Product Design using Value Engineering

Prof. Inderdeep Singh
Department of Mechanical and Industrial Engineering
Indian Institute of Technology, Roorkee

Lecture - 12
Function Cost Relationship - II

Namaskar Friends! Welcome to session 12 of our course on Product Design using Value Engineering. In the second half of our course, our focus primarily is to understand the application of the tools and techniques of value engineering. In the first week, our focus was to understand the basic aspects; the fundamental aspects related to the principles, definitions as well as the functional analysis which is an integral part of the value engineering approach.

We have seen that how to identify your function, how to define a function using a verb and a noun type of definition. We have taken certain examples where we have tried to find out that what are the basic functions, what are the secondary functions, what are the tertiary functions for different products. Now, we are trying to relate the cost with the functions, as you are well aware that the functional cost relationship is very important.

If cost is not important then each and every designer has the liberty to design a product which can be multifunctional, which has a wide variety of function. And in today's scenario you will see that there are number of products for example, a smartphone. There are so many functions in a smartphone so, are these functions being really used by all the customers? Is the company having some data related to the relative usage of all these functions that the companies providing in the smartphone?

No, many times there are functions which some specific group of users may be using and in other case there can be another specific set of functions being used by a specific set of users. From value engineering point of view, we try to relate the functions with the cost. We see that in a functional cost relationship what is the impact on the cost of the functions that we are providing. For example, a product may have combination of basic, secondary, tertiary functions.

Now, we will try to see that, what is the cost implication of the basic functions, what are the cost implications of the secondary function and can some of the secondary functions

be clubbed together, can some of the secondary functions be eliminated; so, that the overall cost structure of the product improves, and the company becomes competitive or maybe the market lead.

So, therefore, it becomes very important to understand the functional cost relationship. And for that we have taken one example of a lead pencil in the previous session, just I have shown one slide. So, I thought that is a very good example after may be discussing on that one single slide later on then I thought that we must have a little bit more detailed discussion on that part. So, that you can always remember whenever, you are trying to put forth or put forward this concept of value engineering in your sphere of influence, which I mean to say, you may be working in a company, and then you may like to propose this idea that why we should not do value engineering here.

And to give an example you must be ready with some set of data which you can easily remember and can easily put forth to the management. So, for that purpose, again today we are going to take, the example of the lead pencil which is being used commonly. It is not only used by children, but also used by executive or it used in the office, it is used by the clerical staff, it is used by the professors, it is used by the architects.

So, a pencil is a very common product which is used by a wide verity of professional as well as by children going to school, along with the students going to the various colleges. So, that product is a very good example of the functional cost relationship of a product. So, here we can see that this is the basic cost distribution, there will be other components also which we can write as miscellaneous but if you see that what are the basic functions.

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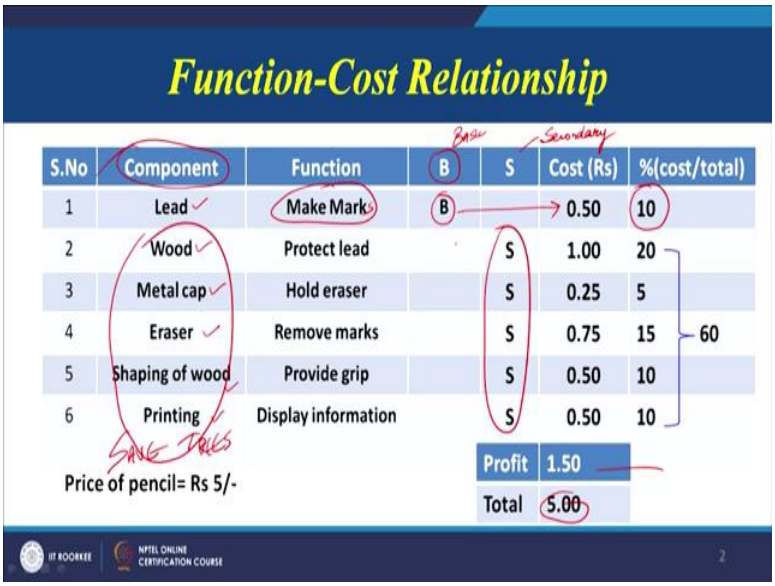

So, here we have a basic function, this B represents basic and this S represents secondary function. So, you can see that these are the components that are there in a lead pencil. So, we can see lead is there, wood, metal cap, eraser then shaping of wood is required, then printing is done to give some message for example, we want to print, save trees.

