Product Design and Development
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Lecture – 09
Function Analysis System Technique

[FL] friends, so here we are to discuss lecture number 4 in our discussion in week 2 related to value engineering. As you are well aware that we are discussing the various concepts of value engineering already we have taken three lectures on value engineering, the basic concepts have been discuss, the historical prospective of value engineering has been discussed, what is not value engineering has also been discussed, what is value engineering is also been discussed.

We have also discussed why the products have poor value or poor value functions. Then we came to the functional analysis, we have seen the value engineering job plan, what is the systematic approach for solving, any problem using the concepts of value engineering. Also we have seen if you remember the functional analysis in which we have seen that how to define or identify a function using a verb and noun type of definition.

We have also seen examples of basic and secondary functions. And if you remember in basic and secondary functions we have taken example of a electric cattle and a mobile phone. That for a mobile phone what are the basic functions and what are the secondary functions. And in the last class or the last lecture we stopped at the function cost relationship. And we will start our discussion today from the function cost relationship, and try to understand the details regarding the function cost relationship and how these type of a tabular arrangement of functions and cost can help us in our overall objective of improving the value of the product.

Now, this was the slide that we have seen in last time. The only thing that was missing in the slide was this 30.

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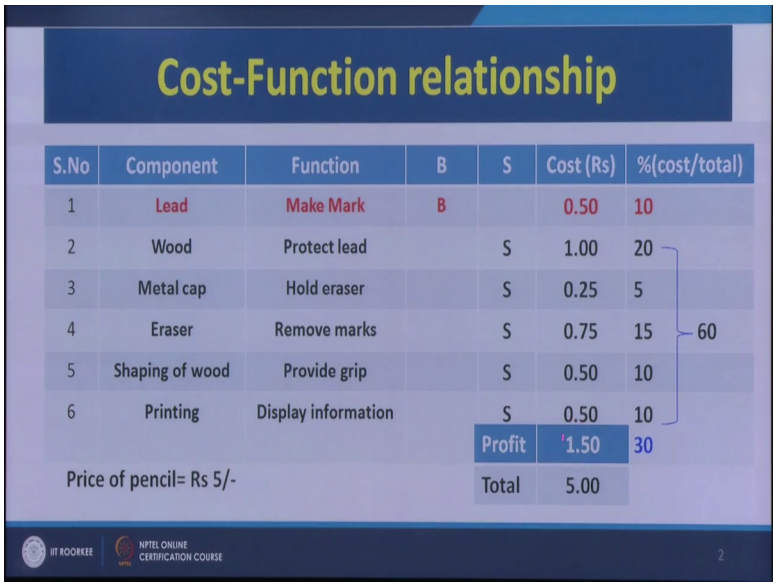

So, 30 percent is a profit for that product. So we can see; if again we see noun and verb type of definition lead make marks wood protect lead metal cap hold eraser. So, we have divided the wooden pencil into its individual components and the process is that add to the cost of the product. And the cost of the product is 3.5 rupees and which is added up here. And profit is 1.5 and the price of pencil is selling price of pencil is rupees 5. So, here you can see from value engineering point of view we have components and the processes like lead, wood, metal, cap, eraser, shaping of wood and printing two processes, shaping and printing and the material that is lead, wood, metal, cap and eraser.

So, all these add up to the cost of the product. And if you can see the functions or the during the functional analysis chapter we have seen that we have to identify the function from the very beginning and we have to use a noun and verb type of classification for a function or a noun and verb type of definition for a function. So, here you can see for each and every even for the processes as well as for the materials we have two word definition; make mark or we can say make marks protect lead, hold eraser, remove marks provide grip and display information.

Through if you take a pencil on just look at it for 5 minutes you will be able to relate to all these aspects. That is the lead is the main component which is used for making marks. Wood is used for a protecting the lead, metal cap is used for holding the eraser, sometimes you will have a eraser at the backside of the pencil which is held by a metal

cap. Then there is a eraser which is used to remove the marks. So, what we can gain out of it, just give a thought to this particular analysis and think that what we can derive out of it.

