Advanced Green Manufacturing Systems

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Lecture – 10
Value Engineering Green Plan: Methodology - Part 1

Good morning, welcome back to the course on Advanced Green Manufacturing Systems. In this course, we are trying to learn how do we convert manufacturing systems to greener one. So, in this module, we have discussed value engineering green plan.

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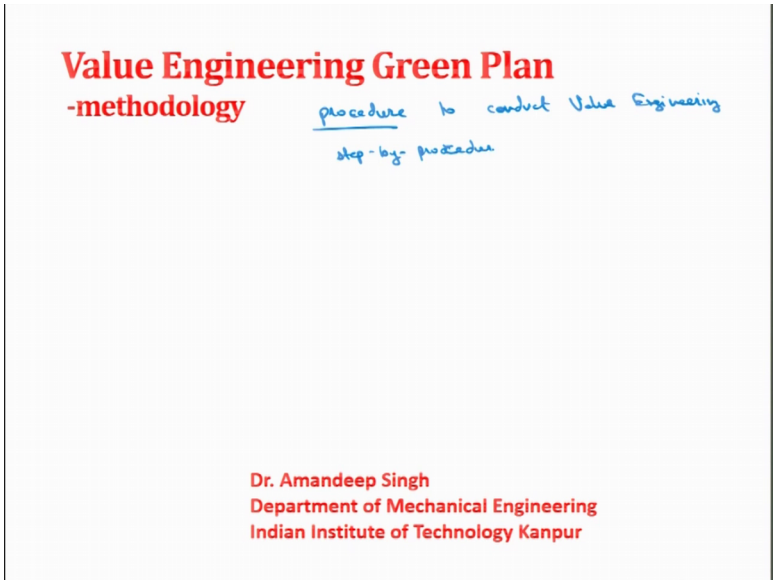

We are discussing value engineering green plan. We have discussed what is value, what is value engineering, various types of value, those were use value, a steam value, exchange value, cost value and green value. And we have discussed how value engineering is different from the normal cost cutting and Dr. Deepu Philip was discussed various quantification techniques to convert a product or a process to greener one.

So, in this lecture, we discussing value engineering green plan methodology. So, methodology is actually the procedure to conduct value engineering ok; it is a step by step procedure.

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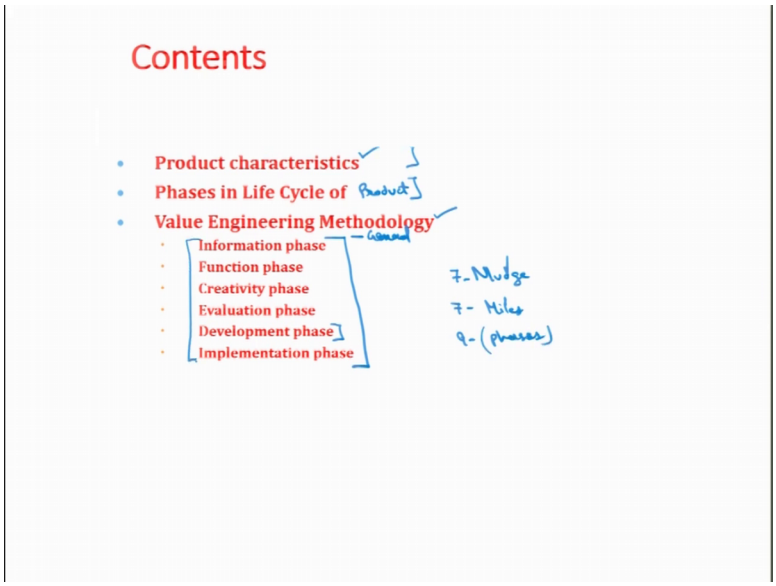

So, the contents those will be covered would be, we will discuss product characteristics, what are the various characteristics of a product, what do customer expect from a product. And what do we have to do to meet those expectations. So, the phases in the life cycle of a product ok. So, these are different phases and where can we inculcate greenness into it.

