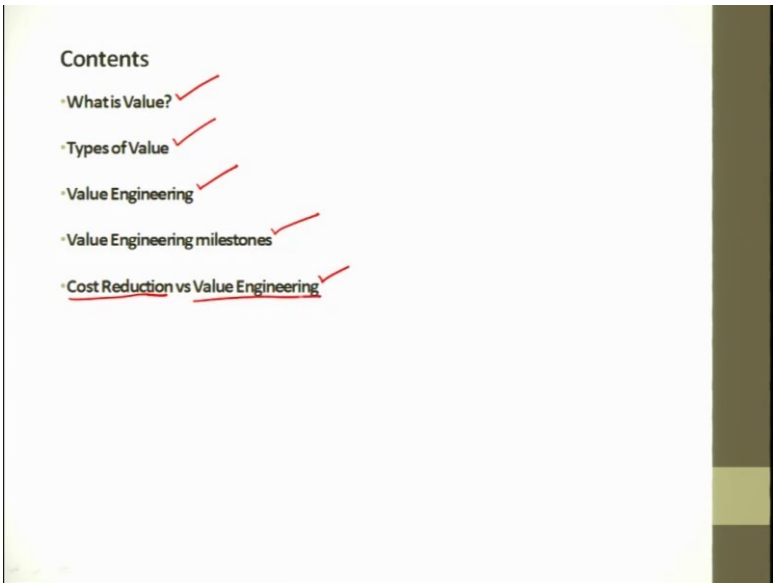
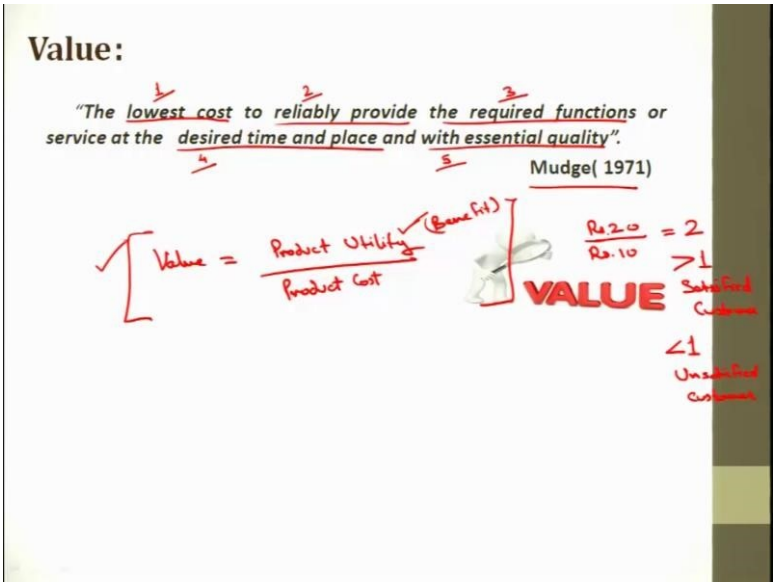
Product Design and Manufacturing
Prof. J. Ramkumar
Dr. Amandeep Singh Oberoi
Department of Mechanical & Design Program
Department of Industrial and Production Engineering
Indian Institute of Technology, Kanpur
National Institute of Technology, Jalandhar

Lecture – 09
Value Engineering: An Introduction

Good morning welcome back to the course Product Design and Manufacturing. I am Dr Amandeep Singh and this is our first introduction in this course. So, I will take the topic value engineering here like we have already discussed, how to convert the voice of customer to the specification of the manufacturer? This is that was the quality function deployment and that was the one of the techniques in value engineering. We learn how to put it creativity how to find the basic functions of the product and work on that. (Refer Slide Time: 00:50)



So, the contents will go like this we will see, what is value we will see the kinds of value and then will discuss what is value engineering? We will see some history on value engineering, then we will compare the general cost reduction with value engineering. (Refer Slide Time: 01:10)



Now, value the definition is given by Mudge in 1971, he says it is the lowest cost to reliably provide the required functions or service at the desired time and place with essential quality you can see there are 4 characteristics.

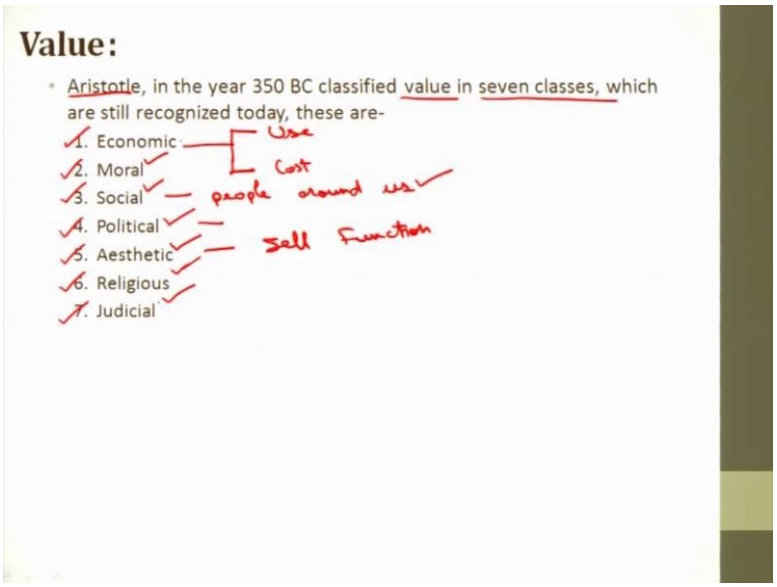
Number 1 lowest cost, number 2 to reliably provide, number 3 the required function, number 4 at the desired time, number 5 with essential quality. So, these are the keywords. So, it looks like a lot of things have being put into one sentence, but will see how do we conduct value engineering study and how this is possible? So, value if I talk about the cost value the value can be given by this relation value is equal to product utility per unit product cost I have put the word utility here it might be benefit.

