

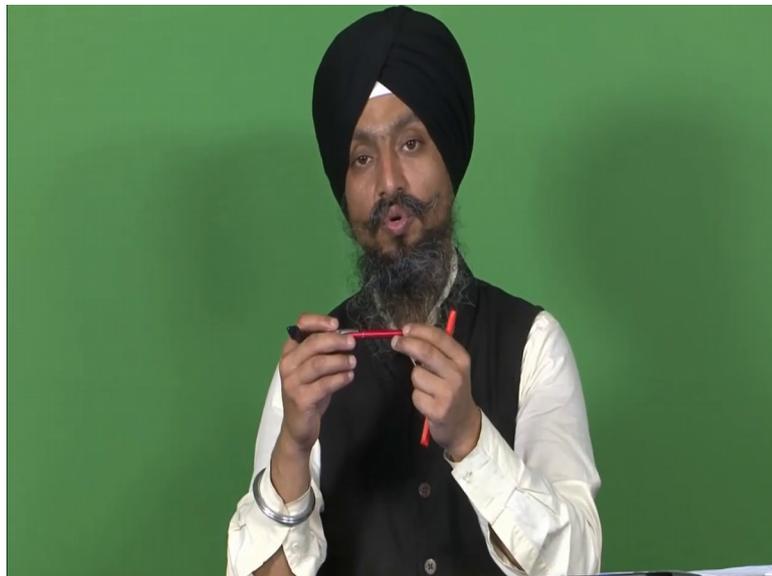
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**Lecture - 12**  
**Value Engineering Green Plan: FAST diagramming**

Good morning welcome back to the course on Advanced Green Manufacturing Systems. And we are discussing Value Engineering Green Plan in this module. We have discussed what is value? What is value engineering? Various milestones of engineering of value engineering where had been value engineering applied?

And we also had a little light on the green aspects those could be considered in value engineering. Now, we discuss the value engineering methodology the overview of that. Now in this lecture I will discuss FAST diagram function analysis and system technique in detail and I will try to develop a FAST diagram for a pen, a general pen that we use for writing.

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So, what is FAST diagram?

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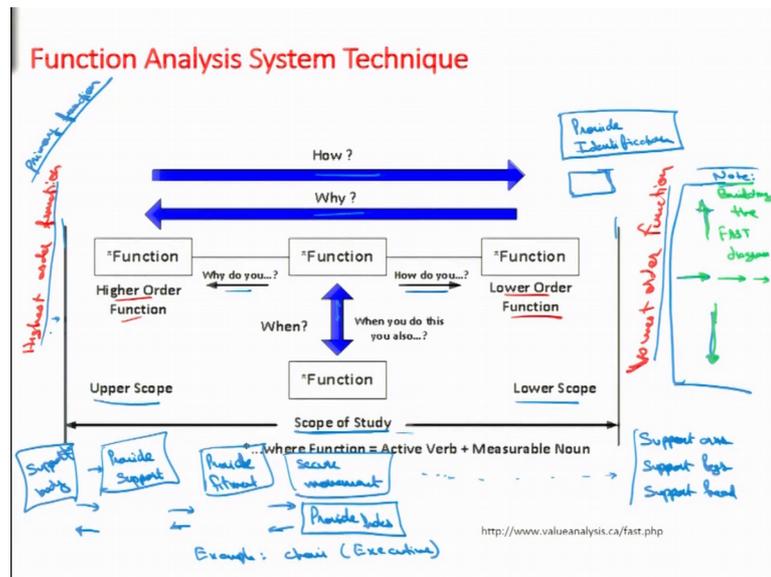
**Function Analysis System Technique**

- The Function Analysis System Technique aids in thinking about the problem objectively.
- The organization of the functions into a function-logic.
- The FAST diagram can be used to verify if, and illustrate how, a proposed solution achieves the needs of the project.

So, FAST our function analysis system technique aids in thinking about the problem objectively I am just recalling a few things. The organization of functions into a function logic the functions are organized into a logic. Now I believe you are very well able to develop the functions for a product to identify the function is better word we are we will be able to it identify the functions of a product functions in the components of the product. And then you can see that whether there is a redundancy or not for instance join parts, fix parts, provide fitment can be a similar kind of thing.

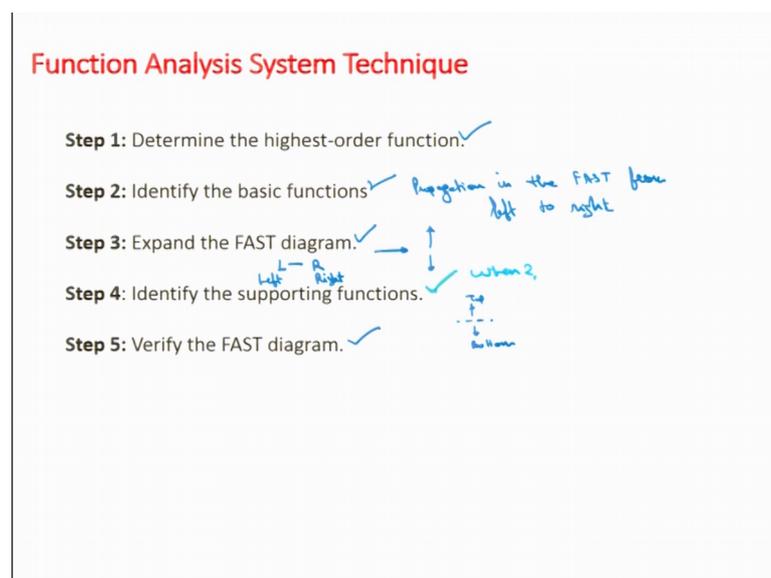
So, we can see that if the functions are redundant if there is a clear line between the two functions separate kind of a job is being accomplished by these functions. Then we can definitely have different functions, but we need to work on that. So, we will try to develop a FAST diagram. Here the FAST diagram can be used to verify if and illustrate how a proposed solution achieves the need of the project; if and how?