Then we will discuss value engineering methodology. In value engineering methodology, I have divided into six phases. It can be number of phases, some people say 6 phases, some say 7 phases in Miles, they have or Mudge has actually given a methodology using 7 phases ok. Miles had again he has also given his methodology with 7 phases. Now, we can divide development phase into two all those things can happen, but before information they can have general phase as well ok. So, those were seven phases some people even say 9 phases, 6 phases are there to discuss value engineering.

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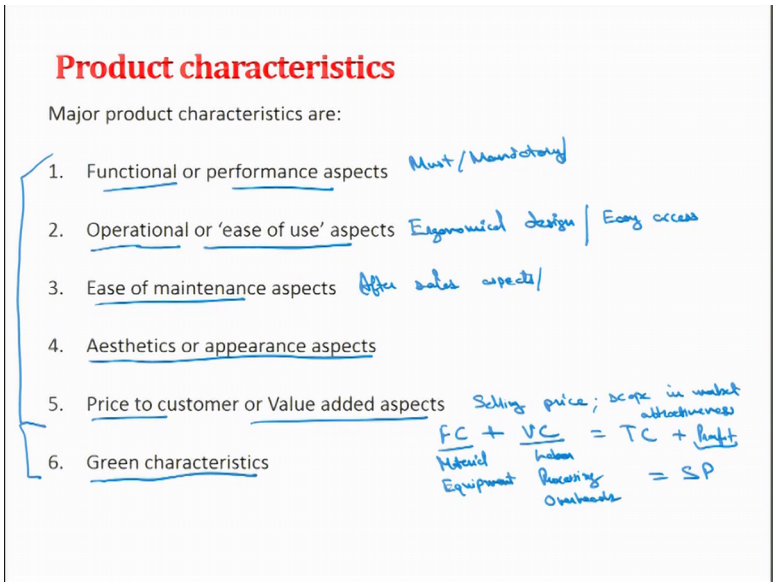

Product characteristics, before talking about the value engineering methodology, I will have to talk about what are the characteristics of a product. Product characteristics can be majorly divided into this five categories I have induced a six category that is green characteristics. Very first characteristic of a product is the use value. Use value is the basic value or the basic functional use function that the product has to accomplished. As I have said a mobile phone is one that has to be able to make calls that has to be able to receive calls, that has to be able to send messages, receive messages. This is the basic value, but the basic value of a product has to be there.

For instance, the pen the basic value of the pen is to make marks. The basic value of this mic has to just receive the voice, the encode the voice and that is recording. So, the basic value or the basic function I am talking about, the basic function has to be there. Other than this mic has this lock here that way that has to be locked with a collar, it has a wire these are all work functions, we will talk about the functions later. But the basic function or the performance aspects are the must or mandatory in a product.

So, when the marketing possibilities have been determined, the functional scope has to be carefully analyzed properly exemplified, functional aspect implies the fundamental reason for the product demand, why are people demanding mobile phone they need to make calls, why people asking for a pen they need to write something, they need to draw something, they need to make mark or make marks. So, then function aspects are often

multiple some times as I said though and usage of the product can be left with the customer's choice. Like I said my friend he is using mobile for surfing the internet not for making calls. The customer can decide the period to exploit it characteristic like till how long would he or she like to use that product.

So, like a iron that used to ironed clothes that is used the basic function is to just iron. Providing streaming and button and all those things are there, these are secondary functions or we can say the multifunction product is there. I will take the example of multifunction products in this lecture only again I have brought some kinds of pens which are multifunctional.

So, next is operational or ease of use, operational or ease of use. In this case, if you know the iron that we are using to we iron the clothes to steam the clothes with a steam button is at the top just at the location of your thumb that is need not that is called as ease of use. It is easy to use if the steal button is at the side ok, he has to use his other hand to click that button ok, then he has to again do again have to he have to switch it off. So, having the button just as an at an easy reach, this is also known as ergonomical design, I can put the word here so ergonomical design, ease of use.

In case of the digital products we call it user friendly products like people who are using Samsung mobiles or android mobiles generally like people like me who are using Samsung mobiles, I find it difficult to use Apple iPad when new function new application comes ok. So,. So, sometimes this is also kind of habitual roadblocks, I can even say, but I am happy with my mobile is doing all the function that I need to accomplish, so that is also an ease of use or easy access.