So, for instance let me take an example of pen. You purchase a pen you are willing to pay rupees 20 for a pen, that write smoothly that you are able to put in your pocket that has the grip and general things what a normal pen has, but when you go to market you find a pen the cost of the pen is rupees 10 and it satisfies all your needs, but you have expected. So, in that case you were willing to pay rupees 20, but you got that thing in rupees 10. So, this number is 2. So, in this case you are kind of delighted you saved your money you saved 50 percent of money in this case.

So, this number if this is greater than 1; that means, satisfied customer if this is less than 1; that means, unsatisfied customer. So, this was one example there are various kinds of value various types of value; I am just talking about the cost value or use value here in this case in this relation. So, the objective qualities of value consist of use value and cost

value the value gives ultimate satisfaction to the customer and is expressed with this relation value engineering is primarily concerned with the economic value we will see what is that.

(Refer Slide Time: 04:20)



So, let us see the kinds of values here this is the Aristotle in way back used this term value. And he divided that into 7 classes which says we have economic value moral value, social value, political value, aesthetic value, religious value and judicial value. Economic value is the one that we are more concerned. In our course in this we have use value and cost value economic value is the one for which I just took the example of a pen.

Next is moral value we generally say the word my parents imbibed moral value in me; we read good books like books by Rume. You by great philosophers we try to learn the moral values we try to be a good citizen, we try to be a good part of the society. So, those values are known as moral value.

And social values are also very close when we are concerned with the people around us. For example, in IIT Kanpur we have green

(Refer Time: 05:40). Green is a kind of sustainability initiative in which we do not waste food the food wastage; whatever is there in each hall that is collected in a bin and that is;

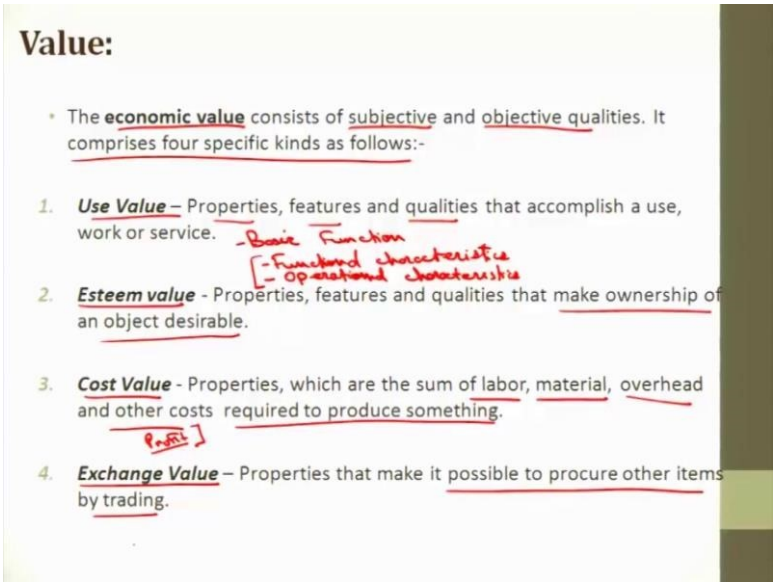
weighed when the weight of for let me say if it is practised for 3 weeks. For the total 3 weeks the hall or the hostel which has the least wastage the least weight of the food is there, that is; given some price or they are named they have worked on this sustainable work.

So, that is a societal social benefit work, then political values are also there aesthetic values, religious values, judicial values, political values are sometimes people are more inclined towards their political interests and the values they use they have they put the time and money into the specific political party I can say for which they are working for.

And aesthetic value some products also have the aesthetic value these are called sell functions; I will say you brought the pen from the market that writes blue in colour let me say if you like a green coloured body pen. So, you purchase the pen you say I want a pen that writes blue, but the pen colour body should be green that is the aesthetics you are looking for you like the green colour you purchase that.

Now, next is religious values and judicious values these you can think of. (Refer

Slide Time: 07:30)



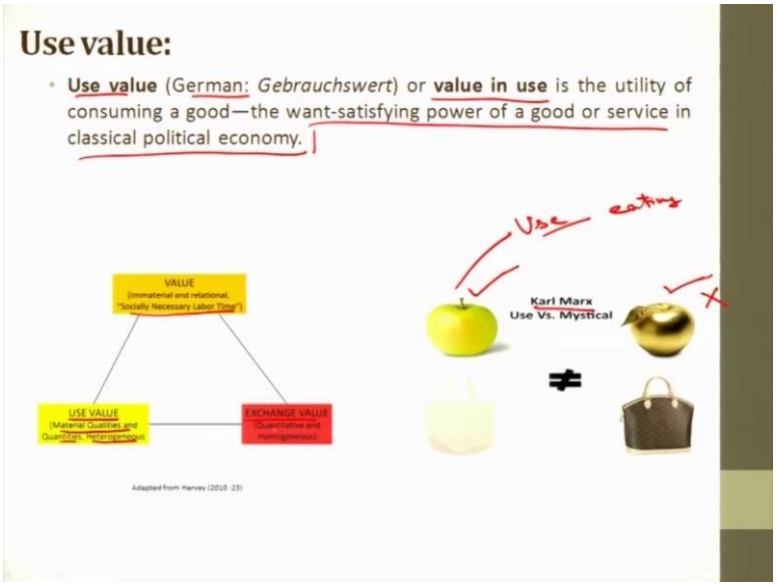
Now, economic value consists of subjective and objective qualities. And it comprises of four specific kinds as follows: use value, esteem value, cost value, and exchange value. Use value is the properties or features and qualities that accomplish a use, work or

service. Now these relate to the attributes of a product, which enable it to perform its basic function; I could write here the basic function or like Dr Ram Kumar discussed the kind of characteristics of the product. The functional characteristics is the use value that, we have I can put here functional characteristics that is; something that is essential sometimes the desired things desired means the operational characteristics those are also here in use value.