We have to find out that how we can improve the value of this pencil by redesigning, or you can say taking decisions related to the customer needs or thinking of the alternatives which can help us to achieve this desired function of making the marks on a piece of paper. So, if you see here we see that most of the money, may be 60 percent of the cost is only going into the secondary functions. Only 10 percent is the cost which is actually making contribution for achieving the intended function or the desired function.

Now, what should be our focus as a product designer or as a value engineer? Our focus should be this cost that is going. So, this cost is the total cost of the price that the person is paying. A person is paying rupees 5 to buy this pencil out of which 1.5 goes to the seller or the retailer and 60 percent cost goes in this material and only 10 percent is satisfying the basic function or the primary function of pencil. Now you can see the how much is scope of saving money.

Now, from this information we can very easily understand that if we are designing a pencil to be used for we can say executives in the conferences which are organized in five star hotels. So, in those particular conferences nobody may be interested in reading what is written on the pencil or displaying the information. For examples in many pencils we will see a message save trees or save girl child. So, may be that may be relevant to young minds or the school going children or the college going children, college going students, teenagers. May not be that relevant to an executive who is mature enough to understand all these things and who has gone to a hotel to attend a conference.

So, if we are designing a pencil to be used by the executives in hotels for attending that during their conferences or we can say during the discussions stage they have to use that pencil, maybe we can avoid the printing which is adding cost to the product. But in case the pencil has to be used by a school going children. So, different colour plots or a cartoons on the pencil will definitely attract that customer and would be kind of adding a steam value to the product.

So, when we are designing a pencil for a student who has to go use the pencil in a school or for young children definitely we will go for printing. Similarly, in a hotel if the pencil

has to be used during the conference may be nobody may like to use a eraser at the back end of the pencil some people may try love to use a separate eraser for that purpose. Those cases may be metal cap and eraser can easily be avoided.

This is an example to understand; very basic example to understand that how functional analysis will help us to take decisions related to the product design, and save money for the organization, and add value to the customer who is using that product. So, add value to the product for the customer who is using that product. So, this is very simple example of functional cost mapping or functional cost evaluation of any simple product.

Similar types of studies can be done for may be big buildings design of bridges design of highways. So, may be all those aspects can also be analyzed using the same principle. And this has lead to savings may be running into thousands and millions of rupees. So, that is the kind of the saving potential that these techniques possess. And if product designers make use of the principles of value engineering during their design stage they can lead to substantial savings for the company.

So, let us now further we can say scrutinize this function cost to relationship and use a other tool which is widely used for function analysis which is the FAST diagraming approach. So, let us see how a FAST diagram looks like and how it can be used by the designers to take decisions which are more logical and which are going to lead to success of the product in the market.

Now, just brief overview of the functional analysis system technique: the FAST diagramming approach.

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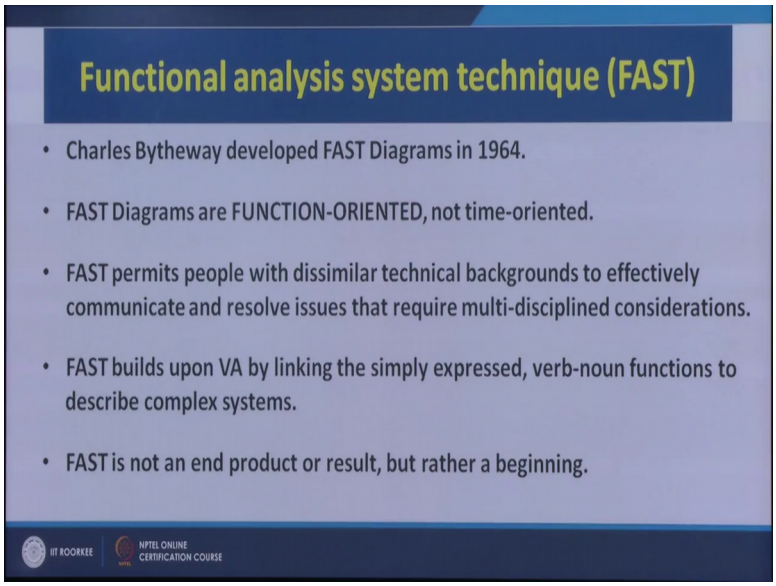

