Product Design using Value Engineering

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Lecture - 14
Value Engineering: Case Study - I

Namaskar Friends! Welcome to session 14 of our course of Product Design using Value Engineering. Just to have a recap of what we have been studying in the last 13 sessions, we have tried to cover the basic aspects of product design as well as of value engineering and as all of us are well aware by now that in value engineering there are two important words; the function and the cost.

So, in our previous discussion, we have try to understand that what do we mean by a function, how do we do functional analysis, how do we identify a function, how we define a function using a verb and a noun? Then we have taken the functional analysis of a few products.

We have seen functional analysis system techniques, we have seen case studies related to functional analysis system technique and thereafter, we moved on to functional cost relationship, and we have try to understand that how the functions can be correlated to the cost. And the major objective is to satisfy the functional requirements of the product at a reasonable or the competitive cost.

Without compromising on the performance of the product; without compromising on the serviceability of the product, without compromising on the quality of the product. So, as a product designer it is a very big challenge that how to ascertain that the functional requirements are being met at a competitive cost, because in the today's competitive business scenario, there is lot of competition among the companies to come up with products which capture the market.

So, therefore, the product designers are facing a lot of challenge in coming up with products which not only satisfy the functional requirements of the customer, but are also able to be competitive in terms of cost. So, in value engineering, the focus is to establish a right combination or establish a right balance between the function and the cost that the function is satisfied and the cost is also reasonable.

So, if you remember I have discussed that in our third and fourth week, we will try to go towards, the application part of value engineering and in third week our focus is on case studies, we have already discussed the functional analysis or the functional relationship with the help of few examples, and in today's session also we will try to understand with the help of a case study. There are different case studies different research articles which have already been published, where a particular segment of a product or a particular part of a product or a subcomponent of a product has been selected.

And then, it has been analysed for it is function requirement, it has been defined that what is the function of the product in verb and noun and then, a alternate material or a alternate design or a alternate manufacturing processes, process can be applied or a sequence of processes can be applied. So, that the functional requirement is met, but at a reasonable cost or at a cost which is lower than the existing cost, without compromising on the performance of the product.

So, in similar lines today, we are going to take an example of a medical instrument and with the case study is taken from a article which was published in the proceedings of world congress on engineering and computer science and at for San Francisco USA.

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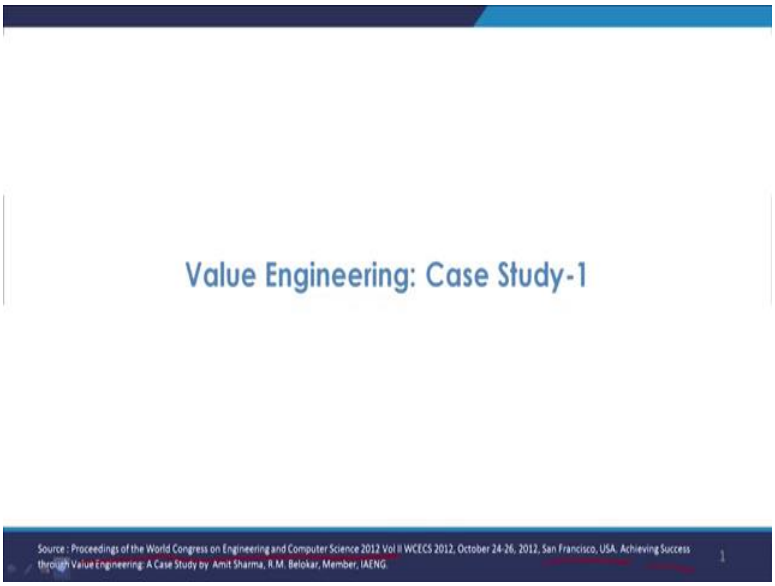

The case study is achieving success through Value Engineering, a Case Study it is a case study based on a study conducted by Mister Amit Sharma and Professor Belokar who is the member of IAENG. So, this is from the proceedings of the world congress on

engineering and computer science. So, the case study is presented in the form of a research article. So, we will try to see this study, and try to understand that how the concept of value engineering was applied to significantly reduce the cost of a sub component of a microscope.