So, this is just one printing which is done then some color printing if we want to design a pencil for school going children, we would like to make some cartoons on the pencil in order to make the pencil more attractive to the student. So, those kind of printing cost is also involved.

But as you remember we have seen that every product will have a basic function secondary function now, what is the basic function of a pencil? So, the basic function of a pencil is to make marks. Now, these making of marks may be related to writing of words, it can be for making a sketch, it can be for making a drawing. So, basic function is to make marks. So, basic purpose is being achieved by 50 paisa, and this is contributing to as per the example, we are taking only 10 percent of the overall cost. So, overall cost is rupees 5 which includes a profit of rupees 1.50 also.

So, the basic cost or the basic purpose for which the pencil is being used that is making marks or spreading lead is being achieved by 10 percent of the overall cost only. All the other functions or the components are secondary in nature, we can see these are the secondary functions. So, secondary functions are really required for ascertaining or for

ensuring that the basic function is achieved. So, they support the basic function, but whether we really need to have all these secondary functions that is an object of our discussion.

Now, here we can see that basic function is contributing to only 10 percent of the cost and the secondary functions or the secondary components are contributing to 60 percent of the cost. So, this is a summary of what I have said, now we can try to see that what we want to keep in our product, what we want to eliminate from our product and if you refer back to what we have already discussed in functional analysis system technique. It helps us to identify the areas where we can do certain improvements. If you go back and see the case study of a overhead projector there we can see that there is a problem of heat generation.

So, the devices, components, part, sub assemblies which are required to dissipate the heat are only required if heat is there. So, if we can use some technological advancements and reduced the generation of heat or eliminate the generation of heat, very easily we can do away with this cooling devices or cooling components in the overhead projector.

So, similarly here also depending upon the requirement, we can see that whether we need to integrate metal cap and eraser in the product which is a pencil or we can provide a separate eraser as a different product. In most of the conferences in most of the meetings you will see that an eraser is provided separately and a pencil is provided independently.

So, we can say that whether this is a really important design requirement integrating the function of eraser and a metal cap. So, if we can think and we can eliminate this, the cost associated with this, will easily be eliminated. Similarly shaping of wood also, we can do some creative thinking and find out that how the wood can be shaped, what are the latest technology techniques, machines, equipment available to shape the wood which can further help us to focus on this component of the cost.

Similarly, if the pencil is being used by executives in the offices or maybe in the conferences, whether we need really need to print some cartoon signals on that pencil or not that is one decision we have to take. And on top of that we can also take a decision that whether, we need to print some message such, a save trees or save girl child on that because their mature individuals are going to use that product or the pencil during a conference or a seminar.

So, we can say areas, which give us an idea that there is a scope for improvement and then from the innovation point of view creativity point of view, we can do a case study all of you can try to find out that what was the type of pencil used 50- 60 years back. How it has evolved? What are the changes which have taken place in the design of the pencil for the last 50 years?

What is the type of pencil we are using today? What are the various types of pencils being used by different types of professions, students, college going students, in today's scenario. And then try to figure out that what can be the future in the next 10 years, that how the pencil is going to evolve in the next 10 years.

So, you will definitely come up with certain creative innovative ideas, which will help you to identify the future course of action for this product.