Charles Bytheway developed FAST diagrams in 1964, just the historical point of view. FAST diagrams are function oriented, these are not time oriented in network analysis sometime or during in schedule graphs we plot on a time scale, but here we are not plotting on a time scale, but we are plotting as in respect of the functions.

FAST permits people with dissimilar technical backgrounds to effectively communicate and resolve issues that require multi disciplined considerations. So, as you know that value engineering is not only related to mechanical engineering or civil engineering or electrical engineering it can be related to any aspect of engineering and science as well as management. So, for any project team I have told you that there will be people from diverse backgrounds, people may be there from marketing people maybe there from, sales people may be there, from finance people may be there, from legal cell people may be there from, environmental department. So, you will have a diverse team.

So, FAST diagraming approach will help you to just put everything on a piece of paper every information related to the functions the product has to satisfy. And then people can give their ideas brainstorm; even brainstorming is function based brainstorming in case of value engineering. So, all functions will be placed at their proper places in a diagrammatic manner and then in the discussion can take place related to the improvement of the project or the process. So, it will help to document the things properly.

FAST builds upon value analysis by linking the simply expressed verb noun functions to describe complex systems. Now suppose we have to analyze a complex a product for example an aircraft. So, for aircraft the basic functions can be carry passengers, but in order to analyze it from the value engineering or value analysis point of view we need to breakdown the complete aircraft configuration into its individual components. And some of the components will have interesting functions also, and then for those functions we need to analyze that how the functions can be clubbed together or eliminated or may be modified in order to solve the overall objective of cost consideration or overall objective of cost justification

So, FAST will build up; the breakdown the complex system into smaller elements which are easier to analyze. We will see FAST diagram with the help of one or two examples and then it will become absolutely clear that how a FAST diagram would look like, and what type of decisions we can take based on the FAST diagramming approach.

Now, you can see fast is not an end product or result, but rather a beginning. So, what we will do it is just representing the complete product into its individual components and then trying to understand the function of each and every component so that we can have a you can say creative view of what else can do the similar type of task and what can be done to avoid or may be some problems that are existing in the system. It can also help us to identify areas where new technological developments have taken place and which can help us in overall improving the value of the product. Maybe in a complete system, maybe to overall automobile there may be a material which has been developed which is impact resistant.

So, when we do value analysis of an automobile we will try to include that material in the front side of that automobile, so that the crash worthiness of the automobile improves. And the value to the customer also improves, because now the automobile has become more safe or the customer and he may like to buy a that kind of an automobile without any further increase in the cost. So, piece wise or piece mill when we do the analysis for each and every component it become the successful analysis, and many of the components which are redundant can easily be eliminated.

Similar is the case with human body: may be if we go to the evolution I am not an expert of that but earlier the body has evolved and the unnecessary parts in the body have now

been eliminated because of the rules of evolution. So, whatever is not required has to be a eliminated. Similarly, in a product when we will do step by step by step analysis and we will do the analysis of or each and every component of the product we will understand that there will be certain parts which are not at all required in the product and can easily removed out, and subsequently leading to improvement in the value of the product.

So, we will try to understand the FAST diagramming approach, and how a FAST diagram looks like in the subsequent slides.