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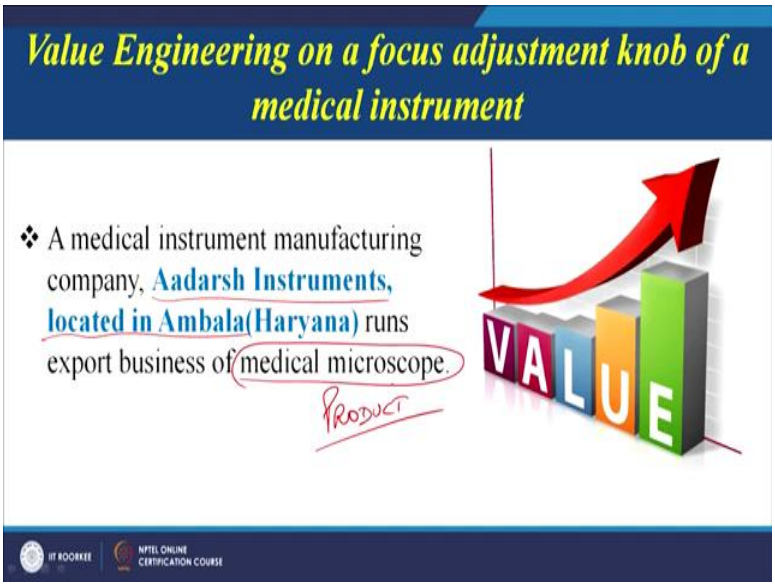

So, here this is related to a medical microscope. So, the product in this case is a medical microscope. So, medical instrument manufacturing company, this is the company others instruments located in Ambala. So, this is case study related to the medical microscope.

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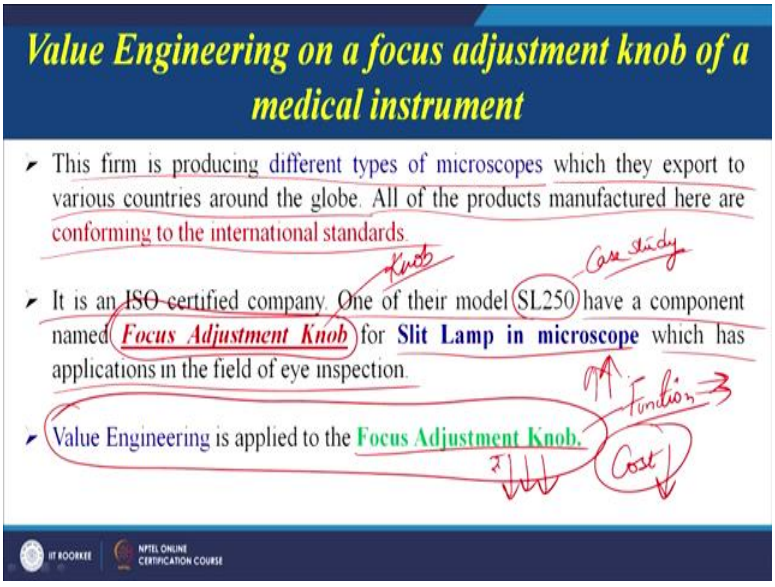

Now, this firm is producing different types of microscopes which they export to various countries around the globe. All of the products manufactured here are conforming to the international standards. So, the company is manufacturing the products which are as per the international standards. So, it is an ISO certified company. One of their model this is a specific model which has been taken as a case study by the authors.

So, one of their model have a component which is called as a focus adjustment knob it is a focus adjustment knob for a slit lamp in microscope which has applications in the field of eye inspection. So, this is a specific instrument of focus adjustment knob which is a specific part of a medical microscope. So, the authors want to see that how the principles of value engineering can be used to focus on the functional cost relationship of this focus adjustment knobs.

So, that is the basic objective of the study, and this is used in the field of eye inspection. So, that objective is value engineering is applied to this focus adjustment knob and what is the target? The target will be to achieve the function of the focus adjustment knob at a reasonable cost. So, currently, we have a focus adjustment knob, there will be some value or some cost related to this, can that cost be minimised that is our target, and can we replace some material or can we do some design modifications, can we make the knob reviews the different manufacturing process so, that the cost is reduced, as well as the function is met or the functionality also improved. So, with this target we try to take this case study of a focus adjustment knob.

