis you will not be able to start the whole process ok. The very much connected method is socio technical system analysis. Anyway this will not be under discussion in this particular course and this stakeholders analysis again this we will not be able to discuss because these are more of managerial tool and less connected with the ergonomics. So we will not be able to discuss these two in detail. However already we discuss this task analysis in our earlier presentations ok.

Reliability & Validity

- There has been considerable debate surrounding the validity of the concept in the practice.
- While function allocation provides a useful theory for automation decisions, the approach typically prescribes methods, or incorporates practices, in an idealized form that fails to correspond to requirements in a practical context.
- There is no real evidence that misallocation has ever contributed to system failure.

So coming to reliability and validity there has been considerable debate surrounding the validity of the concept that is in practice because you know as this is completely depend very much not completely very much dependent on the tacit knowledge and accessibility to the stakeholders. So it is actually the validity is always on debate ok. So while function allocation provides a useful theory of automation decision, the approach typically prescribes that particular method or incorporate different practices, in an idealized form because you know we are actually idealizing ok. This is ideal situation in that case this is going to happen, but if you look at industry always it is not ideal situation there are different changes happening in continuation ok. So I really do not know which manpower is available very next day. It may happen there is a drastic change. So how do we handle all those things? For those cases this particular process may fail and there is no real evidence that a misallocation has ever contributed to a systemic failure, because we being human, we have always a nature to handle the situation ok. So if I am allocating a particular function to human computer and there is a failure we really cannot say that this failure is because of this allocation because maybe during the failure something has been taken care by human or something has been taken care by the whole system. So we really cannot say if the allocation fails, we the whole system will collapse. It is not like that right. So this gives an indication this help us to understand the whole situation however, it will not really know very much valid no so that is why people say we really cannot completely rely ok. Of course, it has it gives a good picture it gives a good picture to understand your situation however, we cannot complete we keep on checking it ok. Once we do the allocation of function on a day basis as I mentioned you know in the initial stage it is very much helpful it gives you better understanding of your planning or your setting up the system, how do you set up the system, how do you start the you know automation. For those cases it is very much

important. However, you cannot keep it as it is for years and years you have to keep on performing it ok. So that that depend depending on the demand it, the decisions will change. So there is the reliability issue however, we can use it for based on the research objective that you have ok.



And of course, there is no special tools that is required for allocation of system function ok. Most important is the need to create the design documentation. So documenting each step is very very important and that can be audited to justify the particular allocation. Now this audit is very important if you that is why I said initial stage you do function allocation ok. Once it is done run it run it for a year or so and once the demand there is a change in the demand again you have to do. So auditing it every time when you are changing and how how the results are coming depend on that your tool will be successful ok. So really we do not need much other tools requirement so with there is nothing so we can do it based on our expertise. So that is all for the example of allocation of function. So next we will start critical decision method. Thank you. .