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So, this is the schematic of the FAST diagram. In the FAST diagram, we have the highest order function on the left and the lowest order function on the right. It starts from the left and propagates towards the right side. So, this is how you build the FAST diagram. This note I have given here is okay. Then all kinds of functions were mentioned, so I just developed a broad flow for a chair.

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Let us again see the steps that are there to build a FAST diagram. The very first step is; determine the highest order of function; determine the highest order of function. What is

the purpose of this product? Why does this product even exist? So, why what is the basic thing that people need when they purchase this product ok. So, for pen we will try to see pen is used for writing.

Pen can be is used for not only writing for drawing for making notes, for recording information. So, all these things we can consider, but we have to come up with one function that is the highest order function all these words just the verb and noun two words abridgment that has to be very crispy and should be clearly able to mention or explain what is our function basic function that is the very first step.

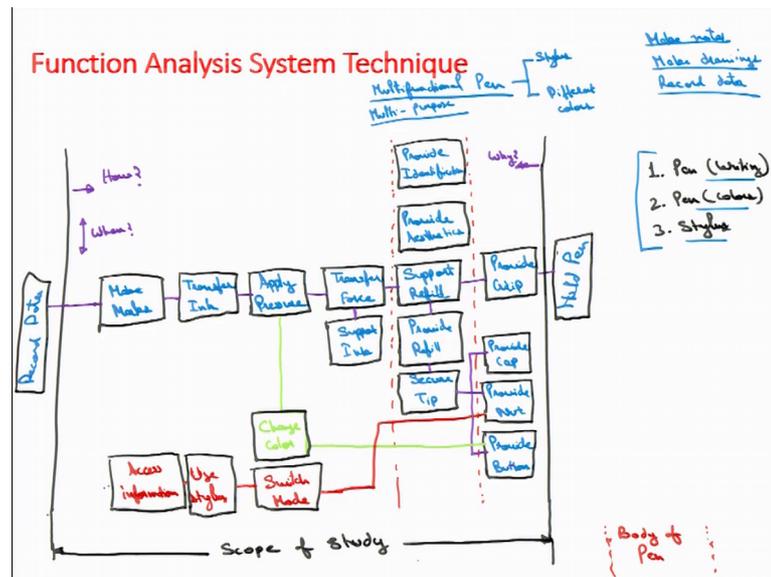
So, then we identify the basic functions. So, highest order function from the very highest order function we can approve it we have this highest order function we can move towards right. And just started with it to why do we need? If from left to right would be how, how would we attain this function? How would we write notes?

So, for that would be the steps identify basic functions this is propagation of the FAST propagation of in the FAST diagram actually propagation in the FAST from left to right ok. Then we expand the FAST diagram; expanding is moving from left to right and then from centre to top and centre to bottom, if they are some support functions to the required.

So, identify the supporting functions this is this step from 3 is from left to right left to right. This is step number 4 is from this centre to top and towards bottom this is from left to right direction. Then we need to verify that FAST diagram for verifying the FAST diagram we can have numerical evaluation.

Numerical evaluation help us to see whether the highest order function is actually rank to one function or not or whether the lowest order function is the last rank of the lowest rank or not. So, that can be verified and we if there is a need we can reiterate or re work on the FAST diagram to identify what you develop the kept FAST diagram.

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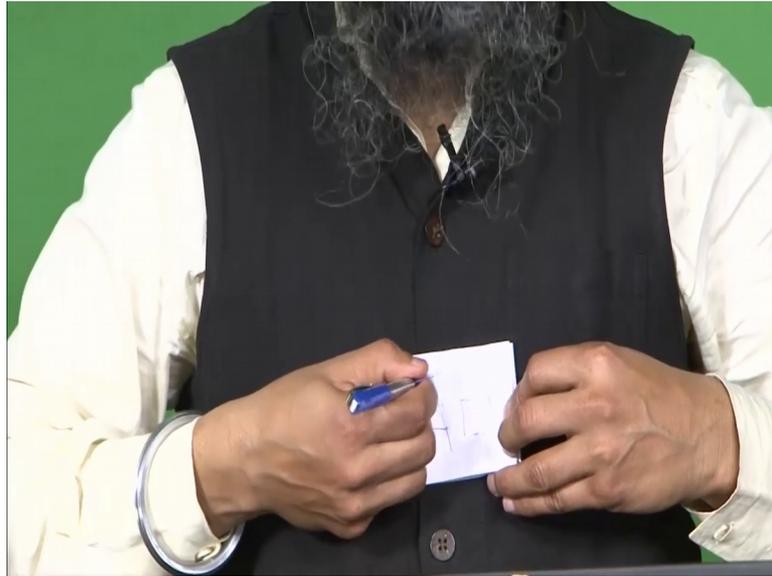
So, first of all I have this pen and I need to identify the basic function that basic function and I said can be make notes ok. That can be maybe make drawings or sketches make drawings ok. So, we some data recording we record data we record the data anything what we are doing trying to record something.

Sometimes what happens even the kids are playing with the pens they are not doing anything they are just doing something they are not recording they are not making drawings or not they are just making marks providing marks. So, we can say provide marks or make marks all those things any with any of these functions we have to pick up.

So, I believe that make notes, make drawings, record data; record data could be the basic function because we are recording the data record data. So, I have put the highest order function and I draw my left scope line. Just to recall these lines this black lines vertical lines are our scope of study this is scope; this is scope. So, highest order function is on the left hand side of my left scope line.