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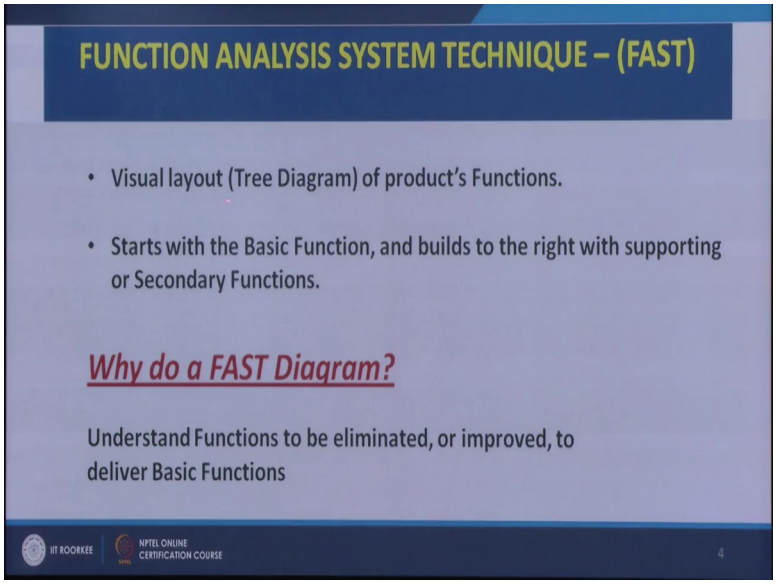

So, you can see FAST diagram it is a tree type diagram visual layout of products functions. We will see with the help of an example. It starts with the basic functions and builds to the right with supporting or secondary functions. So, it will list all the primary as well as the secondary functions. Why do a FAST diagram? Just one line answer: understand the functions to be eliminated or improved to deliver the basic functions. So, these are the two or three objectives for FAST diagram.

We need to understand what are the basic functions, which is the product should satisfy, and what are the functions which are redundant and which can easily be eliminated. Or, I should not say eliminate sometimes some functions will be combined together and made a third function which will be helpful to us.

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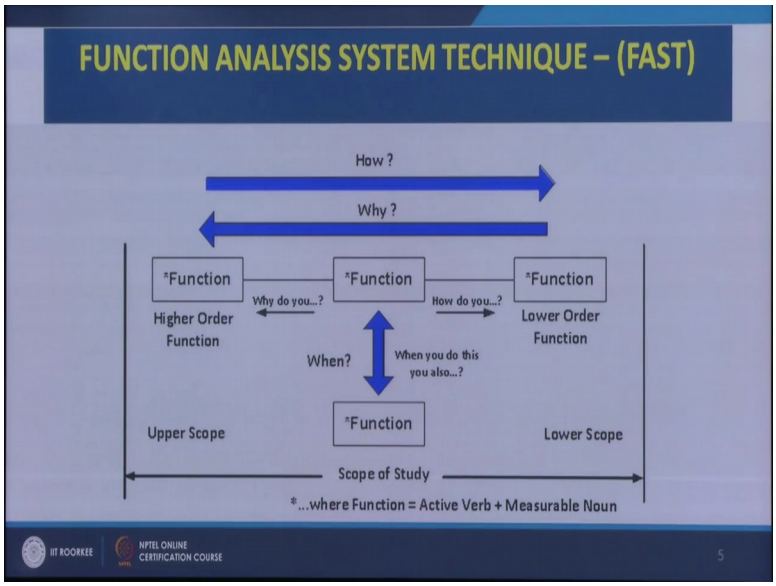

This is standard FAST diagram: functional analysis, system technique diagram. You can see there are two lines: let us see this is line number vertical line one and then the right hand side vertical line two these are the scope of study. Whatever functions are there will be this is you can say boundary lines for the study and the all functions will be listed inside.

If you see the blue lines from this side we will ask how type of questions. How this function is achieved, then next how this function is achieved, next how this function is achieved. And from this side we will start asking why: that why this function is required because of this; why this is required because of this; why this is required because of this; because here we can see why do we do this, how do we do this, when do we do this, you also do this.

So, when means it is not an time domain, but when is that is this you are being when we will do this or during it is giving a vertical scale that when this particular thing will be done. So, it is fixing up that will be this particular function this things are also the going on simultaneously. That we will try to understand with the help of the diagram, but first let us see the overall picture of the diagram.