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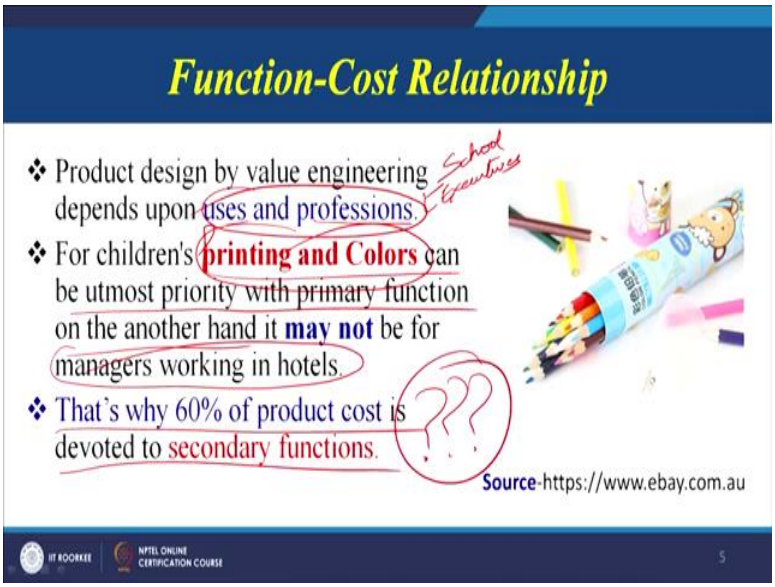

So, here, we leave this discussion here related to the functional cost relationship for a pencil, and we can just conclude here that product design by value engineering depends upon the uses and professions. We have seen that for school children, the design may be different, for executives, the design maybe different. So, we can see that by professions also the product design will change, and how it is going to be used that also will be affected. That will also will affect the product design; for children's printing and colors printing and colors can be at most priority with primary function.

On the other hand, for children printing and colors is important, and on the other hand it may not be for the managers working in the hotels or for the executive is attending a conference in a hotel. So, for them the printing and other you can say, messages may not be that important, if that is printed on the pencil. So, that is why 60 percent of the product cost is devoted to secondary functions, which is our area of concern, and which we want to target and try to design a pencil which is less in cost, but is able to satisfy the basic function for which it has been designed.

So, I think with this example the idea is utmost clear; the idea is absolutely clear, that why do we need to look at a product with value engineering approach. Because here, we are trying to target the basic function of the product, and we are trying to achieve the basic function of the product at the lowest or the optimal cost.

Here, I must also admit that we are not always going to reduce or eliminate the unnecessary cost associated with the product. Sometimes in special circumstances the cost of the product may also increase. So, it is not always that cost is going to decrease, the cost sometimes may increase, but the resultant functional upgradation of the product will offset the increment in the cost.

So, obviously, if suppose we are trying to give a pencil which will last long so, the current design is offering as a pencil, we can design a new pencil which is costly, but is going to help us right for a longer period of time. So, we can say that although there is a increment in the cost, but it has lead to the lower life cycle cost of the product. This is just one example there can be other examples also for example, in an aircraft industry, we change a material for a particular type of component or a particular set of components in a aircraft.

Obviously, the new material is going to be costly, but it is going to save a lot of fuel because it is a lightweight material. So, the overall impact of reducing, the weight of the aircraft is seen as improvement in the fuel efficiency, the improvement in the carbon footprint that the aircraft is producing. So, we can say that by changing the cost structure of the product, by changing the cost; changing means here, we are taking examples where the cost is increasing.

So, I must address here because number of time there will be a question by the users that whether value engineering will always lead to cost reduction, I am trying to dispel that

doubt, I am trying to clear that doubt that value engineering is not always going to reduce the cost of the product.

In many cases, the cost of the product may also increase, but the additional increment in the value; the additional increment in the functional value of the product will offset or will be able to nugget, the effect of the increase in the cost, because now, the customer is getting a multifunctional product at a reasonable cost. So, that is what is important from value engineering point of view. Many a times when we talk of the functions and the cost independently, many learners may confused value engineering with cost cutting.

So, we have to sum it up that functions, we will not be compromised, functions may further be improved, but the cost may increase or may decrease that you will depend upon situation to situation and the example of a divan that we have taken, we have seen that the cost is coming down. Similarly, one more example we will see today in that case also the cost will be coming down, but it is not the case in each and every situation, each and every scenario in many cases, the cost of the component may also increase.