Now how do we record the data to record data we have to make marks. So, I can put make marks how to record data, while making marks ok. Now how do we make the marks? The marks that we get on the paper while using this pen we get marks what is happening here?

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Now, how we are making the marks I am just putting a pen on it pen trying to write it. So, I am writing the letter A. So, this is making marks I am drawing a rectangle here ok. I am just marking a line you see, I am making marks how is it happening the ink that is there in the refill of the pen ok. The pen has various components that we will see.

The ink is being transferred or being deposited on the paper. So, I can put making marks would happen while transferring the ink we have to transfer ink or deposit ink ok. We can just try to be transfer in good also be. So, how is ink being transferred? I am applying, I am putting the pen or what is it put pen on paper or put pen on the object on which we are writing ok.

Actually what I am doing I am putting the pen would it work if I just work like this without applying any force I have to apply some force here some force, some pressure ok. How do we transfer it? Transfer ink we take the pen close and apply some force or some pressure then we move our pen ok; in this way we are transferring ink.

So, this happens transfer ink is happening while applying pressure; so, I will put apply pressure. Recording data how are we recording data? While making marks. How are we making the marks? While transferring the ink. How are we transferring the ink? While applying pressure. So, in this case as you can see the two words are here verb and noun make is verb marks is noun.

Transfer is verb ink is noun apply is verb and pressure is noun here. And as we said we need to have active verb make is an active verb and measurable noun the mark size are to be measurable. So, that we will see when we will we need to be; actually why it has to be measurable because we need to quantify it, we need find the cost of doing specific function.

What is the cost of making marks? What is the cost of applying pressure in the specific pen? The pen is say for instant the cost of the pen is rupees 20 what is the cost that is there to for applying pressure. For applying pressure I need to have the size of the pen it is around the normal pen size from 8 mm to 12 mm the size is around maybe 11 mm ok.

This is dia diameter is 11 mm they are such we have to hold it ok. I have to put I have a refill and ink all those things in this. So, this functions we will be divided into different components in different cost parts as well; how we will do will see. So, apply pressure and why do we apply pressure from right to left if I go? To transfer ink. Why do a transfer ink? To make marks. Why do I make marks? Finally, I need to record the data.

Now how do I apply pressure I have pen in my hand I have to bring the pen closer as I said, I have to apply some pressure what is happening? The force in my hand is being transmitted or being transferred here ok. So, what we are doing; this force is being transmitted to the object on which we are writing and applying pressure we are getting we are transferring the ink in that is way.

And we are getting marks and this marks is recording data ok. While I can write number 1, 2, 3, 4 so this I am recording data. So, how do we apply pressure? We have to transfer force transfer force or transmit force or convert force. So, transfer force is done to apply pressure so this is that.

So, transfer force now what is the function in this pen if I see this pen it has various components to apply pressure. What is it has this back body the front body ok. So, we have a refill here, in the refill we have nib ok. The refill is put here and the pen tip or nib actually is a pen tip only and we have ball in here. So, this is a nut and bolt mechanism that is that is helping us to screw this on.

And there are certain serrations if you say for the grip there are certain serrations we need to hold it there. There is a cap that is to cover the tip of the pen. Because if I do not

have this cap do not take this tip of it might affect try to put in my pocket, it might make marks on my clothes or my shirt or it is not recommended.

So, there is some mechanism we can have the back click kind of pen ok. This is the pen in which the tip is taken inside using a spring mechanism with a button at the back or we can have a cap. Or also we can have this roller type of mechanism nut and bolt mechanism to take the tip tip in and out ok. I have got some pens here just to show the types of the products.

Now how do we transfer force transfer force from the pen to the paper. We have to use this outer body to transfer force because now force is actually transferred from the refill to the paper. Actually this refill is transferring force why can you write in this way as well ok. So, we need to support the refill support refill.

How do we support the refill? We provide this outer body we provide this outer body to support the refill ok. This body is helping to support the refill what else is body this body helping us to do that we will see. So, to support refill I can it is not how actually we to support refill there are certain supporting functions here. Supporting functions is we need to provide refill provide refill ok.

And in the refill we need to have the tip tip of the pen we need to secure tip. What else is this doing with body I am actually the in this portion ok; in first let me cover these make marks. First of all record data make marks, transfer ink, this is done by applying pressure, this is done by transferring the force, this is done by supporting the refill.

To support refill we need to provide refill in the body ok and we need to secure the tip in the body. Actually in this portion in this portion I am talking about the body of the pen. So, these two lines represent the body of pen. So, within body what for the functions is body doing it is helping us to provide grip here ok.

It is helping us to share the identification the name of the company is there also you can see the various colours; blue colour, silver colour, all those things are there. So, this is a static and appearance as I said the product characteristics. One of the characteristics was the statics or the appearance of the product by those are the sell functions.

So, along with supporting refill and providing refill and securing tip which are the work functions; work functions means these help the product to work. In this pen actually we can see the refill if I take another pen I cannot see the refill in this pen I cannot see the refill, but still it is helping us to make marks 1 2 3 4.

I cannot see these functions, but this function these components actually refill etcetera. But those are there and those are required to make the product work. So, these are verb functions actually. And what else it is doing this pen it is providing identification. So, I will say provide statics the colour etcetera.

And also it is giving information of the company or company identification it is providing the identification. So, how do you support the refill in this front portion this front portion of the pen and back actually whole the body is helping to support the refill this these orange lines orange dotted lines we are talking about the body of the pen only.

So, support refill one of the functions that in come in direct line can be provide grip. So, we provide grip finally, what we get; we get a pen. So, if I stop here and write my lowest order function that is the product the product that we get got is I will draw a scope line here. And I have got my pen here I have got a pen here I will write hold the pen ok.