Next is esteem value this is these are the properties, features and qualities that make ownership of the product as desirable. So, this is the kind of the additional premium price which a product attracts, because of its intrinsic attractiveness to the purchaser or customers. Next is cost value these are the properties which are the sum of labour, material, overhead and other cost required to produce. The product other cost means we also have profit involved; in this if we are talking about the value or the cost to the customer that is the selling price it also has this profit in it. So, it is the total cost of producing the product.

Next is exchange value this is the properties that make it possible to procure other items by trading. So, let us discuss.

(Refer Slide Time: 09:44)

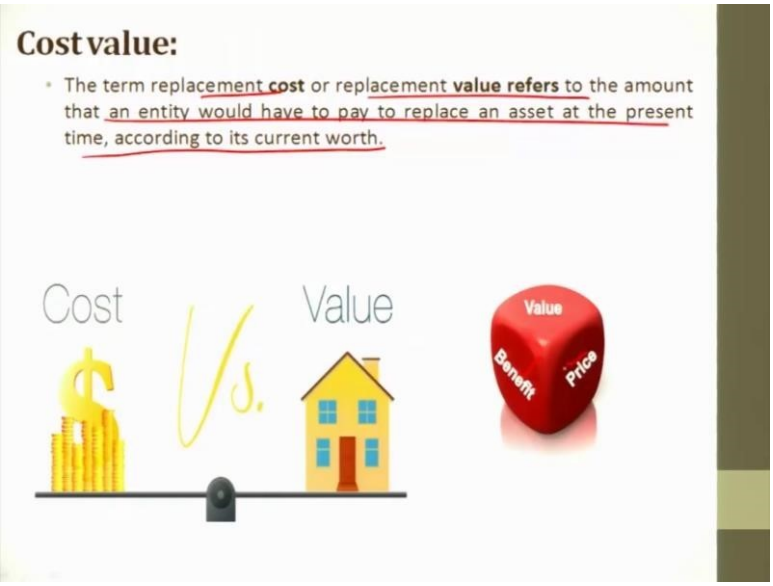


A little more about the kinds of value; the use value it was the definition given by this German philosopher. He said the value in use is the utility of consuming the good; the

want satisfying power of a good or service in classical political economy this is two broad definitions like the use value I can discuss. Using this Karl Marx philosophy, he says that the political economy any product has a labour value or a use value and if it is traded as a commodity in markets.

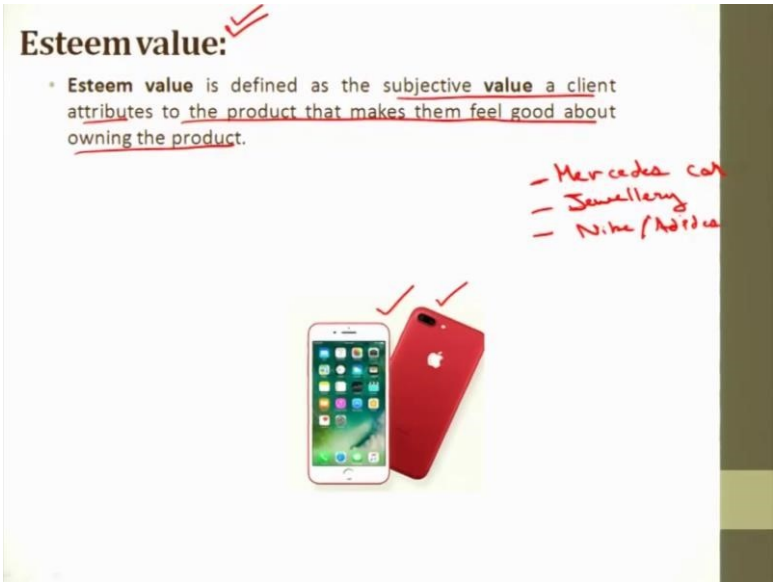
It additionally, has an exchange value here Karl Marx compare the value of the object. In this case we have this apple that is fruit and a kind of antique piece that you can put in the showcase in the display in your drawing room, but the use value is eating this does not accomplish the use value. So, the value that is socially necessary labour time the; it has use value and exchange value as its components. So, these are the material qualities and quantities these are heterogeneous exchange value is quantitative and maybe it is homogeneous.

(Refer Slide Time: 11:14)



Next is, cost value the term replacement cost or replacement value refers to the amount that an entity would have to pay to replace an asset at the present time according to its current worth. So, simply we can say it is the amount one is willing to pay for this specific product. So, it is value is benefit per unit price.