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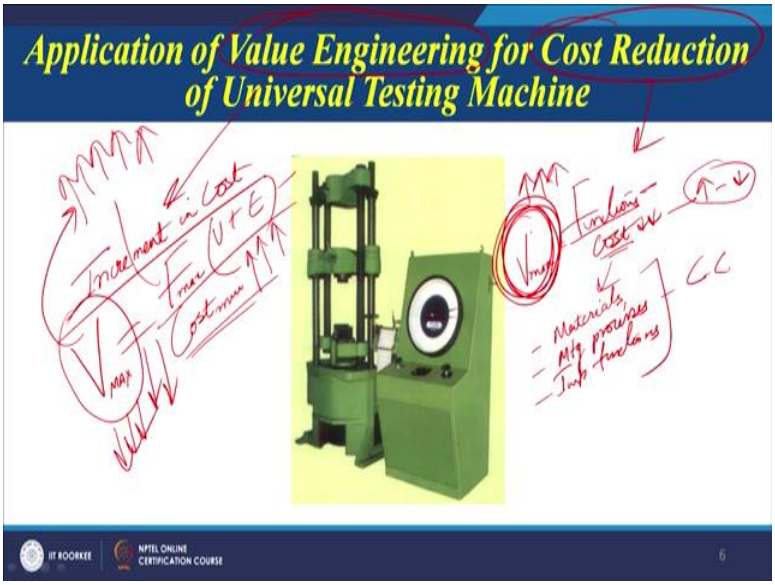

$Value^{max} = Function^{max}$ (Use Function + Esteem Function)/$Cost^{min}$

Now, today we are going to take an example of application of value engineering for cost reduction in universal testing machine. So, the two terms are coming here, value engineering as well as cost reduction. So, both are coming in two picture. So, I have tried to explain the difference between these two terms in the previous discussion that we had. Today only I have tried to emphasize that value engineering may also lead to sometimes increment in cost, which we can explain with this formula. We always say that we have to maximize the value of the product which is directly related to the functional value which we want to maximize the function. And the functions can be both, these can be use functions plus these can be a esteem functions as well as divided by the cost, which has to be minimized, all of you know this equation.

So, cost reduction basically means that cost has to go down necessarily whereas, in value engineering, the cost may also sometimes go up, but the increment in the functional value will be extremely high. So, all though the cost is increasing, but the overall value is improving because there is a large increment in the functional value of the product.

So, we have to differentiate between value engineering and cost reduction, because here this is an example where the cost is coming down and the value may also come down because we may be compromising with some of the functions, which are related to the product usage and which the customer wants. If on other case, we are focusing on the functions which are not required by the user, which are redundant functions, which are unimportant functions, which are not adding any value to the product.

So, we eliminate some of those functions. So, our value will increase, because we are eliminating the unnecessary functions. So, when we eliminate those unnecessary function, the cost associated with those unnecessary functions will also be reduced. So, we will see that the cost has reduced, but only the unnecessary functions have been removed from the product design.

So, in that case we will see that the value has increased because the cost now has reduced. So, we have to be able to differentiate between value engineering and the basic concept of cost cutting. And in case of cost cutting, there can be a compromise in terms of materials that are being used for making the product. There can be compromise in terms of the manufacturing processes being followed for making the product, sometimes

some of the important functions may also be eliminated because you want to cut the cost of the product.

So, all these will lead to cost cutting whereas, in value engineering, we will not go to that extent in value engineering our only focus is the value of the product. So, the value has to improve irrespective of the cost; cost may increase, cost may remain same, cost may reduce that is immaterial, only thing is the value to the customer must increase.

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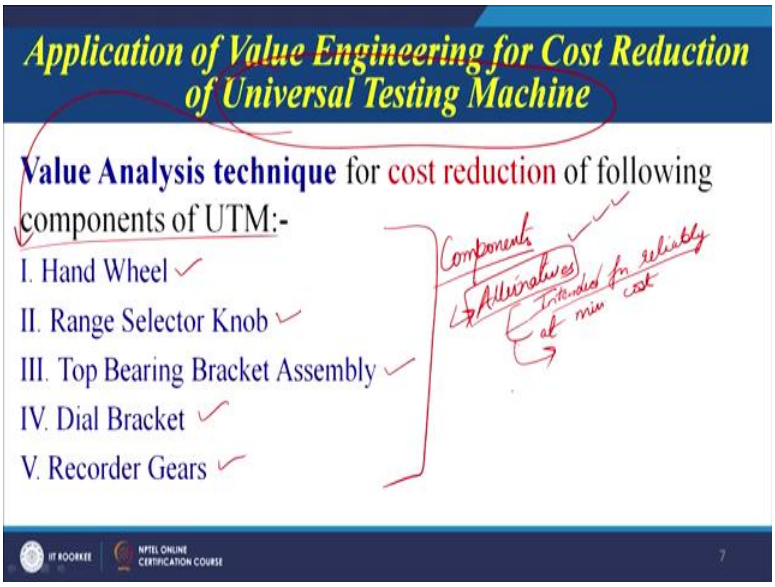