So, this is my lowest order function hold the pen and this is the second lowest order function. Because we know providing grip whether or not to provide the grip you do not have any grip in this pen. And the cost of this pen is around 20 rupees and this pen cost around 100 rupees. Why 100?

Because it is the as well as the capacitive stylus here if I do not consider the stylus the cost of this pen should be around 50 rupees, the cost is higher the thing that is making this pen to sell is the aesthetics ok. The quality of the ink the dye of this pen is around 7 to 8 mm this is around 12 mm ok. So, this is not having any grip. So, the grip is not the you can say the basic function or the necessary function.

So, in this pen in the specific pen because they consider to have this grip I am considering this as a basic function. Now what are basic functions here? This central line here. Let me first cover this in blocks and these are the basic function from record data ok. To make marks, to transfer ink, I will just draw a straight line to apply pressure, to transfer force, to support refill, to provide grip, and to finally, get a pen.

Now let us see each function and let us try to identify do we need to have some support functions for them. Make marks, how do we make marks? To be need to support just depositing or transferring ink can help us. And how do we transfer ink? We need to apply pressure; we need to apply pressure. And how do we apply pressure? We need to transfer the force.

To transfer the force I can put refill also has to support or have ink in it. So, I can put this here as well provide refill support ink. Ink is actually an important function. So, better I would say because ink is required how do we provide refill? How do we provide if it why do we provide refill? Actually we should go on this side; this side on the left side of the provided refill.

Because why do we provide refill? We need to support ink we need to support ink. Also securing tip we can have certain mechanisms like we can have the cap to secure the tip or to provide the tip ok. This cap is one mechanism another mechanism is provide nut and bolt as I said.

Then other mechanism as I said we can have a button here. So, let me try to put this to secure tip that can be done in three ways. Secure tip can be done in two three ways which is provide cap, provide nut, nut and bolt mechanism ok and provide button. Any of these mechanisms could be picked to secure the tip. So, let me have the connections again.

Support ink support ink let me first cover this to the block support ink is an important function and that should be there connected with my critical path. So, this is connected here support refill is also connected with provide refill is connected with secure tip. To secure tip is an important function we can have any of these options to secured the tip, provide nut or provide cap, or provide button right.

So, this is how we are doing. In this direction we have why? Also when do we support ink? When we need to transfers force? When do we provide refill? When you to support refill and when do you secure tip? When we needed to provide refill? In this direction we have when? When do we need this thing?

So, this is the FAST diagram of a pen broadly we have to try to; we have to try to identify the functions of a pen and we have put it in a format. So, what if we have multi functional pens or we have multi colour pens.

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Like this is a pen it is a multi colour pen ok, this is a multi colour pen that can help us to change the colour using the buttons at the back. It is having 4 colours it is another pen that is having 10 colours this pen is having 10 colours.

This is actually for it four colour micro colour sometimes if I making some sketches I need to put it dimensions in a different colour. And I to make notes put my special notes in different colour like I am making this diagram here on the tablet.

And I am putting different colours to make you understand the diagram in a better way colour coding is there all the text is written in blue black line represent the major boundaries, and the purple lines represent the connection or the notes here. So, we can change the colour; to change the colour what is the way to change the colour?

We can either have a button at the back or either sometimes if you remember if you have looked there are certain they have certain pens which were having tips on both the sides. This side we had blue tip and this side we had black tip.

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What we did? We just swap the position and start writing on black colour. And swap the position that again blue colour to those were the ways. So, if I try to make a FAST diagram for a multifunctional product.

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So, the multi functions can be anything like this is one of the pens that can even hold the tablet ok. And on the head and on the tip of this pen here we have the capacitive tip or capacitive head I could say; also we have this capacitive tip.

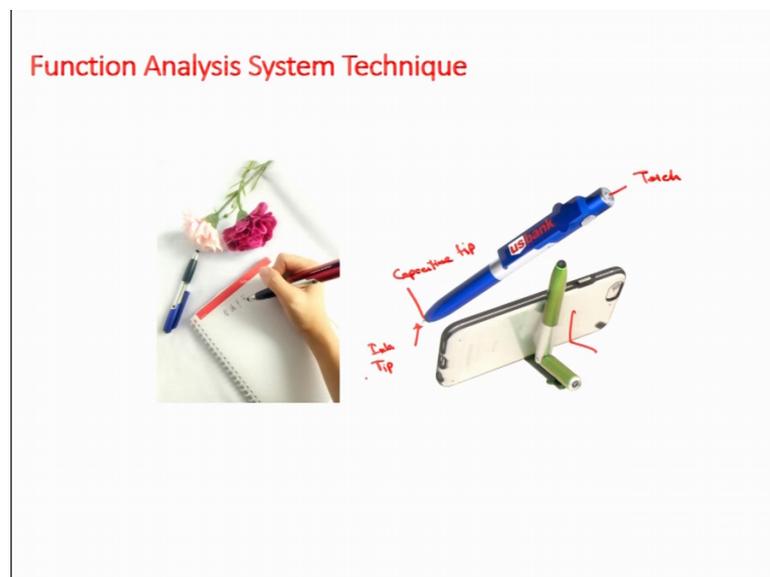
Like I have a pen here in which I have this tip I can keep making notes ok. If I require internet to surf or use my phone I can use just my this to head of this pen with capacitive head to surf on the phone to use it on the phone to open something. So, this is multifunctional pen.

There are certain ways we can have in this pen that is there on the slide we have the head to capacitive head and tip both. So, we can have both or we can have on the one side like this is the pen that is having the tip on the front side only. We I am trying to make notes I will rotate this and tip goes inside then this capacity tip box I can work using this.