(
Refer Slide Time: 11:41)

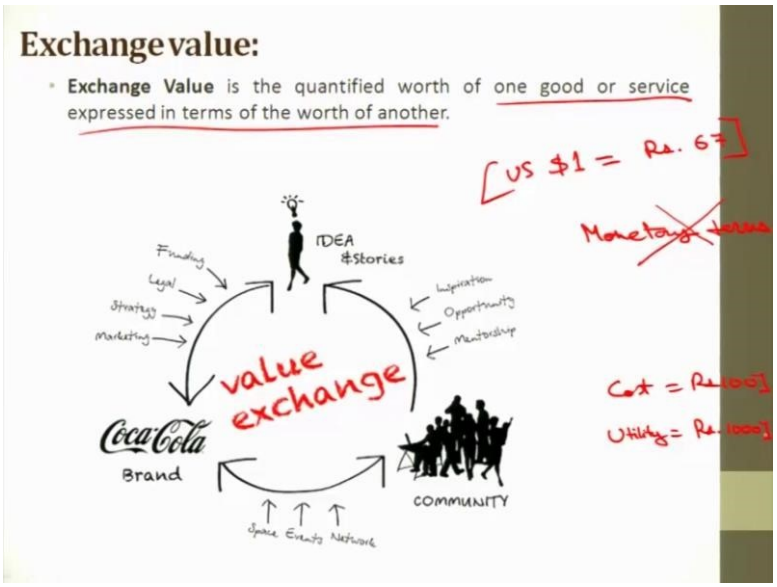


Next is esteem value esteem value is defined as the subjective value a client attributes to the product that makes them feel good about the owning the product. The brand values the apple iPhone Mac computer. For example, is a good example of a product that contains high esteem component in the value of the products of the company manufactures look at the Macbooks, iPod, iPhones. All these products have use components functionalities very good, but the price people are paying for is also the esteem value.

So, people feel good people who like to work on the apple products also feel also have this esteem component in them. So, they own apple products they take pride in showing of the apple logo sometimes. So, this esteem value is something like Mercedes car then jewellery like doctor Ram Kumar said you wear Nike or Adidas shoes the shoes were once designed to cover the foot, but now these are considered as a status symbol of the person.

Refer Slide Time: 13:14).

(

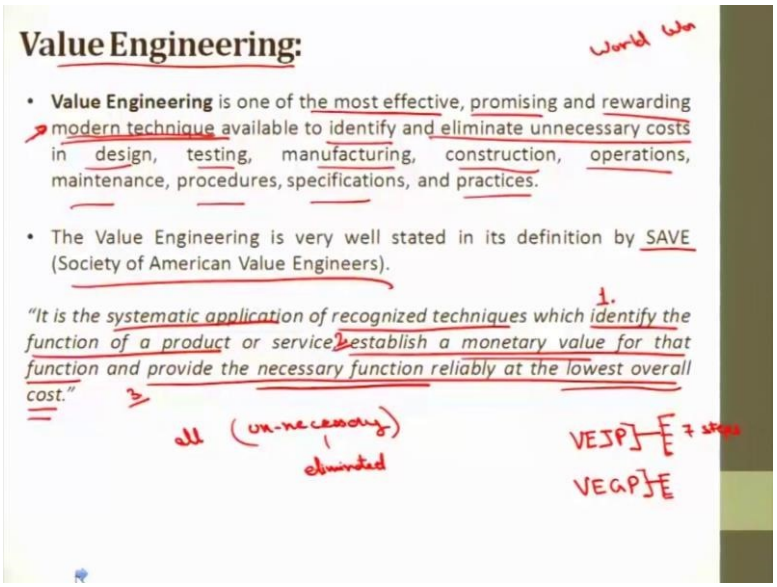


Next is exchange value is quantified worth of one good a service expressed in terms of the worth of another. For example, in the business of foreign exchange the value of each currency is in terms of the value of other currency we say dollar 1 or US dollar 1 is equal to rupees 67 this is the exchange value. So, this creates an exchange value or exchange rate for each major currency relative to the benchmark currency. This is this is the benchmark currency us dollar 1 exchange value does not need to be expressed in the money terms monetary terms not always I will have to cross this thing sometimes; the emotional value is also part of the exchange value.

For example, my mother gave me a pen as a gift the cost of the pen was rupees 100. My friend asked me to lend him that pen or he says you give that pen to me, I will keep it I said no then he says ok. I will offer you rupees 50, that is; the cost of the pen then he says I offer you rupees 100, that is the cost of the pen is say. No then he say I pay rupees 500 for that again I say no then he say I will pay rupees 100 for this pen. If you lend me this again I say no, because I have some emotional values attached to that pen. So, in that case the value of the pen or the cost of the pen cost is equal to rupees 100 and the utility I am not even willing to lend it for rupees 1000 that is exchange value.

Refer Slide Time: 15:30)

(



So, next comes is value engineering. Value engineering is one of the most effective, promising rewarding modern technique available to identify and eliminate unnecessary costs in design, testing, manufacturing, construction, operations, maintenance, procedure, specification, and practices and so on. So, I have put the word modern techniques here though the value engineering started in world war two only, but these days also the value engineering is being applied and recently we the other management techniques in sustainable manufacturing.

We are developing the value engineering green plant; generally it is value engineering job plan that is the systematic way it has normally it has seven steps 7 steps through which we try to improve the value. So, we are working on the value engineering green plan. So, these days also this technique is being very much utilized to improve the value of the product or service. Let us see the definition of value engineering that is given by society of American value engineers they say "it is the systematic application of the recognized techniques which identify the function of a product or a service establish a monetary value for that function and provide the necessary function reliably at the lowest overall cost".

Number one identify the function, number two establish the monetary value, number three provide the necessary function. If they say necessary function there might be some functions which are unnecessary I put hyphen here unnecessary functions. So, these are

eliminated. So, what do we do in value engineering will talk about this in very much detail, but broadly what we do think of the function of a product.

For example, I was talking about the pen I want something to write in blue colour. So, pen is the first thing something; to write is pen is the pen only option though my purpose here my basic function here is to provide marks to make marks on the paper to make lines on the paper. So, I can use a blue colour pencil I can use a paint brush I can use crayons for that.

So, these are the ideas those comes into my mind. So, these ideas do not think about the basic facts that pen is the basic thing that is to be used to make blue marks. So, this thing is known as creativity think of something that is not factual. So, it is said human mind works like an umbrella it works only when it opens. So, this is the basic thing basic criteria of value engineering.