So, now let us take this example of a universal testing machine which has been published. So, the source is given at the end of the presentation. So, the application of value engineering for cost reduction of universal testing machine. So, value analysis technique for cost reduction of following components of UTM.

So, hand wheel range selector knob, top bearing bracket assembly, dial bracket recording. So, all these are the components, on which a value engineer will focus, and try to see that what can be the alternatives. As we have seen that value engineering will always focus on the alternatives, what are the alternatives possible, and which alternative will be able to perform the intended function reliably at minimum cost.

So, our target will be to look at the alternatives and if you see that whenever we talk of a product, we have seen blast, create and refine which means that this total universal testing machine; first we have to divide into the components on which we are going to

focus. So, these are the components on which we are going to focus, and on these components we will look for their alternatives.

And from alternatives; which alternative we will select, which we will perform the intended function, for which the component is being used reliably without compromising the quality performance or serviceability at the minimum cost. Let us take, one by one.

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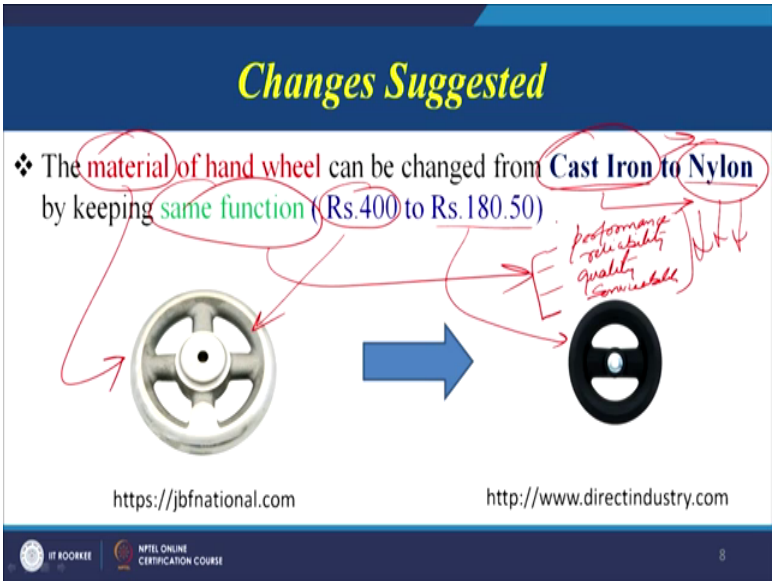

So, the material of the hand wheel can be changed from cast iron to nylon. So, this change from cast iron to nylon must not affect the performance if we are doing the value engineering. It must not affect the reliability of performance, it must not affect the quality of the product, it must not affect the serviceability. So, we can see that this list is an endless list, there can be long list which has not to be compromised.

So, basically this change here what is being suggested that the material of this hand wheel can be changed from cast iron to nylon by keeping the same functions. So, this function is that it should not compromise on any of these aspects. Now what we gain? We are gaining cost advantage. Earlier this metallic wheel is costing 400 rupees, this nylon hand wheel will cost only 180 rupees or 180 rupees 50 paisa.