Ease of use is easy to handle or easy to operate, adaptable to various operational conditions and subjected to a varying degrees of skilled of potential operators. For instance, skill of potential operators is always there. For instance, Smartphone I can use a Smartphone, I can surf internet on that I can read my emails right my emails over there. For instance someone who is a little aged my mother would not like to use a Smartphone, she just knows and the earlier button phone that we have then we have the grid button red button is for switching off; green button is for switching on those are only things that she could understand ok.

But now we have got her a Smartphone, we have made her to understand these you have to just put this pass code, we have to make her to learn those things. So, this is these all depends upon the skill of the user ok. People are using mobile phones to operate or to work on their big software's as well ok. So, it all depends upon the skill of the user. So, this is operational or ease of use aspects. So, the designers problem become all more critical here, rising trend of increased versatility because characteristics implies using basic attachments as elements for buildings suitable combinations for specific purposes. So, this is happening these days.

So, next is ease of maintenance. Ease of maintenance is that after sales aspects, ease of maintenance is that how easy is for me to maintain my product to get my product serviced or to clean my mobile phone if I talking about the example of mobile phone or to get maybe screen guard changed if I have a screen guard on it. It is ease of maintenance.

If I having a motorbike I have purchased a bike, do I have service station close to my house, do I have all the components available within my locality so that is ease of maintenance when we design a product that is the third characteristics. So, customer is considering all those things. So, the very first characteristic of a product if I take an example of a bike again, the very first it has to run ok, second could be easy operation, how do we operate the gears, is it auto geared or does it have gear for instance all these manufacturers Bajaj, Hero Honda, Hero is now ok, Hero is a separate entity now, then Yamaha they have different mechanisms to operate the gears. So, ease of operation is a second characteristic here.

Third one is ease of maintenance. Ease of maintenance as like it is said generally that Hero bikes are require very less maintenance the maintenance cost is lesser. So, I am not actually advocating any specific product, but I am just telling ok, any product can be more easy to maintain than the other one.

Next one is a aesthetics or appearance. Now, aesthetics or appearance as I have discussed this is one of the cell function of the product. Aesthetic aspect is mainly concerned with the moulding the final shape around the basic skeleton putting a colour, texture. So, this moulding of shape may be severally limited in scope. And finally, it emerges in terms of a junctional shape. The study of gradual reversal in the shape of these objects in the past

few decades, convince us that there has been an increasing portrayal of statics in design, aesthetics of design people are just purchasing a product because of a aesthetics, sometimes this happens.

So, could you please think of a few products those are just sold because of aesthetics. The very first product is jewellery. Jewellery is there because the steam lead is there people put jewellery they have a gold or diamond ring, etcetera all those things aesthetics is the basic criteria in that case sometimes ok. So, and as I said mobile phones with a certain colour rages are available, which colour who would like to buy which colour pink colour, girls would like to have pink colours, kid will like to have the colour which are a lit little bright in colour bright and shiny. So, it all depends what type of customers segment is there.

In aesthetics, aesthetics is the governing factor in design and completely dominant share in some cases. So, this is especially true for many customers goods or fashion goods. Sometimes I do not need a shirt, but I just purchase that because I like the texture or the colour of the shirt or the t-shirt ok, sometimes those are the driving criteria sometimes over there as well.

So, price to customer or the cost of the product value added aspects. So, the product cost means its selling price, selling price of a product and the scope in market attractiveness ok. If I am taking about bikes are generally or any automobiles or any products are generally divided into certain segments. If I say I need to buy a motorbike motorbikes come from the it starts from a very 40,000 to 20 lakhs; 20 lakhs is, generally I am talking about in India generally in India most of the bikes ranges from 40,000 to 1.5 lakhs. So, it all depends which segment I am looking for between 40 to 60 the certain bikes ok.

Now, in that specific bike within this specific range I can compare to with three products, and then try to decide which I would like to purchase. And within the higher range maybe from 1.25 to 1.5 lakhs, I can decide products that is the different segments ok. So, in that case, this price to customer becomes one of the characteristics in what price range we are trying to put our product. So, this does not infer that price is the sole determinate of which buyers find allure about the product. Cheaper, but inferior quality products tend to fall by the wayside.