There is a certain as you know limitations of this pen; one thing is one has to use it is other hand to make it come out and make it go in number 1. Number 2 there are certain chances that the tip might makes scratches on your on the screen of your phone ok.

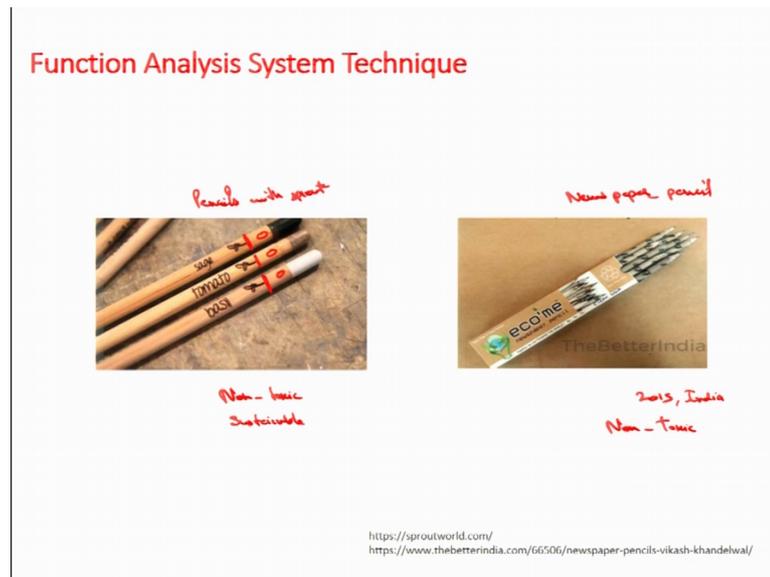
The certain you know the certain drawbacks or certain limitations with products those we need to see. So, this is not only a capacitive tip pen it also has a laser light here, it has a laser light here it also has it torch here so this a multifunctional pen.

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Similarly we can have this kind of pen, this pen can be tilted in this direction to support to provide or support for the tablet or the mobile phone. Also it has it torch here it has the capacitive tip and the basic function it has a nib or tip ink tip also this will talk green products.

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So, green products how can we inculcate greenness into this product. So, this is that pencil with a sprout these are pencils with sprout. What happens when you use this pencil this is a small pencil that is a better very big idea when is use this pencil you just use this pencil up to this point to this point you will use this pencil.

And at the this portion we have a sprout to the sprout for sage, tomato, basil and if we use pencil and after using we just try to sow it in the sand we sow it on in the ground. This plant would grow tomato plant will grow, basil plant will grow. Now what is happening here? If you remember we had three phases in the life cycle when we talk about the environmental aspects in the product.

Before use, during use, after use and I had the impact environmental impact 0, negative, positive. And I told that I will give some examples in which we have positive impact as well. Now, in this case in the phase this is before use during use after use. In the after use phase this is a positive impact it is contributing to the environment; however, while using the sharpening happens and the certain scrap is produced that can be recycled that can come to 0 or this is a positive refill just throw it away.

While manufacturing certain energy is used. So, certain we have certain energy pollution all those happens in manufacturing. So, there is a negative impact, but after use we have a positive impact to help us to so grow plants, so, some you know positive thing happens here.

So, this is an idea actually there are three things about the sprout that characterize the sprout team those who develop this one. First was that they believed in sustainability, second was they want more people to care about the mother earth more and more people buy this pencil when they will actually show the seed will have this kind of feel this is required this might become some like bring some awareness.

This might bring some awareness yes of course; capability is there they can do some other activities also in this direction. So, this is one second part and other third part was it is simple fun and simple cactus simple exercise that they plan to this. So, by planting a sprout pencil instead of throwing it out one can make a sustainability visible to others.

And also inspire others to make a small change in their routine life this is the idea behind the sprout pencil. Now it is available in more than 60 countries, so, the full range of this sprout non toxic sustainable pencils are there. Even this wood that is from which it is made is non toxic wood so this is one idea ok another idea is this is the pencil it is made out of newspaper.

As the pencil made of newspaper what happens the Chinese actually made the pencil of newspaper at first and that have been in the market for a long time. And in India also the paper pencils were manufactured by someone who took this idea. And what is happening the raw material is newspaper these pencil is generally have an attractive plastic covering at this point of time to make it a little effective.

But the raw material the core material here is newspaper. So, this plastic covering is just that entices children to buy these pencils. So, this is actually developed by zebra stationery products. So, they decided to make this pencil using only old newspapers for more than 2 years.

They kept on experimenting with various newspaper and different glues and ultimately in 2015 in India they came up with the pencils. And now they are working of they are able to sell this the quality of the paper and everything was controlled and glues this is also a non toxic pencil. So, this is how we can make the product green.

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I have this pen here this is a pen this is not the complete green pen we have the ink here everything the metal tip here that has to be there. And but the body major part of the body or major portion of the body is made out of a cardboard, coat out of a paper.

So, this is this is compostable material, but the head and the tip the front and the back end as is made up of plastic to provide this button mechanism it is. However, the pens are available which are completely made of made out of material that is biodegradable. So, in those ways we can inculcate the greenness in the product.

So, now, here I am talking about the multifunctional products. So, I will write here multifunctional pen. Previously I just had a FAST diagram for a pen the product is pen. Now I have a multifunctional pen, I am just telling you how to bring more functions in a single product.

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Now, this is a pen that is having multifunction it is angle laser in it is having the torch in it there are certain buttons is a button for laser button for torch. And also there is a magnet here this magnet can be used to pick the pins are there ok. This magnet can be used also we have the stylus not stylus sorry this is a pointer here when you are teaching.