So, we can see that without compromising on any of the aspects of performance quality, reliability, durability, dependability we are able to save the money, and there you can see the amount of money saved. So, even if we say it is 200, the initial cost is 400 So, we are

able to save a lot of money just by changing one component of the universal testing machine

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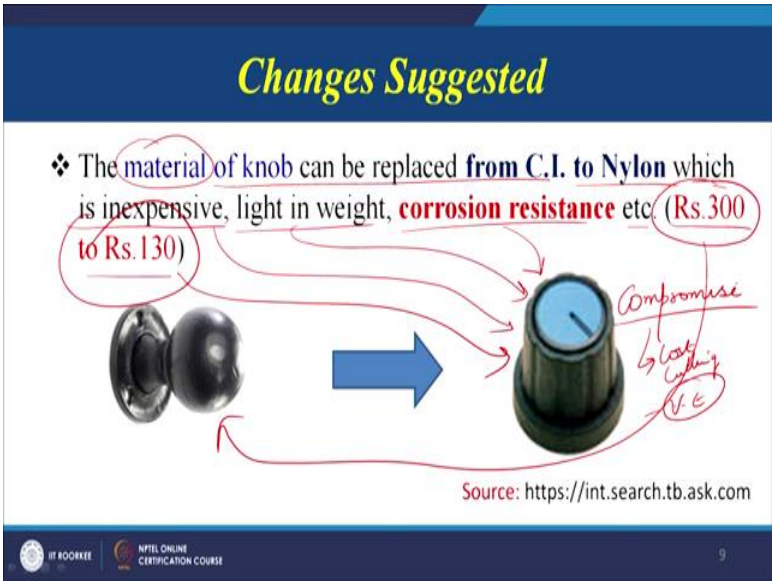

Now we come to the second; again the focus is on material. The material of the knob can be replaced from cast iron to nylon, which is inexpensive light in weight, corrosion resistance etcetera. So, these are the advantages of the nylon material inexpensive, lightweight, corrosion resistance, and it is offering us a cost saving also. Initially the knob which is being used is rupees 300, and the new knob of nylon is giving us only rupees 130. So, we can see that by changing the material again, we are able to save a lot of money.

One thing has to be kept in mind that it must not compromise on any of the performance features. So, there has to be no compromise. So, if there is a compromise on the performance features, then, we can say that we are doing cost cutting, we are not doing value engineering. Our focus is value engineering that without compromising on any of the functional aspects of the product or a part or a sub assembly the cost can be reduced. So, that is the basic purpose of approach of value engineering.

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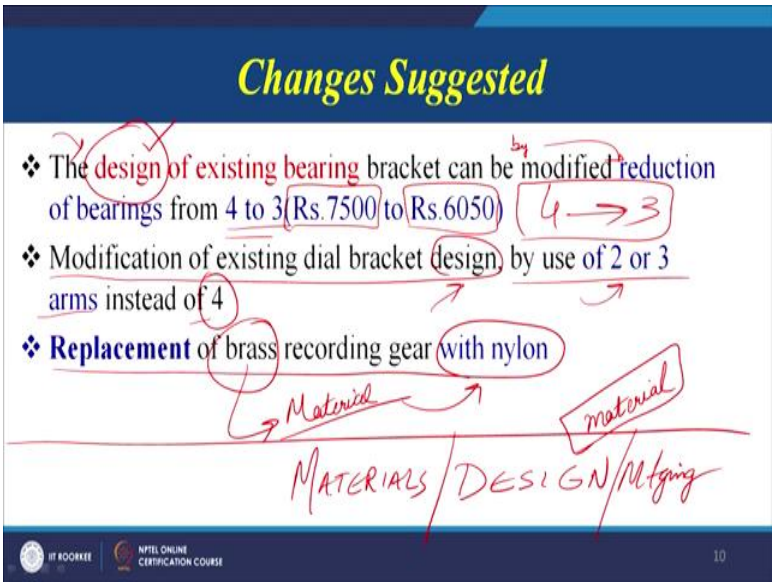

Now, we can see the design of the existing bearing bracket, now what we are focusing? Design; what was our earlier focus in both the changes? It was the material. So, earlier we were focusing on material now, we are focusing on design. So, the design of existing bearing bracket can be modified by reduction of bearings from 4 to 3. So, we are modified by reduction of bearings from 4 to 3. So, here also we see that we are saving cost 7500 was the earlier cost, by reducing the number of bearings from 4 to 3 we are now able to achieve the same function at rupees 6050.

Then, this is another change by number of bearing, but this number from 4 to 3 when we are going now as a learner of value engineering, what should not be compromised? The functional aspect should not be compromised, the performance aspects must not be compromised, the serviceability durability and dependability must not be compromise, but still we are changing from 4 to 3 and we are saving a significant amount of money.