So, product cost is a function of both fixed cost and variable cost. So, this cost in can be fixed cost plus variable cost. Fixed cost is the cost of equipment or capital or equipment. Variable cost is a cost of labour. I will put it here labour and processing and overheads. So, this is cost of material and equipment that is used to manufacture this one, this is equal to total cost the total cost plus profit for all this middlemen that is equal to selling price ok. Now, there come the million dollar characteristic that is green characteristics that we are trying to talk about in this lecture.

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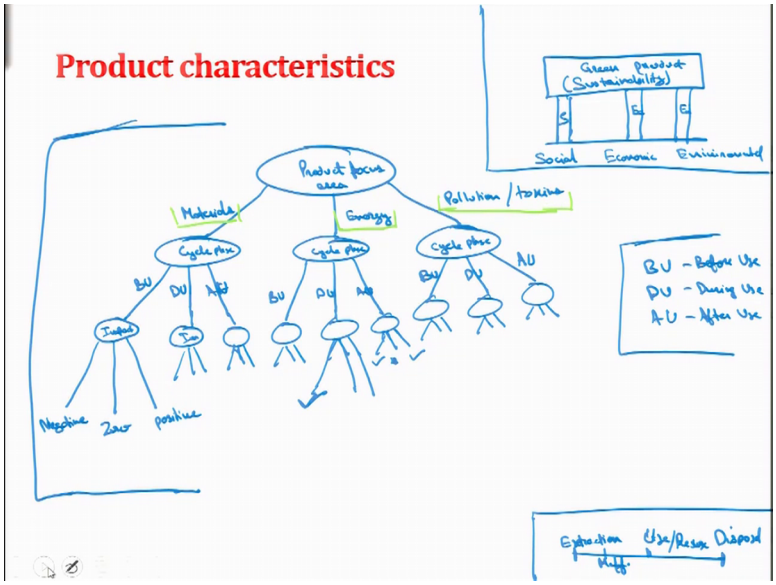

Green characteristics are those products green products that will goes products that will provide environmental, social and economic benefits while producting public health, environmental benefits they have over their whole life cycle like from the very extraction of raw materials in the final disposal. So, I can say these are the three pillars green products better to say here as I said sustainability ok, three pillars here ok, this is social, economic and environmental ok, social, economic and environmental.

So, these products as I said are to provide the benefits in these terms social, economic and environmental throughout their life from the extraction of raw material to the final disposal, this is the life cycle of the product from the very extraction to the final disposal. I can say if I need to identify the green characteristics of the product. So, I can take it in this way, this is a product in product as I said three major areas are there, product focus area I can say that can be materials, energy and pollution.

Now, this product is set to be green if the material that is used is biodegradable or the material some of the materials of some of the parties biodegradable if not complete product ok. I have brought this pen here. I will discuss for these pens. This pen the major body of this pen is made of a recyclable material it is made of paper ok, and other you know the tip and the head is made of plastic. So, some part is biodegradable. So, this product is greener than the other pen which is completely plastic or metal ok. So, this is a greener product in terms of material.

Now, next is energy. Energy is energy can be at the three stages ok, I will I will divide this all these things into three stages further three stages. So, energy can be before the use of the product, during use of the product or after use of the product. So, I have read this in a study that was made on the comparison between steel and aluminium. It was mentioned that the steel as is it is also heavier and it is also melted at high temperature.

The processing or the manufacturing of steel products consumes higher energy and aluminium it is a little lesser. And while using also because aluminium is lighter in weight, aluminium uses less energy that is why automobile components, automobile parts are argon bodies are made of aluminium that is why automobile found replacement for steel in 1960s when it came when it was discovered ok.

So, plastic ever a composite materials came way late up. But the pollution or the toxic fumes those are produce I can say toxins, those are produced while manufacturing aluminium are higher. So, we need to have this trade off here. Now, I can divide this into three phases, energy before use, during use and after use. I can say BU for before use; DU for during use; AU for after use. This is before use; this is during use; this is after use ok. Before use is actually when the customer is using the product.