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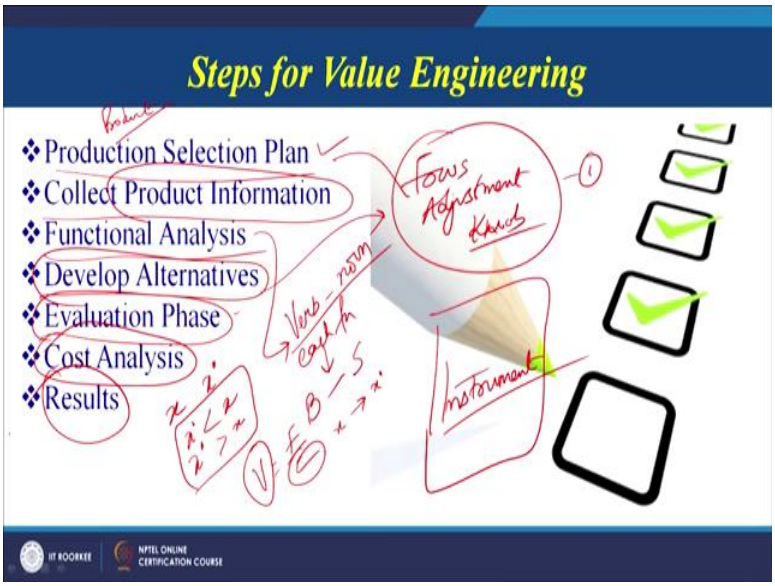

Now, these are the steps for value engineering which we have already covered. So, basically we have to first select, may be if you are talking of improving or manufacturing facility or a manufacturing process. So, we will select the production selection plan, then collect the product information or here we have to, we can also select the product also. So, we have to first select the products like in our case what we have selected? We have selected a focus adjustment knob. So, in our case, our product is a focus adjustment knob which is a one part of a bigger instrument.

So, we are focusing on one part of a bigger instrument that is a focus adjustment knob. Once we have collected the product information we will do the functional analysis, how do we do it we always try to put a verb and a noun type of definition for each function of the product, and try to find out whether this function is a basic function or it is a secondary function.

So, the next is functional analysis that what are the functions of the product, what are the functions of the focus adjustment knob? That has to be taken into account and once that is taken into account then we try to develop the alternatives, that what can be the alternatives for this focus adjustment knob can this be completely eliminated, can there be a two points through which we can digitally adjust the focus or can we change the material of the knob or can we find out some other ways in which the focus can be

adjusted without the use of a knob. So, there are number applications of number or alternative which can help us to achieve our function.

So, we have to develop the alternatives. Then we have to evaluate these alternatives now we can evaluate this alternative using different types of mattresses, we can have different evaluation schemes through which we can give the desired weightage to the different criteria, and then rate the various alternatives based on this criteria. For example, we can have 10 x 10 score for excellent and 1 score for poor and accordingly rate the various alternatives add up the scores for each alternative and decide that which alternative can give us better the value for our product.

So, that is the evaluation phase there can be other techniques for evaluation as well. So, once we have done the evaluation we can do the final cost analysis that suppose x is the cost for the current focus adjustment knob. So, with bring out the changes by the alternative suppose we get x dash as the cost for the new alternative. So, we will see whether x dash is lower than x or x dash is greater than x, even in both cases we will try to see that how this cost is going to affect the value of the product and as all of us know value is going to be give defined by function by cost.

So, we will see when cost is changing from x to x dash whether the overall value is changing or not or what is the effect of the change in cost on the overall value of the product in our case it can be the focus adjustment knob. And once we are able to establish that value is increasing we will document the results, and send the results for final implementation. So, this is a standard approach which is followed in most of the value engineering studies.