Then, the modification of existing dial bracket design again there is a change in the design by use of 2 or 3 arms instead of 4. So, we can change the existing dial bracket, what we want to change the design, how by changing the arms from 4? Now, currently we have 4 arms in the dial bracket, we can reduce the number of arms to 2 to 3 without compromising on the performance. Replacement of brass recording gear with nylon.

So, again a change in the material from brass we are changing to nylon, which will also significantly result in the saving. So, if in nutshell we see what are we changing? We are

basically trying to change the materials, we are basically trying to change the design and in some cases may also try to focus on the manufacturing. So, when we change the materials, when we change the design, when we change the manufacturing process is being used for converting the material to a product. There are chances, there are possibilities, and there are opportunities which can help us to significantly save certain amount of money.

And that is basic idea behind value engineering or that is the basic idea about the value analysis approach. So, the target has to be that we must focus on the materials, the processes, and the design so, that we are able to achieve the desired function reliably at the minimum overall cost.

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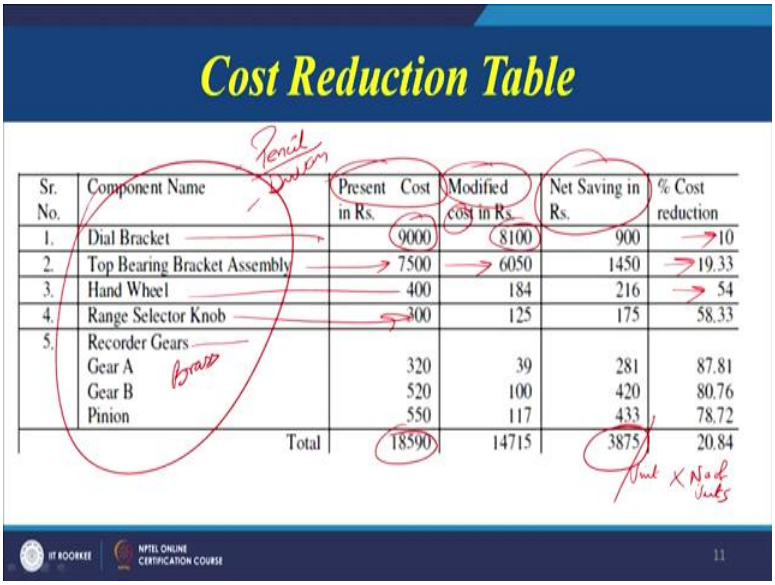

Now, here we can see this is a summary. So, we have seen that in dial bracket the initial cost is rupees 9000, modified cost is rupees 8100; similarly top bearing bracket assembly 7500 to 6000. So, this is summary hand wheel is again, we are saving money range selector knob also we are saving money, recorder gears we have seen that we are changing the material from brass to nylon, and again we are saving a lot of money. So, we can see that percentage cost reduction we can see 10 percent here, 19 percent here, 54 percent here.

So, we can see that initially, the present cost of the machine or some of these component dial bracket top bearing bracket assembly hand wheel. So, we can see this is an example

related to UTM machine you can take any other example, and for that matter we have taken an example of a pencil also in financial cost relationship, we have taken an example of a divan also to analyze the basic and the secondary functions of the product. So, we can take any example here, and try to see that what is the present cost, what is the modified cost and what are the net saving.

So, we can see by minor modifications of material and change in the design, we are able to save 3875 rupees per unit, and if you multiply it with the number of units, we can see what is the overall savings for the organization.