If I consider manufacturing of automobile when the driver or the owner is driving the motor driving the automobile or the car that is the use before use is during the manufacturing of that automobile ok. After use is when that automobile is used for his lifetime for his complete life cycle it is used. And it has to finally, it is used and reused second owner is there, third owner is there finally, it is disposed of that is after use. After use when we need to disposed off then what is the energy that is consumed ok. There certain plants which actually dismantle the automobile parts and divide the metal and

plastic components and rubber components, all are segregated and they are put into different uses and some finally, they are disposed of. So, those things happen.

So, materials also those could be divided into these three, these three phases. So, I can say this is cycle phase, cycle phase, lifecycle phase actually. In the whole life cycle, if you remember again life cycle is from the extraction to disposal ok; in between we have manufacturing then use and reuse. So, this is life cycle. When we talk about life cycle assessment, I am I am not talking about the marketing life cycle that Dr. Deepu Philip discussed that is the product life cycle from the where it purchase the growth and maturity and declined and disposal that is different thing. So, this is life cycle of the product from the extraction of the material to the final disposal

So, this is again before use, during use and after use. Pollution before use, pollution during use, pollution after use ok. Like I took the example of battery vehicles electric vehicles. During use the pollution would be lesser quite lesser, because it does not have any fuel that is to be burnt, but batteries are there after use after the vehicle is used, how many batteries are to be finally in disposed off after use pollution in that case would be higher during use pollution would be there in that case would be lesser than the general gasoline vehicles.

So, before use it all depends upon the infrastructure that we have in the present scenario, the gasoline vehicles are easy to manufacture and pollution is also quite because I set up is already there. So, the embedded energy is lesser in this case.

So, now, in this case finally, after these divisions, we can see the impact to the environment is the impact 0, or is the impact positive, or is the impact negative. So, for all these we can again have these three legs here.

Negative impact is, it is affecting the environment, the material that is before use it is impacting the environment, or it does not have any impact on the environment or it is contributing to the greenness. This is also there sometimes we use a material, but it also contributes a it will come up with an example so that as well. So, for instance energy during use it is negative if you talk about vehicles, because maintains of vehicle is there; however, the need of the customer is being met, but maintenance fuel is there everything is there. So, it is negative in this case ok.

And after use again it is negative. So, for some of the components because those are recycled that can be positive and maybe 0, because whatever an energy is used to produce that that is again compensated. So, it can be 0 here. So, this is the green characteristic of a product how we can see those. So, green characteristics of a product majorly I just wanted to mention these things materials, energy and pollution. These three areas or the product focus areas are there which determine the greenness of the product

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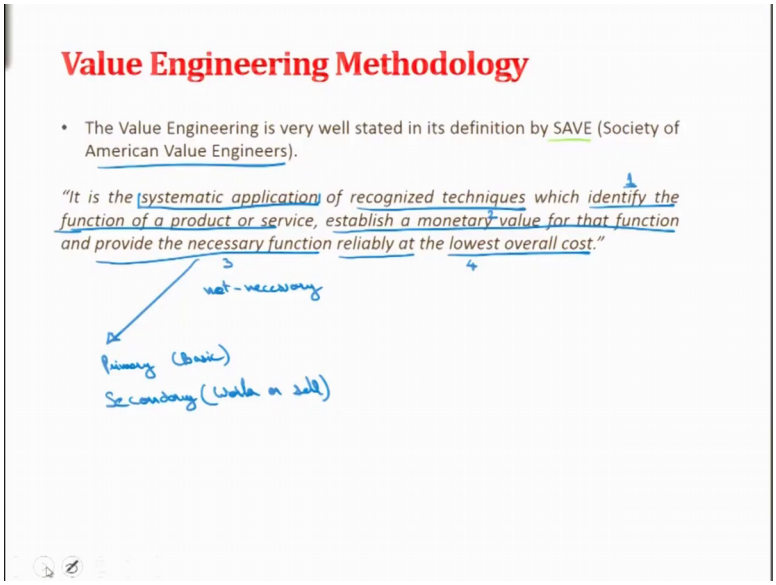

Now, value engineering methodology. Before talking about the values engineering phases, I have brought this definition that is given by SAVE Society of American Value Engineers, they say value engineering is the systematic application it is systematic application. Systematic means organised in a proper way the specific procedure of recognise techniques which identify the function of a product or service, establish a monetary value for that function and provide the necessary function reliably at the lower cost.