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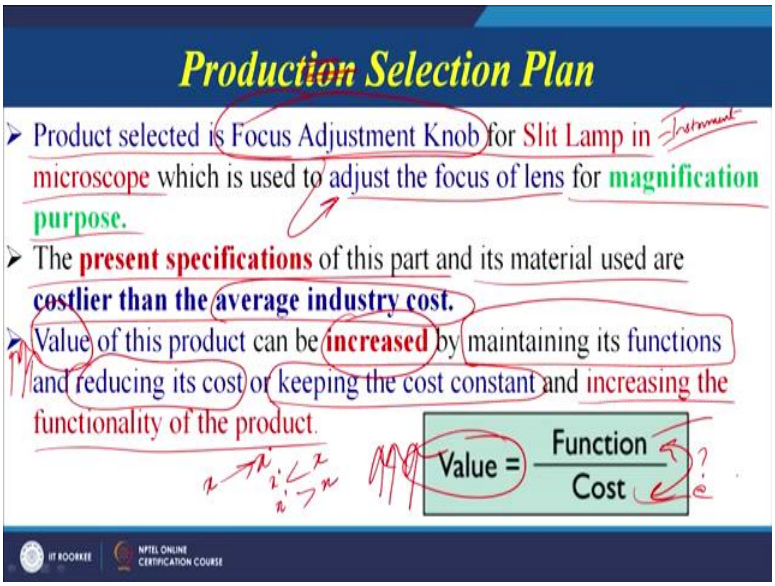

Value= Function/Cost

Now, first is the product selection. So, in case of product the product selected here; the product selected here is a focus adjustment knob for slit lamp in microscope. So, this is the way we can say instrument, and the product is a focus adjustment knob. So, this we have I think discussed earlier also, this product is used to adjust the focus on the lens for magnification purpose. So, we have to adjust the focus for magnifying the image that we try to see and it is used for inspection of eyes, it was given in the first slide.

So, the present specifications of this part and it is material used are costlier than the average industry cost. So, the company realizes that the present specifications and the material used are costlier. So, therefore, there is a scope for improvement or changing the material to alternate material which can significantly reduce the cost of this focus adjustment knob.

So, value of this product can be increased. So, it is found out that, there is chance or there is an opportunity of increasing the value of this product by maintaining it is function, that is very important we cannot compromise on any function of the product when we are using value engineering. So, maintaining it is function and reducing it is cost or keeping the cost constant. So, as I have already told, suppose the initial cost is x, we are changing it to x dash, now x dash can be less than x or x dash can even be greater than x.

So, the change in cost it can be same, it can be higher also, it can be lower also, but the focus has to be on maintaining the functions of the product. So, we have to ascertain that the function is not compromised and in other case, we have to increase the functionality of the product. So, this we have already seen in the previous slide when we are doing the functional analysis and then trying to relate the functional output of the functional analysis with the cost.

We try to find out that the combination between function and cost must be such that the overall value of the product must improve and therefore, it is mentioned here the value must improve it must increase. So, the function and cost we have to establish a relationships, that how much functionality we are providing and at what cost that functionality is added into the product.

So, the product is selected, it is a focus adjustment knob and now we have to see that how we are going to tackle this problem. So, the first thing is we have identified the problem, we are found out which part we are going to focus on, now we have to do the functional analysis or we have to first in collect all possible information related to this product and as we have seen the face is product specifications.

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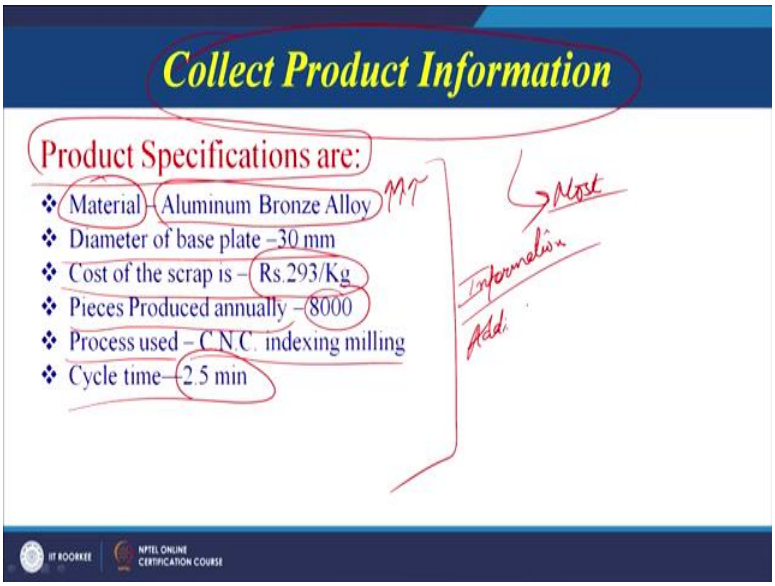

So, first is collect the product information. So, this is the most important thing, because we will be able to come up with the different alternative if we have all the information related to the product. So, product specifications we will try to first look into so, the

current material for our focus adjustment knob is the aluminium bronze alloy and this maybe we can say the cost is higher for this material. Diameter of the base plate is 30 millimeter, cost of the scrap is rupees 293 per kgs, pieces produced annually, process used is CNC indexing milling, cycle time is 2.5 minutes.