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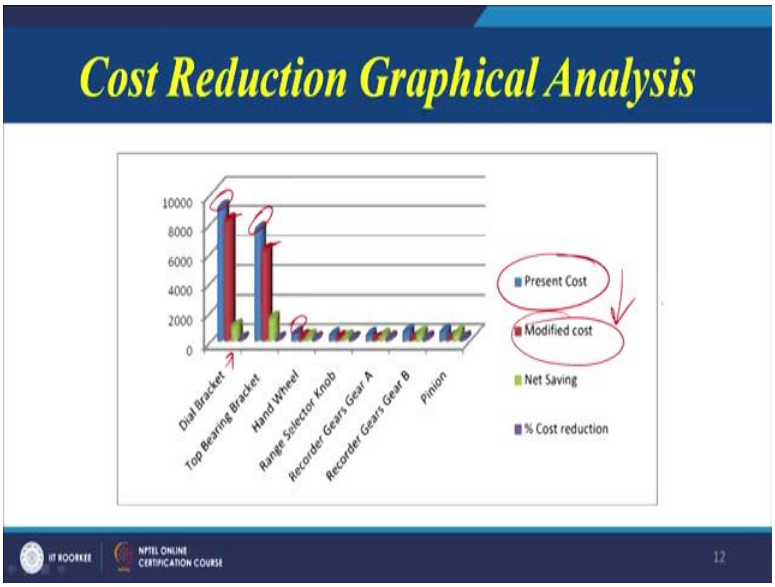

So, here we can again see; you can see dial bracket, the data is represented again the blue towers are representing the present cost and the red ones are showing the modified cost. So; obviously, you can see red is always lower than in most of the cases the present cost; which means that from the present cost, our modified cost is lower because we have changed the material, we have changed the design of some of the part.

And that is why we have been able to significantly reduce the cost of our machine, which will make the machine more competitive, make our company more competitive, we will be able to acquire more number of models or more number of orders, and when we have more number of orders we will get more revenue and therefore, the companies financial health will definitely improve.

So, minor modifications in the materials design and the processes can help us to make big profits and each and every company I believe that must have focus on all these aspects related to value engineering; so that, there further able to make their products more valuable, more worthy for the customers who show confidence in the company or in the products manufactured by the company.

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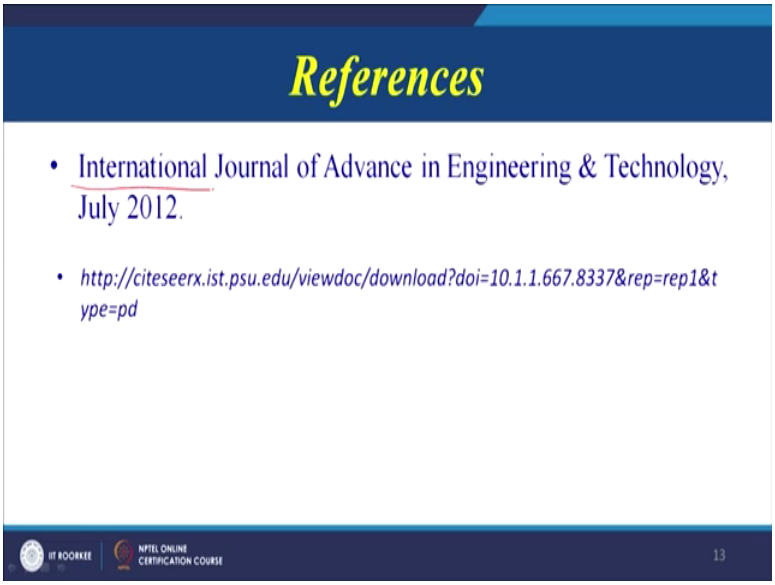

So, this is the source which from where this case study of universal testing machine has been taken, international journal of advance in engineering and technology, this is the case study published, and this is the link on which the pdf file for this case study is available. So, this presentation will be available to you, you can go into the presentation to get even further cites into the changes suggested by the author in the universal testing machine.

And what are the tests conducted to find out the suitability of the change in material or the tests carried out to establish that the change in the material or the design is not going to affect the performance of the product because that is the key area of value engineering, we cannot compromise on any aspect which is going to affect the performance of our product.

So, with this we can conclude the today's session, I think today we have tried to focus on two different types of products one is a very commonly used house hold item which is a pencil and another one is a industrial item which is a universal testing machine. And we

have tried to see that how the basic aspects of value engineering in context of the functional cost relationship be applied in order to make the company's more profitable.

So, in next session we will try to take another case, where we will try to understand that what can be the possible improvements, possible outcomes or the possible benefits of applying the functional cost relationship or in general, the techniques of value engineering to a specific product. So, with this we conclude the today's special.

Thank you very much.