See, how many components are there in this definition. It is a systematic application. I can put this as one component systematic application of a first I will divide of what of number one is identifying the function ok. Then number two is establish monetary value of that function. Number three is provide the necessary function reliably at the lowest

overall cost, I put it number 4. I have divided providing necessary function and lowest overall cost into two parts.

So, why because the certain functions which are necessary and which are not necessary. Necessary functions can be the primary or basic functions and secondary functions. Secondary functions are work or sell functions ok. Lowest overall cost as I said value engineering is either reducing the cost or improving the utility or benefit. So, lowest overall cost is a component here. Identify the function identifying the function as I said we do not look at the product from the component view point or from the part view point, we looked at the function that has to be attained that has to be fulfilled.

So, for that is establish a monetary value, we need to identify what is the monetary value of a complex these accomplishing these functions specifying a function. Based upon that we need we can identify whether this product whether this specific function is has a scope of improvement or not. We will discuss this in a case study. So, this is value engineering methodology.

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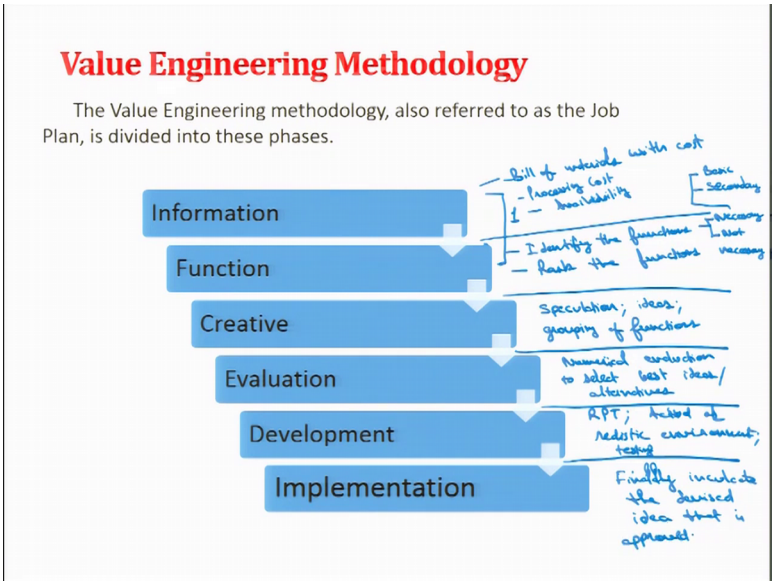

The different phases of value engineering; now, a different phases of value engineering. The very first phase is information phase as I said value engineering, I have divided into six phases which are information phase, function phase, creative phase, evaluation phase, development phase, and implementation phase.

So, information phase is just gathering the information about the product. Information phase as I said identify the function of a product number-1. Number-2 establish monetary value for that function. Number-3 provide the necessary function reliably at lowest overall cost. So, if I say these are 1, 2, 3, 4 in the information phase, then function phase, we do part-1. Information phase is actually collecting the bill of materials with cost of each material ok. Then processing cost right, then availability of the resources.

So, this is now in function phase we identify the function, identify the function functions of the product. We divide into a I will just explain those the coming slides. Then in function phase we have rank the functions rank the functions, which are necessary identify the function as necessary and not necessary. And the necessary function as I said these can be basic functions or secondary functions.

In creative phase, we come up with the idea, this is speculation ideas. Then we have a grouping of functions like can we group of the functions for instance we are just remember the part, the component or mobile.

Let me say a I have to manufacture a table, table has a top, it has legs it has the connection connecting rod at the bottom. It has support at the centre there certain components here, what is the function of that? Function of the leg is to support the top to support part the function of the table top is to provide flatness ok. So, as a table does not have to be at an angle that makes the material to fall things which are kept on that. Can we combine a few functions, can we make a group of them or can we have a function that can be attains with the for the whole group together. So, this is this is done in creative phase.