As I have told you in the very beginning related to the concept of value engineering that five W's are very very important that is questioning technique is used to identify the problem. So, here also we are using three important questions that are how, why, and

when. So, from one side we are asking how type of question, from other side we are asking why type of question, and then when that particular function is done that is also listed in the FAST diagram.

So, whenever you see any FAST diagram these are the three directions in which you have to focus; direction which is horizontal direction and the vertical direction. And when you move from left to right you have to ask how type of questions, and when you move from right to left you have to ask why type of questions.

So, let us now see and function as written here is active verb plus measurable noun which we have already discussed in the previous class, where we have seen that for example, for a watch the definition of function can be show time that is verb and a noun. Similarly for we can say camera record information again it is verb and noun type of definition. So, wherever function is written you will get two word verb and a noun definition of that particular function. So, this is overall skeleton of a FAST diagram

Now, we will try to fix some example in this diagram. In this diagram then they will try to see that how a FAST diagram can be drawn for a pencil or for a overhead projector. Let us go to that.

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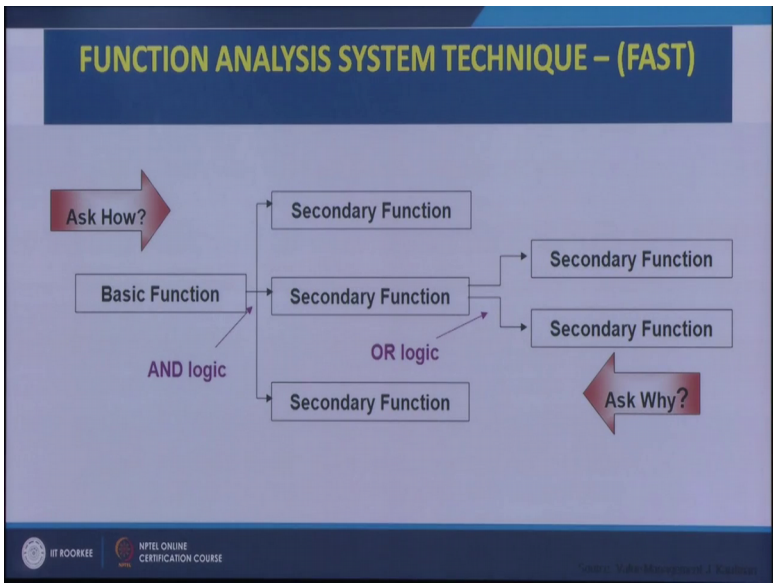

This is again I guessed as skeleton ask how ask why already I have explained and there we can see. Or logic can also be used and logic can also be used, so may be that we will try to understand when we see that example.

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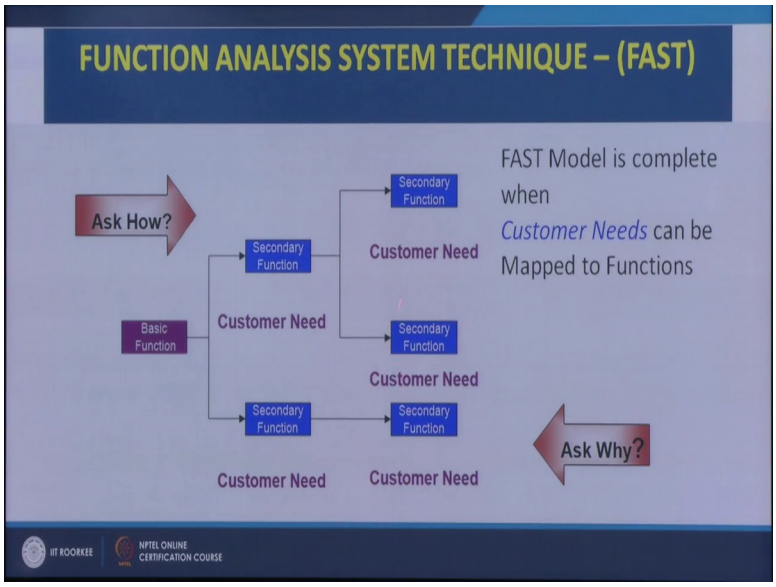