So, this is all the information related to the focus adjustment knob, there can be additional information also which can be sort by the value engineers before jumping on to the functional analysis. So, this is the basic information suppose we are doing any other analyses, any other product the first and foremost target must be to collect as much information as possible related to the product that we are targeting.

So, this is the bare minimum information how many number of parts are produced per year, what is the material cost, then what is the cycle time, what is the time required for machining, which machine is being used for making the components, and all additional information.

Whether some other process like anodizing is being done on these materials so, all that information has to be documented, then only, we will be able to establish that these are the focus areas where the cost is going on necessarily. These are the focus areas where we can eliminate some of the processes, these are the areas where material can be changed. So, first and foremost is information related to the product.

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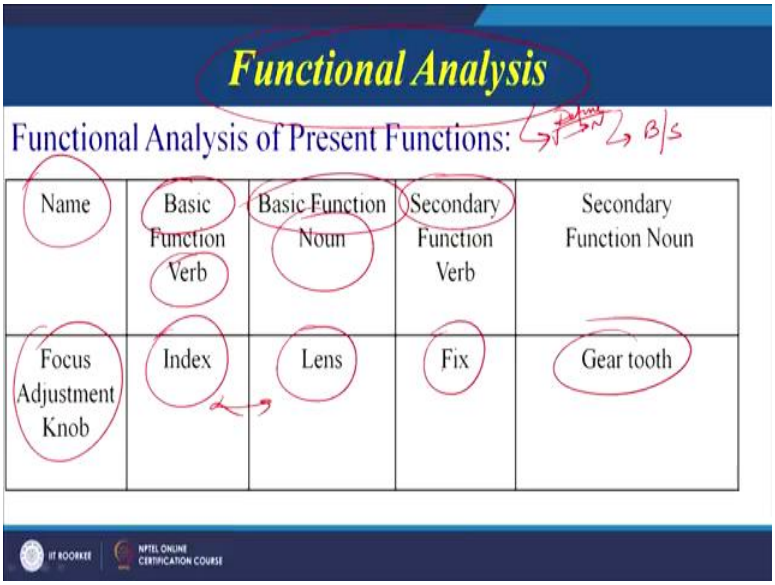

So, once that information is available with us then, we go for the most important part that is functional analysis. So, once we have the information, we will go for functional analysis and as I have told you, in general, how do we do the functional analysis. We try to define the function using verb and noun and then, we try to classify these functions as basic and secondary so, all that is done in this table.

So, we can see name of the product what is the name? Focus adjustment knob, now this a basic function, secondary function. So, basic function there is a verb and there is a noun. So, what is the basic function? The basic function is verb and noun, index lens. So, this is a basic function. What is a secondary function? Fix gear tooth. So, we have to index the lens and fix the gear tooth, these are the two functions of this focus adjustment knob.

Now, whatever we have studied by now in this case study, we have tried to find out that product has to be selected, a product that is focus adjustment knob has been selected, then we have tried to collect all possible information related to the focus adjustment knob. Then, we have tried to classify the functions as basic and secondary functions by giving them by defining them as a verb and a noun. Now, our target is whether this focus adjustment knob need some changes, if it need some changes what are the possible alternatives available with us.

So, for that one of the most commonly employed technique is the technique of brainstorming and how do we brainstorming in a systematic manner this is given in this points. So, once we try to develop the alternatives, we can use the concept of brainstorming or the scientific technique of brainstorming. How it is done that, I will read for you.

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A group of individuals representing different disciplines. So, for focus adjustment knob we can have different people who are involved here people can be from design team, they can be from the manufacturing team, there can be personal from sales and marketing department, because once you are selling a microscope to a vendor so, or to a customer the customer may have his or her specifications related to the types of knobs that are being used in the microscope.

So, the group of individuals representing different disciplines in the project are brought together in a group. So, when we are brainstorming, there is a group from comprising of professionals from diverse disciplines. The group is led by an individual, and a recorder pick up all the ideas that all are generated by the group.