So, this the teachers gadget; so, there is a tip that can be used to write something ok. We can write something we can make marks. If I would not discuss about these many functions in pen, but let me just discuss the multifunction pen that is having a stylus in it and it can have different colours let me say.

So, multifunction pen it is having a stylus capacitive stylus. And it is it can have different things different colours ok. So, for different colours as I said we need to have the button at the back because button at back let us a stylus here as well ok. The capacitive stylus it has an it has button at the back so this button mechanism. Why do we need to the button? Because we need to switch colours as well.

Let me try to move from right to left now. So, from right to left we can move, we need to have a button because we need to switch mode. When do we switch mode? When we are going to write, when we need to change colour; so, I will put here change colour ok.

When do we change colour? Because we need to have different kinds of inks. So, this set this can be connected here with applied pressure early; this can be connected here with

apply pressure change colour. Also we need to secure a stylus here how do we secure a stylus? We need to switch mode; switch mode from a pen to a stylus for that in this case we have just we need to just swap the pen and start writing.

So, we need to switch mode we need to switch mode or we can have it using the nut and bolt mechanism. In this case nut and bolt mechanism is helping to switch the mode from pen to stylus this trip is coming out an ink So, provide nut this change colour is connected with provide button ok. All these things come in between, so, this provide button can also have to change colour.

And provide nut can help us to switch mode; switch mode from the writing pen to the stylus. So, why do we switch mode? Because we need to use stylus or we have to secure stylus we can put anything like that. Why do we need to secure stylus? We need to collect information we need to assess I will put assess information.

So, this is connected here with provide nut. This is connected here change colour is a separate function. So, we have three functions here; number 1, in this specific pen number 1 record data, number 2 assess information. Asses information can be the highest order function as well this can even go here; even go here.

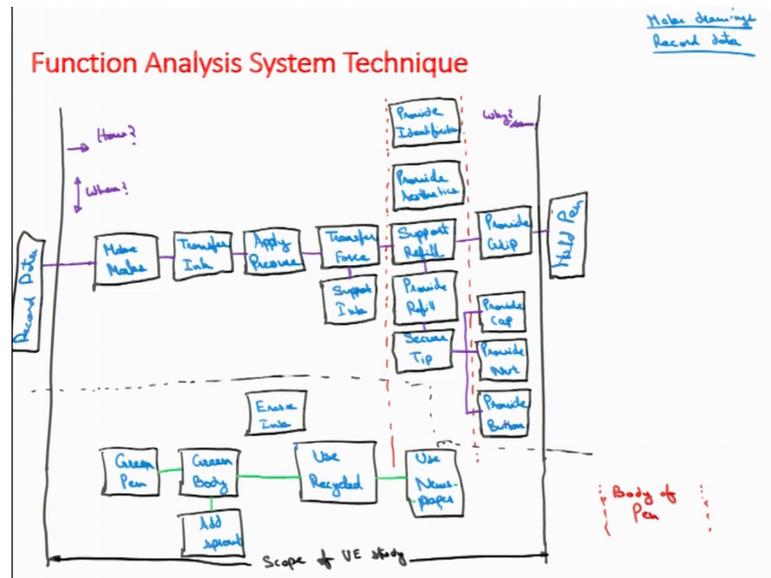
Actually not for the basic pen just for as stylus not a highest order, but the second highest order it is actually parallel to make marks not supporting, but it is something that is parallel to make marks. And you stylus is how we excess the information on the mobile or on the tablet.

So, this all functions so the your three function is 1, 2, 3. One is pen that is writing, number 2 pen with colours, number 3 is stylus. So, this is not to forget this is the scope of the study where we can use value engineering. So, we have seen the FAST diagram for a multifunctional pen with the functions are the basic function is writing.

And the second function is providing colours and the third function is stylus. So, multiple purpose I would say, but a multipurpose ok. Because the word function is something that we are defining each of them is a function actually. So, let me try to develop for add a few functions in respect of greenness for this pen.

If I am taking over this pen this pen is having green body ok. So, in green body so I will try to start again from the left in this FAST diagram only and I will try to see how can we develop a function the body is green; so, let me try to put here.

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So, I would like to have a green pen or green the pen; green the pen means greening of the pen as you know the first word is verb second word is a noun. So, this green is verb greening of the pen like or having a better ecological status of the pen. So, this is green pen how do we get the green pen? By having this kind of body; that is biodegradable ok.

That is I would say compostable that is that can be thrown away. So, I can say greening of the pen can be done by having compostable body. So, I would say compostable composed body compostable body ok. So, as I said the pencils were there other thing that we can have in green pen is I will write as a final function to this, we can add seed or sprout.

How do we get the compostable body? We provide the body of a biodegradable material or I can say we provide something like use recycle material. Compostable is not a noun I would say biodegradable body biodegrade or green body providing green body. How do we provide green body? We used recycled material.

How do we use recycle material? In this case in the place of body here we will put here we use I can put directly material here use newspaper ok. Newspaper or anything that is

recycle or reusing this is reusing actually this portion is reusing the newspaper and this one is recycling green or sprout green pen.

So, let me try to connect this with a green line green pen is used by this also a sprout can be added use recycled, use newspaper. Again this can lead to this can this can connected to in this pen we have provided button security provided button all those things are there finally, we can hold the pen.

So, this is the green pen where I have brought it a little lower so as to show it as a separate entity now this is my scope of the study again. Now this is my scope of the study this is scope of value engineering study. So, this is how we establish a FAST diagram and we try to have a diagrammatic representation on the relations between the functions. Now the question comes is my FAST diagram correct? Or is there any other way to develop this FAST diagram? Or can I have some other name with function? As I mentioned earlier there is no correct FAST diagram.