This is again how and why type of questions. So, when the customer needs are satisfied by the functions that the product is providing. It means, the product is going to be successful. So, fast modal is complete when the customer needs can be mapped to the functions. So, if the customer may be if you draw a FAST diagram may be it can be an assignment to you that you draw a FAST diagram for the washing machine. So, somewhere in between you will see a function wash cloths. So, wash cloths are a requirement of the customer and if it is getting satisfied, it means that the overall representation of the functions on the FAST diagram is successful.

Now let us try to understand I can understand that it is not that easy to comprehend until and unless you see a particular example. So, we have taken two examples to clarify this.

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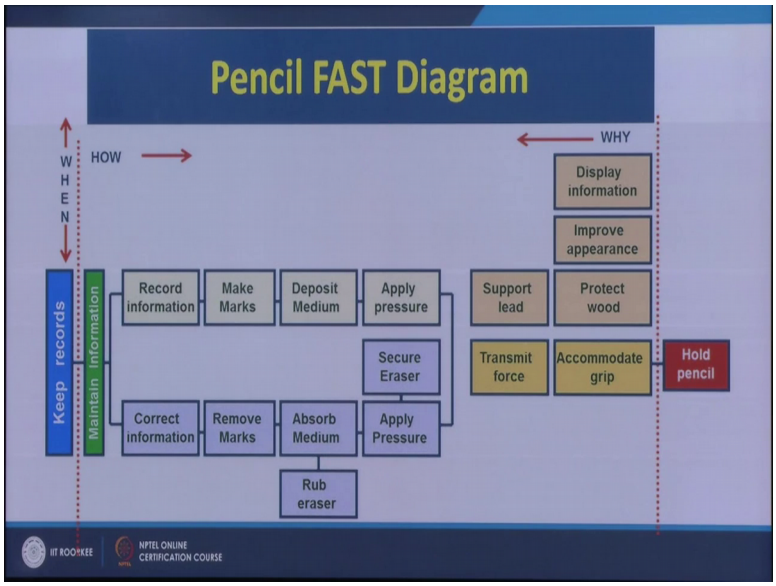

Now here you can see this is pencil FAST diagram or you can say FAST diagram or you can say FAST diagram for a wooden pencil. Now you see there are how type of questions, why type of questions, and then this is one function and this is another function, this can be this can be higher order function, this can be lower order function. So, first is hold pencil and on this side on the far left side, on the left scope line you have a keep records. Now let us take example and ask ourselves how and why type of questions. We start from here.

How we can keep the records by maintaining the information? How we can maintain the information by recording the information? How we can record the information by making the marks? How we can make the marks by depositing some medium? Medium can be pen or a pencil, right now we are not clear that we are going to use a pencil, but maybe we will deposit the medium. How we can deposit the medium? Medium is lead or ink something by applying the pressure. How we can apply the pressure? By transmitting the force and by supporting the lead. So, both things have to be done in order to apply the pressure.

So, there are or and logical come into picture that we have to transmit the force also and support the lead also. Then how you can transmit the force by a accommodating the grip? And how you can accommodate the grip by holding the pencil? So, we can say higher order function keep record, lower order function maybe we can say hold the pencil. So,

by holding the pencil you can keep the records. So, this is we can say we can sometimes call it as a critical path also.

So, from how type of questions from left to right we can see what is the relationship among the various functions or what is the relationship among the various we can say methods with which we can achieve our higher order functions. So, it is not methods basically we can call it functions only, but what are the functions which will help us to achieve our higher order function.