So, next is evaluation phase. In evaluation phase, we use an certain criteria that is numerical evaluation numerical evaluation to actually we get the alternatives from the creative phase. And the in evaluation phase, we do the numerical evaluation to select best ideas or alternatives ok.

In development phase, we try to develop those alternatives. Develop means, we are actually try to it is kind of a variable rapid prototyping or we would like to see whether the groups those who were made could those be fulfilled could those be actually manufactured or not ok. These are actual or realistic environment, then testing. And then

is implementation, implementation is actually finally implementing or inculcating inculcate the devised idea devised and proven that is approved ok.

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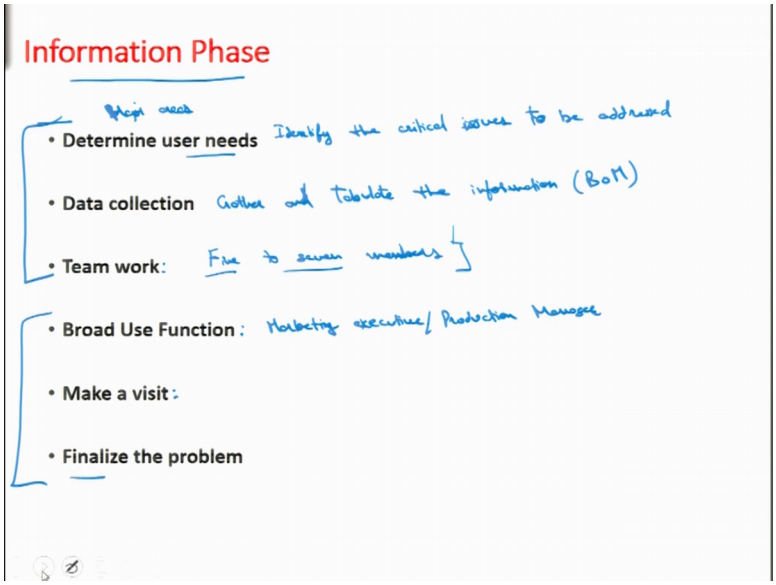

So, I will put some more light on this function one by one. In information phase, very first thing is to determine the user needs that is identify the specific issues those are to be addressed. So, in this case as I said the major purpose is data collection. Data collection is to gather and tabulate the information the gather and tabulate the information. And there the information that is concerned with the item that is presently designed. Then we information again I said we have the bill of materials with cost and other things like processing, the people who are there number people who are working all the information that is required that is again that information is gathered.

Then teamwork is the part of information phase, because value engineering I do not know whether I put this is one of the points there or not. In the general cost reduction that can be one or two persons also, but in value engineering we have people from different areas of manufacturing. We are talking about manufacturing systems advanced green manufacturing systems. And manufacturing systems in the certain areas, these marketing, production, finance, human resource, design ok.

In production the first part of this an production design only. So, all these people from all these areas come to gather to work on a specific value engineering product ok. So, this in

this case teamwork is very important. Teamwork like appreciating each other's view points, and then like marketing people can tell what is user need.

So, the production persons can say these are the availability, these are the things which we are we can do, these are the functions which likely to identify the functions all this people actually needed. So, to build a team knowledge at understand the project essential, team member characteristic include technical or functional expertise problem solving, decision making abilities, interpersonal skills. Then participants should be team players who were willing to share responsibilities, and accountability also they need to share accountability while working together towards a common objective.

So, the ideal team size for value engineering should be, what do you think should be the team size should be 50 members, should it be 4 members, it is ideal team it is 5 to 7 will very large numbers sometimes, lot of more opinions sometimes does not help us to come into a single consensus. So, 5 to 7 5 to 7 members, these not a hard and fast rule, but this is something that is a suggested by mudge.

So, this team members as I said would have these skills interpersonal, decision making, and all these. So, what do we do in information phase, besides these major areas, we have something additional which are broad use function has to be defined. One can even make a visit to the factory or the sight, if a construction build see construction project is there, then finalize the problem, because we have team members from different areas 5 to 7 team members are there.