So, normally once we have a objective at hand people started discussing on that objective and there is a recorder who will keep a record of all the ideas generated, all the members of the group or all the professionals, all the executives of the team. Then, the team participation must have reviewed the background information and as we have seen that we have already collected all the background information that is available with us for the project, and they must have familiar with the requirement of the owner.

So, then, the other thing is the customer, the owner here is the customers. So, the objectives must be clear to the team or the personal who are involved in the team or the professionals or the executives drawn from different disciplines they must be aware of

the background information and the specification requirements need that are put forth by the customer.

The brainstorming session is started by having each individual first list, his creative problems so, first creative ideas for the problem. So, we start with giving time to each individual so, that he or she can come up with idea or the creative ideas that, how the objectives can be met, how the functions can be achieved in specially in case of a value engineering project.

After that the team is asked to come together as a whole; as a whole and work as a group in determining the creative solution to the problem. So, once individually suppose I have a idea as Inderdeep Singh I will come up with my creative idea that this is the situation at hand, this is the product we are analysing, these are the functional requirement so, which can modify the product in this manner, we can change the design of the product.

So, this is my personal creative idea coming up with alternative design to the existing design. But some other person in the group may suggest that along with modification of the design, we must also focus on the alternate material so, that is a creative idea coming from another individual of the group.

So, finally, all of the team members have to come together, and they have to find out the creative solutions to the problem at hand. In this technique external evaluation by team members is completely absent. So, this is an internal evaluation only so no external evaluation of the ideas is done. Internal means that the group members will only among themselves try to focus on the creative ideas that are coming to the group members and there will be no external evaluation.

So, there is an environment of open through so, open environment is provided to all the members of the group to come up with a creative solution. So, finally, a consensus is build up based on which the ideas are proposed that these are the major ideas on which the work can be done or can be taken to the next level of evaluation. So, first and foremost we have to develop a large number of ideas and finally, from those large number of ideas, we will be able to fine-tuned, tweak some of those ideas find out the final solution to the existing problem.

So, in today's case studies our target is a focus adjustment knob and we are collected all the possible information related to the focus adjustment knob, we have tried to find out what are the functions of the focus adjustment knob, we have classified them into basic and secondary functions by identifying the verb and noun definition of the functions. Finally, we have learnt a technique there are other methods of brainstorming as well, but this is a general approach of brainstorming. So, with these brainstorming steps we will try to develop the alternatives for the situation at hand.

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And this can be in the form of, we can change the design of the focus adjustment knob, we can change the material instead of the metallic alloy, we can go for plastic, we can try to make it lighter, we can change the production process that is being used as we have seen index building with indexing head is used, we can use the nylon indexing unit. So, these are some of the broader areas in which we can focus like change the design or change the material or use the plastic, make it lighter.

So, all these are the focus areas of brainstorming. So, this is you can see a depiction of a group which is working to develop an idea. So, this we can say is representing a idea or a collection of ideas coming out of the brainstorming or the creative thinking by the individuals of the brainstorming group.

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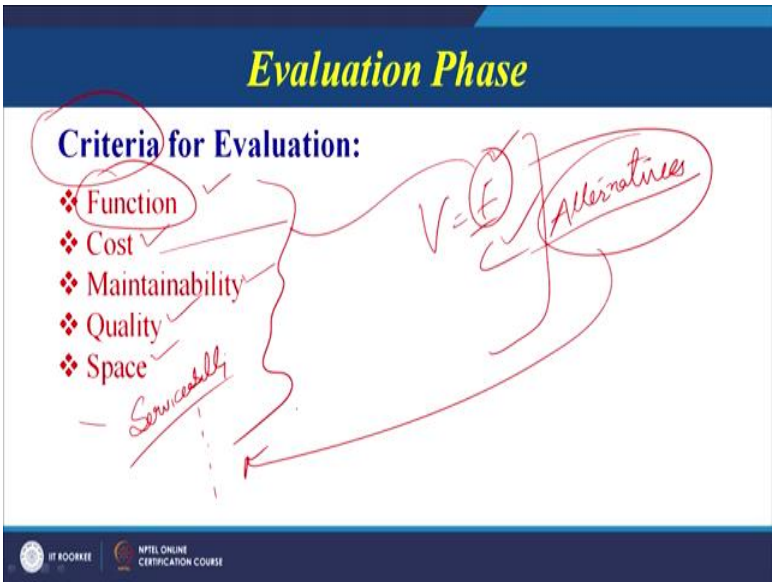