So, here you can have an idea. If you start from right hand side start asking why type of questions. Maybe you can try it on your own. If you start why a type of questions you will see why should we hold a pencil; why should we hold it; in order to accommodate the grip; why should we the accommodate the grip? Because then only we will be able to transmit the force. Why do we transmit the force? In order to apply pressure; why do we apply pressure? To deposit the medium on a piece of paper; why do we deposits some medium? Medium means again I am revising it is lead or ink, now we are depositing the medium in order to make marks; why do we make marks? In order to record information; and why do we record information? To maintain the information; and why do we maintain the information? For keeping the records.

So, if you move from right to left we have to ask why type of questions, if you move from left to right we have to ask how type of question. And when we will protect wood, wood will improve the appearance and improve the appearance it will display the information. So, at this level only when we are using wood these things are also happening at the same time. Because we are using wood for covering the lead so wood can help the other functions also. It will improve the appearance as well as it will display the information. Suppose you are using plastic here then also there will be some additional functions or secondary or tertiary functions that become into picture.

So, from here we can see there is another path also which is related to the eraser, secured eraser, apply pressure, absorb medium, remove marks, correct information. So, similar type of why this is the pencil we have seen in the first slide today pencil has a metal cap as well as a eraser. So, what does that mean? That means that you have a secondary purpose also. So, primary is to make marks, but secondary is to help erase the marks which are may not be correct.

So, we can see now whether this is required or it is not required. If it is not required you can even eliminate this particular function of the eraser and the metal cap. So, FAST diagram will help us to identify which are the functions which are not required.

This is again an example of the overhead projector of FAST diagram.

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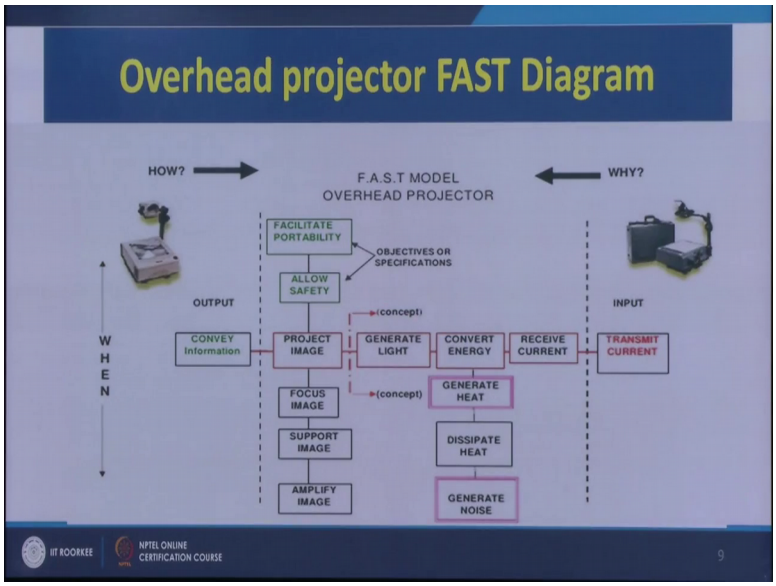

Again you can see from the left hand side you ask how type of questions, right hand side you ask why type of questions. This is the fast model for the overhead projector. Let me just go to one direction to other. If you start higher order function is to convey the information, how we can convey the information by projecting the image. How we can project the image by generating light. How we can generate light by converting the energy. How we can convert the energy after we receive the current. The how we will receive the current when the current will be transmitted.

And if you start from the right hand side start asking why; why current is transmitted to receive the current. Why do we need to receive the current? To convert the energy; why do we convert the energy? To generate light; why do we generate light? To project image; and why do we project image? To convey information; and when the image is projected we have to ensure allow safety, facilitate portability, focus image, support image, amplify image. So, when the image is projected these are the other functions which also need to be satisfied.

So here we can see; when we convert the energy it will generate heat when; it will generate heat that heat meets to be dissipate heat and then the heat will dissipate may be with the help of a form it will generate noise . Now, you can see for yourselves that we have taken an very simple example of a overhead projector that everybody uses. And use the FAST diagramming approach to breakdown its individual components and try to understand the function of each and every component.