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**Function Analysis System Technique**

Is there a "correct" FAST Diagram?

- There is no 'correct' FAST diagram but there is a valid method of representing the logic in a diagram.
- The validity of a FAST model for a given situation is dependent on knowledge and scope of the workshop participants.
- The FAST diagram aids the team in reaching consensus on their understanding of the project.

In that I have a note; is there a correct FAST diagram? There is no correct FAST diagram. But there is a valid method of representing the logic in a diagram. No correct FAST diagram, but a valid method of representing the in a logic the logic. So, this is a method let method is we start from the step that we mentioned.

The first identify the basic function or the purpose of the pen. The highest order function we start from the left and we start propagating towards the right wherever we feel we can add the support function. Some function which might not be the part here like provided identification that has come on the body and some other functions that might be unnecessary or maybe tertiary function.

If I say primary secondary and tertiary function tertiary function is might be there that can be reduced or that can be eliminated or that can be changed or brought or maybe a mixed with some previous function with the secondary functions so these things can be done.

So, a validity of FAST model for a given situation is dependent on the knowledge and scope of the workshop participants. So, what is the knowledge into participants number 1 knowledge, number 2 is scope at the scope of the work. So, the FAST diagram aids the team in reaching a consensus on the understanding of the project.

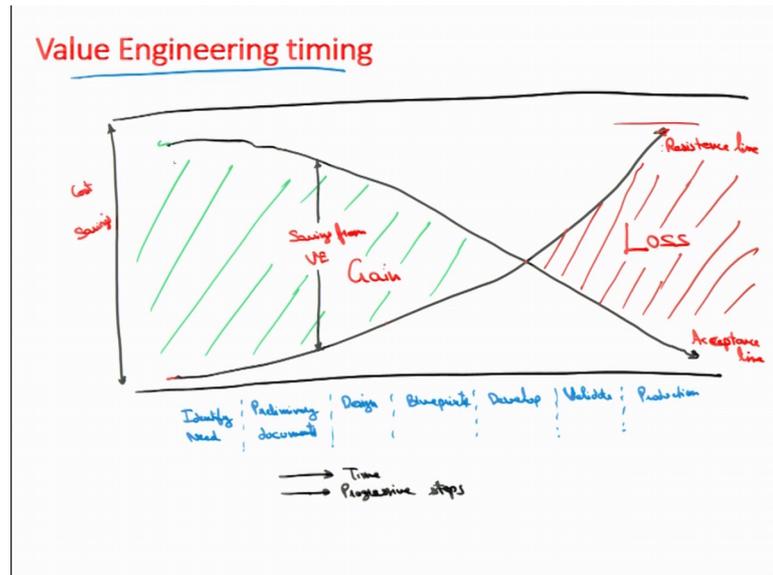
So, this is actually the way to have a feel that what the functions are and what we can do with functions the way to deal with do develop a FAST diagram one of the ways can be we can write the names on the slips separate slips can be made. Like this size slips can be made one slip, slip number one, slip two. So, the names can be written here and slips can be arranged in order to see whether the flow comes correct or not.

And then slip slips can also be compared that whether there is redundancy or whether the function as repeat it or not both things also can be seen. So, whether the functions are same or not well redundant or not those can also be identified in numerical comparison. If in numerical comparison the score that we finally, get the total score is same for two or three functions. And the functions are kind of doing the same kind of purpose they kind same of purpose.

Then the functions might be taken together and they might be you know compiled into a one function two three function those things can also happen. So, this is all we do in value engineering this is my FAST diagram for a green pen. We are developing green pen we can also have erasable ink green body and that is sprouting the body use recycle we can also have an erasable ink erase ink.

So, there is a pen that is developed by friction company for this pen has a ink that is sensitive to thermal the resistive to heat. And at the back with friction when heat is produced is ink is erased ok. This is also given in the sheet I will talk about this when I will talk about the creativity techniques. So, erasing can also be one of the functions that can be added. So, this is my second section of a FAST diagram.

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So, next I have value engineering timing when to apply value engineering. So, when we talk about a project or when we talk about manufacturing a product; the very first thing is we identify the need identify need. Based upon need we have some preliminary information some preliminary design preliminary documents I would say. Preliminary documents for identifying need or co instants people are demanding something to hold a mobile phones.

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So instantly this mobile phone people like to hold this mobile phone to this is a ring that is produced here and this is a cover ok. This is a bumper cover which helps the mobile to be safe from falling or from breaking. Like it can fall, but it would not break so there are less chances.

So, this is something that helps I put my finger here to single hand operation can be done ok. Sometime when the phone is hold like this now my thumb cannot reach each corner of the phone; however, their function in the phone that the screen can be made smaller. But it cannot reach when I have a finger here fixed here so it can reach each corner here.

So, this is something need identify need the preliminary documents is what can be the way can we have a some rubber slip here or can we have a ring here this ring can also has act as a stand for my mobile ok. So, preliminary documents are there. Then after preliminary documents we have design. After designs we can have a some specifications work specifications or blueprints I can say ok.

So, this is next step after blueprints I can think of having or develop I would say I can have think of and your prototype for this develop then validate. After development is there I just develop the prototype and or prototype why we can develop a few pilot pieces pilot pieces piece the products which are manufactured in the very beginning.

And those are used for having the feedback from the customer from the internal customer those is there was some time known as minimum viable product ok. So, those are developed would that has to validate a better whether any changes are required, finally, you go into production. Now, knowing all these things that the steps are here when should one apply value engineering or what happens if we apply value engineering at later stages or the earlier stages.

So, what happens this is that time also going on here. Timing is going on also we having progressive steps. Now value engineering if we apply value engineering at this point then we identify the need, I would see the this is the line I am drawing this is actually resistance line. Resistance line means resistance from the manufacturers or from the people who are working in.