First, what we do? We identify the function of the product the function of pen is to make marks. So, let us think of I have a pen for example, this is a stylus the length of the stylus is about 15 centimetres here.

(Refer Slide Time: 19:26)

So, if there is a stylus that is of only 5 centimetres this diameter is about 20 centimetres, if they stylus the diameter is about 50 centimetres. For example, if this is the stylus

holder if this is, my pen would I buy this no. So, identify the function of this body is to make grip it is take the anthropometric dimensions of the hand human hand can hold from may be 7 to 25 mm pens it depends on the precision that we require the blackboard marker are quit broader; because the precision is precision is less.

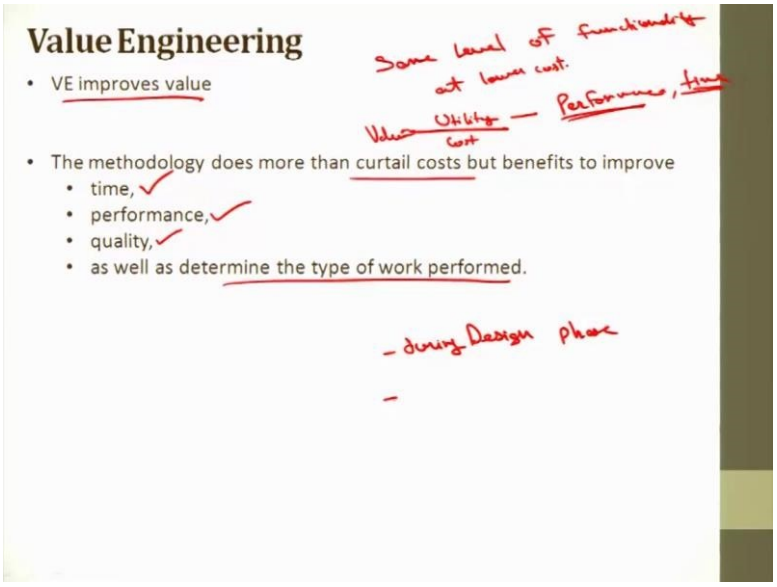
So, this size is larger for the pen that, I use to write precisely for which we want good handwriting to be there in on the paper the size is from 7 mm to 20 mm this is the function of the body. Now this body needs to hold a refill in this in case of stylus it needs to hold these switches it needs to hold this click here need to hold this tip here this is the functions of my product.

So, we identify this function then we see are this function necessary is this much length necessary. So, this small length pen or stylus would not work this much length is necessary to hold it properly ok; then we see the monetary value of each function, what is the function? What is the cost of the body of the pen to provide this much of diameter, this much grip. This is actually a rubber grip, what is the cost of this rubber body? So, if we provide a metallic body what would happen the grip would not be that good. So, we have in electronics we have electronic integrated circuits in this stylus. So, what is the cost of that?

So, is this is the kind of an active stylus the cost may be from 20,000 to 25,000. So, is 25,000 worth for this pen. So, we establish a monetary value this is value engineering first we identify the function establish the monetary value, then we see what is necessary and what is unnecessary if there is some unnecessary function which we can eliminate?

And a corresponding cost can also be eliminated, then we can provide it at a lower cost the lowest overall cost is eliminating the all unnecessary functions or may be providing these necessary functions also at the lower cost. So, in this week we will go through the value engineering systematic study and we also see the various examples. So, by the end of this week you would be able to apply a value engineering technique to the various products and also will have a task on this thing.

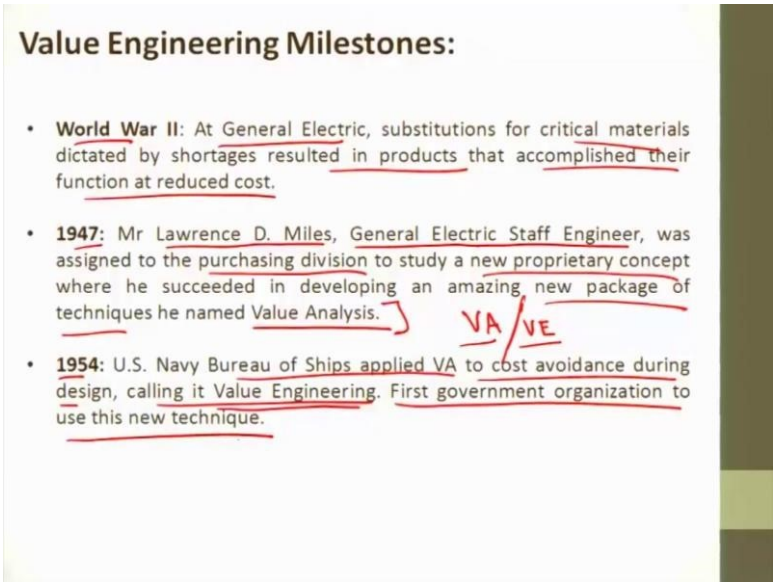
(Refer Slide Time: 22:44)



Now, value engineering improves value. Value engineering is an approach to productivity improvement that attempts to increase the value obtained by customer of a product by offering the same level of functionality at lower cost. I can put here same level of functionality at lower cost. So, value was utility per unit cost this was our value this utility can be performance; this utility can be time utility can be quality the methodology does much more than just curtail the cost it improves the time performance quality as well as determine the type of work that is to be performed to have this level of performance the same level.

So, value engineering is the review of new and existing products during the design phase to reduce cost. So, this is applied in design phase only value engineering is applied in design phase in to increase the functionality in order to increase the value of the product the value of the item is the most effective way of producing an item without taking away its function.

(Refer Slide Time: 24:34)



Let us see some history on value engineering. During world war II: At General Electric, company Dr. Lawrence D Miles, during world war II were general electric company, substitutions for the critical materials dictated by shortages resulted, in products that accomplished their function at reduced cost.