Now, suppose with the technological advances we come to know that there is a source of light which is available and which does not produce any heat all these things can be eliminated. Because, our function is generate light. So, light has to be generated as per the existing technology there is a source of light which also produces heat, which has to be taken away and for that you have additional functions in the product.

Now, suppose we know from our background that there are sources of light which do not produce any heat all these functions will be completely eliminated, and your product will become simpler product, it would there would be no noise, there would be no heat. So, it will become a more valuable product for the organization as well as for the customer whose going to buy the product.

So, we have tried to understand that how the basic FAST diagramming approach can help us to list out the functions of the individual components of a structure or of a product or of a assembly, and try to eliminate or redesign or reinvent the product in such a way. So, that our product adds value to the customer.

So, that is the basic concept of FAST diagramming. We have seen that pencil can also have certain modifications in order to suit the customer requirements. Similarly the overall projector can also be redesign in order to suit the customer requirements. So, with this we come to the fundamental or the basic aspect of FAST diagram that what are the benefits of FAST diagram.

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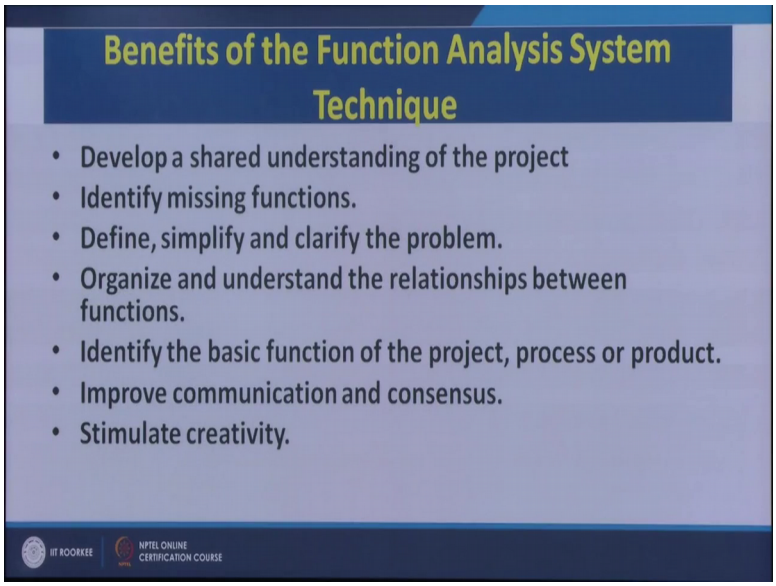

We can now I think all of you can try to find out. A product when I am giving you washing machine, you can take washing machine whatever you are using and try to make a FAST diagram for the washing machine. And then you will see that that FAST diagram will help you develop a shared understanding of the project. It is the common you can say knowledge for everybody; everybody can use a same a FAST diagram and try to understand the functions of the product.

Identify the missing functions; define, simplify, and clarify the problem; organize and understand the relationships between the functions; identify the basic function of the project process or product; improve the communication and consensus; and stimulate the creativity.

So, all these are the advantages of the FAST diagram approach. If you are able to construct a FAST diagram for the product that you want to value analyze all these advantages will automatically accrue. And you can easily lead to may be identifying there are some missing functions you can add those missing functions, there are some additional functions which are not required you can eliminate those additional functions. There can be functions three or four which can be combined together into a single unit that can also be done if you know the FAST diagramming approach.

And it will stimulate as it was given in that first or second slide that it is not the end product of your value analysis, it is the beginning, it will help you to create new and new

ideas. It is just the representation of the complete product in its functional form or as per the functional analysis.

So I will advise, I would request, I would ask all of you, I will argue to make a FAST diagram may be one or two FAST diagrams for different products that you see around you. So, with this we come to the end of our discussion on functional analysis and FAST diagramming approach. We will have our last session on value engineering which will be related to that various case studies which have been performed or which have been reported are available. We were the successful implementation of value engineering has been shown. So now, we will go further down into the application areas of value engineering.

Thank you very much.