If I apply value engineering at later point during production and it done I see this change can be there this functions are there then people who have very high resistance this high resistance would be there ok. At this point when design is happening the resistance would be less or but when we even identify need we can just identify the function; what do people need? People needs something to hold the mobile phone, so instants this mobile phone.

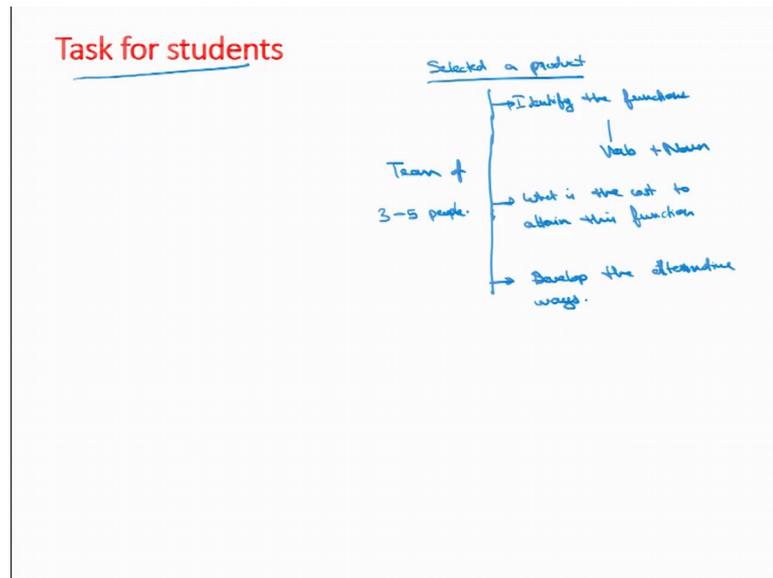
So, can we have something different can we have a gloves for them in which there is a rubber band they fit the mobile phone over there? Can we have something a mobile phone itself that has an attachment to fix the fingers in there? So, identifying need is one thing so that here we start.

So, lesser bit resistance then opposite to it we can have an acceptance line people are highly acceptable to the new ideas or the new functions from creativity or from value engineering those come here, so, ideas to fulfill the functions this is about acceptance line this is acceptance line.

Now, between these two I can have the cost savings. So, these are the cost savings. So, cost savings so this is the saving from value engineering from value engineering. So, this is the loss if we start here the resistance is higher so I can put here it here this is actually loss this is the gain.

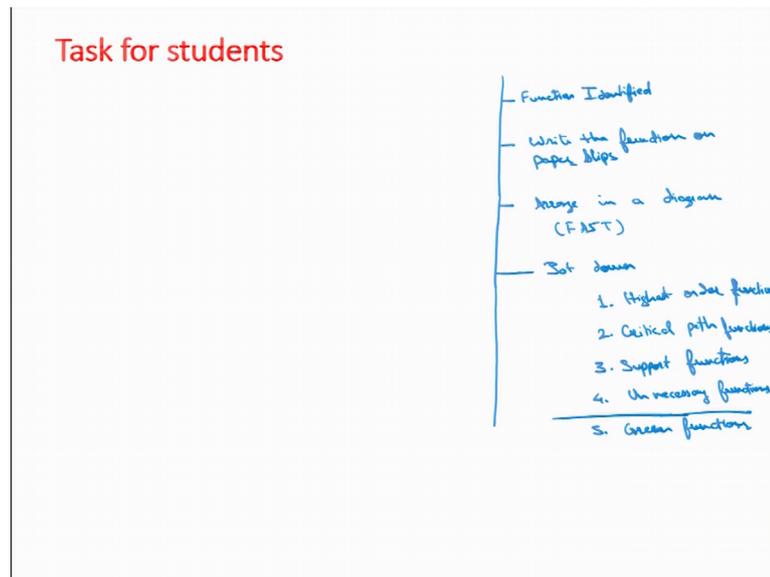
So, this portion I will make it red, this is the loss and this one is gain ok. So, it is recommended to apply value engineering as early as possible. If you have thinking of a new product that has to be come to the market, so, this is about the FAST diagram and value engineering timing.

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Let me have a task for you, earlier I have given you this task you were asked to identify the functions as a verb and noun. Then what is the cost to attend these function? This function specific function specifications you were asked to do this. When develop of the alternative ways the broad way you were to develop.

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Now, I will try to request you to please the function that your identified functions identified. So, I even request if you have not perform this task just identify the function then move to next step. Functions are identified they try to write the functions on slips; I will request you to write the functions on slips ok.

Then try to arrange those slips in a diagrammatic way on paper slips ok. Then arrange in a diagram that is the FAST diagram. Now just jobs down number 1; highest order function, number 2; the critical path critical path functions ok, number 3 support functions, number 4; then unnecessary functions if you find something.

And try to see what you could do for greening green functions of the product that your chosen ok. So, try to perform this task with exercise will definitely help you to have an insight in developing the FAST diagram and understanding the value engineering process. We will come up with the creativity technique then I will ask you to come up with the creative ideas to perform the functions that you are selected in a alternative way ok.

So, let us be the next lecture we will discuss the case study on value engineering, in which if the case study of product the product case study selected is foot operated air pump. So, the drawings were made and the functions were identified the costs for the components were their actually those were obtained from the manufacturer.

Then we develop the cost for the functions and also be rank the functions. And we try to identify what is value improvement potential for the specific function so those things we are done. So, I will come up with the case studies in the next lecture. So, please try to study FAST diagram you can refer these notes also some of the links will be provided to you for further studies. So, let us meet in a next lecture.

Thank you.