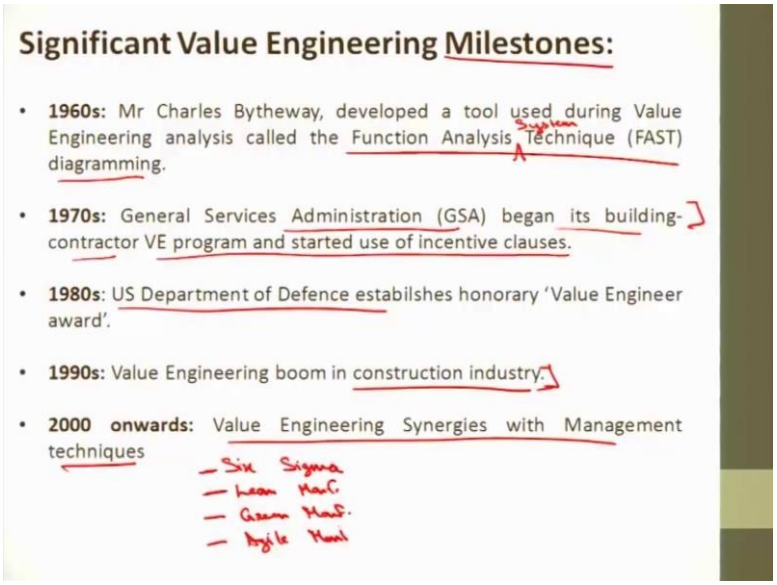
So, in 1947: Mr Lawrence D. Miles, who is the founder of value engineering, he was a general electric staff engineer, and he was assigned by the task in the purchasing division to study the new proprietary concept where he succeeded in developing an amazing new package of techniques and he named them value analysis. This was the first name given value analysis these days. Value analysis and value engineering are used interchangeably though there is still debate going on that value analysis is different from value engineering.

Value analysis some of the contributors say that value analysis is only up to the analysis part if we identify the functions we establish the monetary value we find what are the unnecessary functions? That is value analysis and if we take forward unnecessary functions eliminate those unnecessary functions and provide a new plan for the products in which those components which are unnecessary those function which are unnecessary are not present this is value engineering.

So, this line between the implementation and analysis makes the difference of value analysis and value engineering some of the authors would say value analysis is; now value engineering only if your provide if you have identified the unnecessary functions

and are not able to implement that you are not able to provide the systematic way; how to implement, how to obtain the final product that does the same function at lower cost? There is no need of value engineering they say. So, use value analysis and value engineering term interchangeably.

So, in 1954: the U.S. Navy Bureau Ships supplied value analysis to cost avoidance during design, calling it value engineering. So, they gave this name value engineering here the first government organisation to use this technique. U.S. Navy Bureau Ships then I have divided into decades here in 1960s, the major contribution. (Refer Slide Time: 27:11)



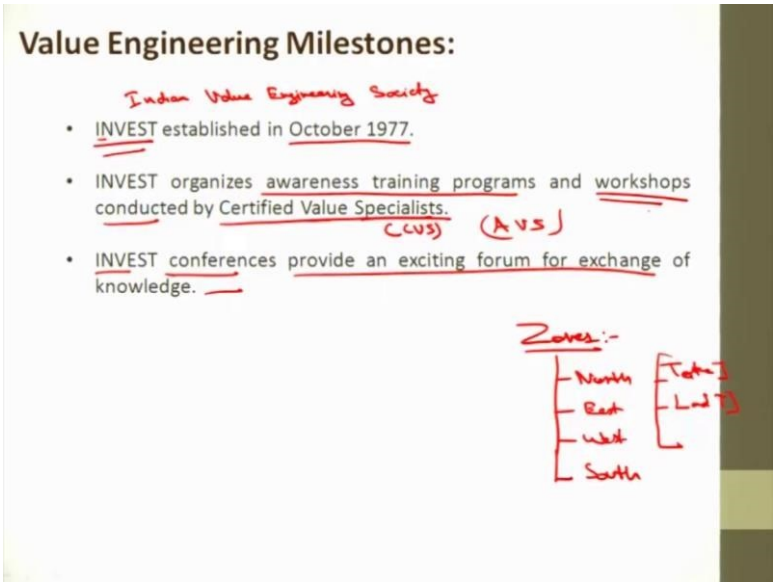
In 1970s the major contribution in 1960s this fast technique came into existence fast is function analysis system technique.

So, what is fast will see in the forthcoming lectures. Since here fast is actually putting all the functions into a diagrammatic form and we see what are the necessary, what are the basic functions? How do accomplish specific functions? And why do we need that function and necessary and unnecessary functions are separated in 1970s. The general services administration began its building contractor value engineering program and started using incentive clauses. In 1980 U.S. department of defense developed or established the honorary value engineering or value engineer award.

So, these are the major mile stones. So, in 1990s value engineering boom in construction industry came into play though it was already there in construction industry, but in 1990s

even the small contractors started implementing value engineering techniques into their works.