The broad whose use function can be defined by the marketing executive or production manager, broad use function ok. We are going to manufacture a table. We are going to manufacture a chair, where people need to sit. The different kinds of chair, these are different types of kinds of trick chair can be tutorial, chair can be an exhaustive chair.

A stool can also help us to sit. And there certain kinds of chairs or the plastic chair, chair with chair with cushion chair with back support chair, without back support chair, with arm supports all those things. So, what is the broad use function is to provide support to a body to provide support while sitting, so that is the broad use function that can be designed. So, make a visit, because we are gone a manufacture a chair or a table the all this team members can make a visit to the factory, where we can see the kinds of machines.

For instance, we are manufacturing the chairs which chair of which only the back, and the bottom is manufactured of plastic, and the body is made of steel pipes, because we might be having an injection moulding machine there, which can be used which is used for manufacturing the back of the chair or of the bottom of the chair. So, can we make small change in this injection moulding machine to make it an extrusion machine or can be can we manufacture pipe sort of that as well.

If not complete mould, can we just combine the legs and the bottom together, can we combine the back and the back support together? For that making a visit to the factory, and looking at the facilities, and identifying that what we can do that is one of the ways. However, we do not fix anything at this point we are just in the very first phase that is information phase. We were not talking about the decision; we are not talking even about the function here. We are just talking about the broad users, these are facilities that list on the facilities making a visit, and just timing information of paper this is a big difference. So, make a visit is a recommended criteria.

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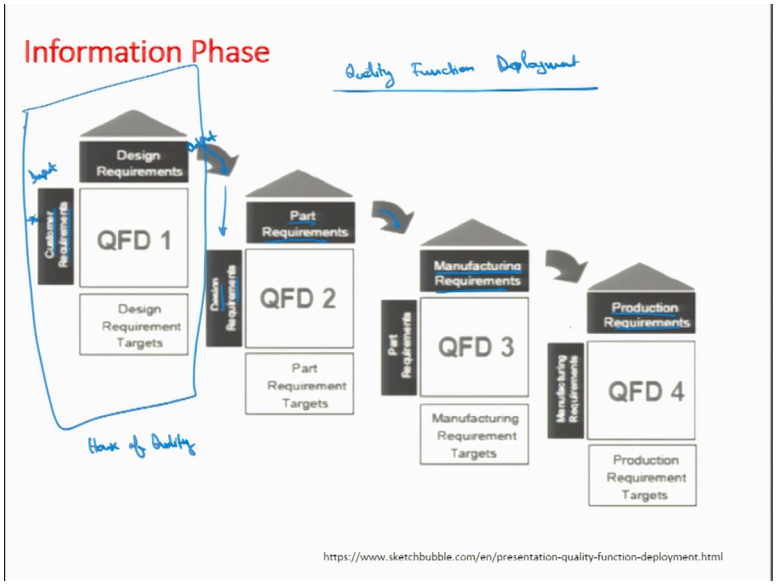

So, finalize the problem, this is the end of the information phase. So, I have this quality function deployment progression QFD is Quality Function Deployment, we will discuss this in very detail in a separate module after value engineering. So, quality function deployment is converting the consumer's voice into manufacturer's requirement, what does consumer need. Consumer wants this based upon what is consumer need and what

is the requirement for finally production requirements, what is there required for the production. So, this can be the part of the information phase ok.

So, in that case the there certain quality, how do we conduct how do we make these houses this is known as house of quality house of quality. And how to construct this house, this is not your prime concern at this point just consider this thing that there four phases.

In very first phase, the customer requirements, this is the input actually ok, so this is the output, this is input, and this is the output. So, this output goes here customer requirements is the input that for it design requirements, customer requirement goes design requirements, design requirements goes as an input in the second phase of QFD which is design requirements come here ok.

Now, this gives the part requirements. The part requirements, now goes as an input to the third phase. The part requirements help us to get the manufacturing requirements in phase-3. Now, these manufacturing requirement help us to get the production requirements in phase-4. So, this can be the part of the information phase if we can do, otherwise just having an information of working in the functions can also be the starting point for the function phase. But, this can be if that a broader information or the you can say a wide or predominant information is gathered, and that can be worked in this way that is also one of the ways to do. So, let us meet in the next lecture.

Thank you.