So, in 2,000 and onwards value engineering synergies with management techniques such as six sigma you will find various research papers on; how value engineering is related to? Or how value engineering can be implemented in a combined way with six sigma, with lean manufacturing with green manufacturing with agile manufacturing and so on. (Refer Slide Time: 29:13)

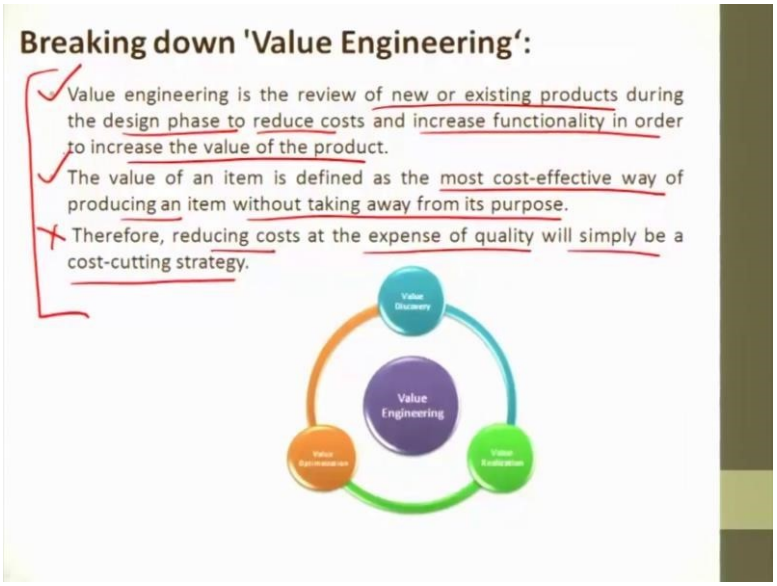


In India we have INVEST Indian Value Engineering Society which was established in October 1977. INVEST organises awareness training programs and workshops conducted by Certified Value Specialists. These are CVS also they provide AVS. AVS is Academic Value Specialist they provide these certificates. So, they make their participants learn the value engineering technique, in systematic way to apply value engineering and they certify them. They are specialist in value engineering also they conduct conferences and provide an exciting forum for the exchange of knowledge. So, INVEST in Indian industry by a dissemination of specialized knowledge to professional who in turn help industry to improve profitability through the technique of value engineering.

So, it has various zones namely north, east, west and south and some prominent players like, Tata, L and T are also the members of the INVEST society note. The company specific the MDs the CEOs of the companies or the upper level management people are

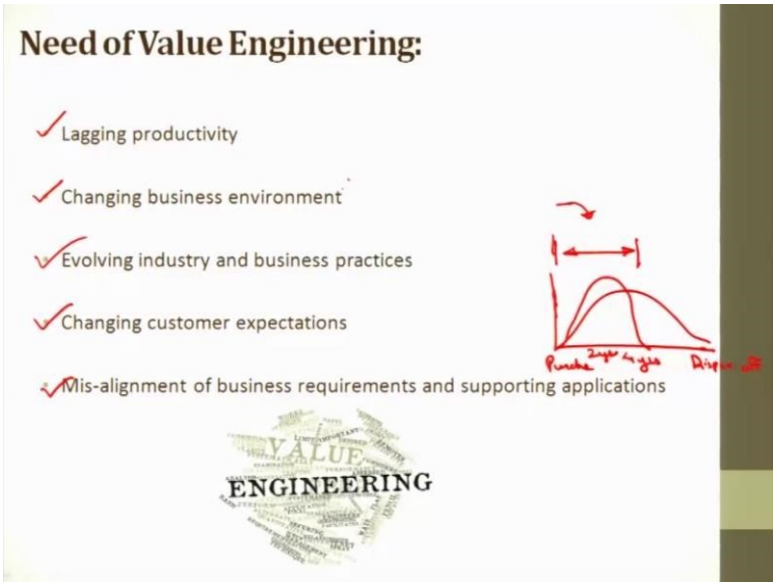
invest members or they are invited to the conferences or the workshops to provide special lecture specialized lectures to the trainees there so.

(Refer Slide Time: 31:00)



Breaking down 'value engineering': value engineering is as I said the review of new and existing products during the design phase to reduce cost and increase functionality in order to increase the value of the product. The value of an item is defined as the most cost-effective way of producing an item without taking away from its purpose. We are revitalising the things again reduce cost at the expense of quality will simply be a cost cutting strategy. So, this is not value engineering value engineering is maintaining the quality and then reducing the cost.

(Refer Slide Time: 31:49)

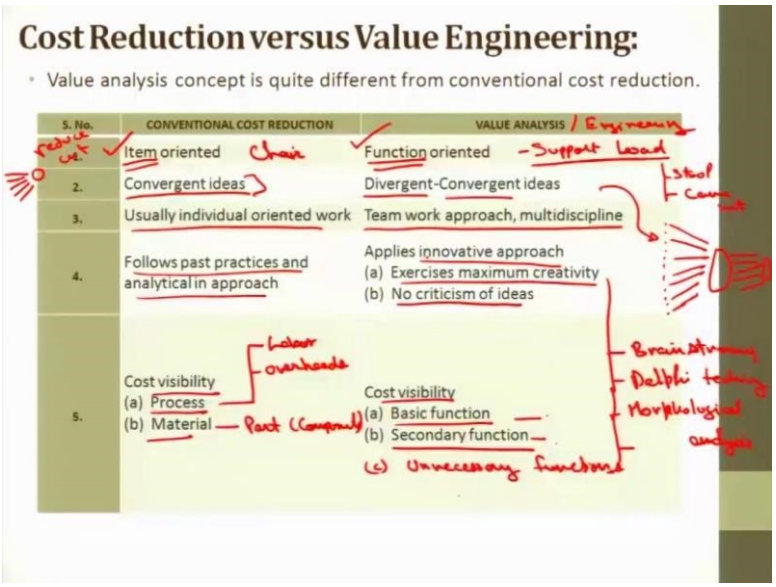


So, what is need of value engineering business are: lagging productivity, changing business environment is there, evolving industry and business practices, changing customer expectations, the product life cycles are contracting. So, life cycle in this case I am talking in terms of when you purchase and when you dispose. So, this was if four years before this has contracted to two years in general. So, misalignment of business requirements and supporting applications is there the reason behind value engineering is; if marketing or marketers respective produce a product to become practically or stylishly obsolete.

The basic reason here is if marketers expect a product to become practically or stylishly obsolete within a specific length of time they can design it only to last for that specific life time they designed the product to last for this thing only like doctor Ram Kumar took an example of tube light they say the tube light. Its tube the; it is outer cover covering the glass does not deteriorate the clips at the ends does not deteriorate only the gas fails. So, this needs some change the whole tube the whole tube light is disposed off, that is; thrown out to the waste just because of the interior working or the gas fails here.

So, this is one example here the products could be built with higher grade components, but with value engineering they are not, because this would impose an unnecessary cost on the manufacturer also an increased cost to the customer here value engineering will reduce this cost accompany with typically used the least expensive components that satisfy the product life time.

(Refer Slide Time: 34:10)



So, let me compare value analysis or value engineering with conventional cost reduction. The conventional cost reduction is item oriented. Value engineering is function oriented. For instance, if you think of the chair to reduce the cost of the chair you would say ok. I change the material if the chair has arms; let us not put the arms that has some additional cost associated with that. So, it is thinking about the item it is thinking about the chair here item oriented is thinking about the chair.

When I say function oriented; I say what is the function of the chair is to support load to support load of the body. Example, the chair is if designed for hundred kgs the average weight is 60 or 70 kgs in India. So, it is actually the things are overdesigned or we have factor of safety in that example, if it is designed for 100 kgs can we have something else or some other way to support he say you use stool first I would put here support load is the basic function here can we use a stool can we use some cane net something like that value engineering works on the function.

The basic function of the chair is to support load, the secondary function might be provide good look provide comfort we have cushions on the chair then provide support to the arms then provide wheels. So, where the rotation could happen these might be the secondary functions then the ideas in conventional cost reduction are just convergent ideas like; I said in chair they say change the material of the cushion change the material of the arms change the ways the legs are designed just convergent ideas.

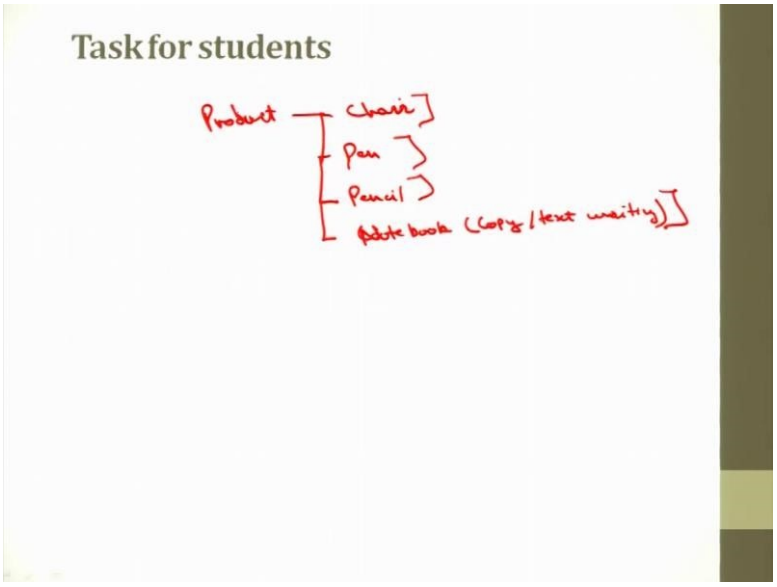
In value engineering first ideas are divergent then convergent. In this case we are just thinking about the chair we are just listing the ideas ok. These are the ideas reduce cost here in this case what will have first will list large number of ideas then will come up with some selected ideas then we converge into one ok. This is divergent convergent this large number of ideas creativity means just do not criticize, I have put this here as well no criticism of ideas do just do not criticise whatever is coming to the mind just put in ok.

So, cost reduction is usually an individual oriented work it might be a team work as well. Value engineering is always a team work the multidisciplinary people work in there, the production people will tell is this possible to produce or not the finance people will tell are the funds available for this or not marketing people would tell would the customer accept this change or not. Actually all these people work together in a value engineering voice of customer is being transformed into the functions here; cost reduction follows the past practises and is analytical in approach.

But value engineering is innovative value engineering says exercise maximum creativity use the creativity techniques like brain storming delphi technique, then morphological analysis there various ways to have creative ideas. So, in cost reduction the cost visibility is the process cost or the processing cost and material cost now these always involve the cost of the part the specific part components, then in processing we have the labour cost overheads, but in value engineering the cost visibility is what is the basic function? What is the secondary function? What is the cost of supporting load in chair that is the basic function?

Then secondary functions are provide comfort. So, what is the cost of providing these secondary functions? We divide the cost into these functions. So, this is value engineering also we have unnecessary functions here these also have cost associated with them. So, these are trying to be eliminated. So, with this introduction to value engineering is over.

(Refer Slide Time: 39:51)



I have a task for you people you, please select a product like you select a chair a daily use product. You select a pen; you select a pencil you select your note book. This notebook is your writing textbook or your copy text writing and think of; how can we reduce cost of this thing? How can we reduce cost of this pen by changing material by changing its appearance and see? What is the cost you are paying for and divide this cost into its various functions? What is the cost you are paying for the pen that is the cost of writing? What is the cost you are paying for its appearance? What is the cost you are paying for its usability. Is the cover of the pen kind of press fit or is it a back click what is the cost you are paying for try to divide this into various elements? This is the only thing the task here.

Next when we will go through value engineering study, then will see the product which you have chosen here the same product will use to provide the alternative for that use the creativity techniques; if possible you should make the groups of 3 or 4 if you are close. So, then you can think of various alternatives you provide some you come up with some creative ideas ok; how this function can be accomplished in some other way those things will do in the second part of this week.

So for now thank you.