Value= Function/Cost

So, in this case what can be the ideas; the ideas we can come up, but there will be a criteria for evaluation, now, what are the ideas that can be different ideas as we have seen in the previous slide change the material, change the designs, use of plastic, use of plastic material, then change the manufacturing process or the production process. But once, we change it how we can know that what changes we are proposing are going to be effective and efficient, they are going to be better than the or providing us the focus adjustment knob, which is better than the existing solution, which is already in use 8000 such knobs are being produced every year.

So, what is the target. So, what will be the criteria as we have seen that value is function by cost. So, we cannot compromise on the functional requirement and to ascertain that the functional requirements are met we have to use the criteria. First and foremost, we have to see that whether the functions are being achieved by the alternatives or not. So, we may have different alternatives, we may have large number of alternatives, but these alternatives have to satisfy the functional requirement.

They have to be cost effective, maintenance also it may so happen that we are now coming up with the alternative design, but it is at the outset it feel, we feel or it seems to be a very good solution to the existing design and our existing problem, it is easy to

fabricate, it is cost effective, it is satisfying the function, but it is very difficult to maintain.

So, maintainability is also an important issue, it is we find it very difficult to dismental and service it so, that is also one issue. So, it is a combination of criteria which has to be satisfied by the alternatives before these alternatives can be implemented. So, we will screen out many of the alternatives based on this criteria which is listed here and finally, we will come up with the best alternative which satisfies all these criteria.

So, function is one criteria, cost is another criteria, function is criteria, cost is criteria or maintainability in this case is a criteria, quality is a criteria because we have to focus very precisely and accurately. So, quality of the product is also very important. Space requirement for this knob is also important, then maybe we can say serviceability can be another criteria. There can be a long list of a material which has to be satisfied by the alternatives, before they can be used or can be used for replacing the current design of the focus adjustment knob.

So, once we know that with brainstorming we can come up with number of alternatives, but then these alternatives will be evaluated against a certain set of criteria, and the best alternative will be taken to the next level of evaluation; so, this is the criteria for evaluation. The above ideas were discussed as we have seen change the material, change the design, use of nylon material, change the production process, make it light in weight, use very less space.

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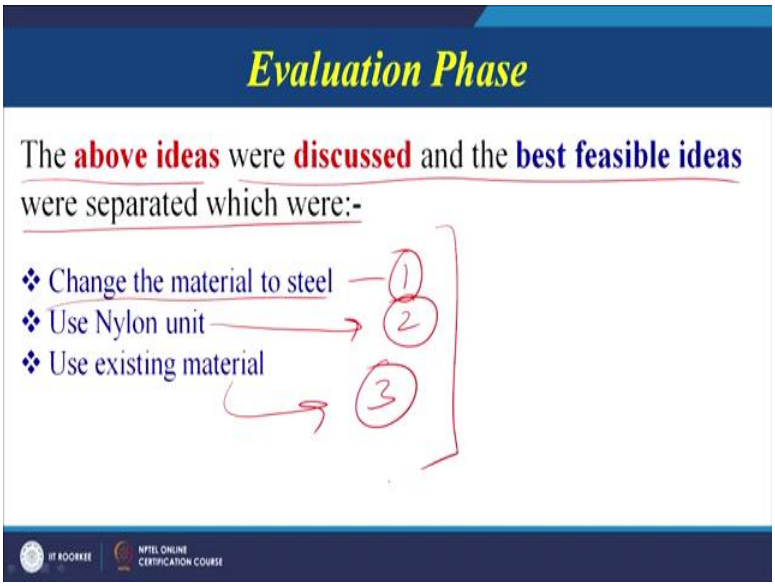

So, all these ideas above ideas were discussed, and the best feasible ideas was separated which were, now after brainstorming if we go back and see; if you go back and see after brainstorming we have all these ideas, change the design, change material, used plastic, make it lighter, change the production process, use the nylon indexing. So, all these ideas are there, all these ideas we will evaluated on all these maybe criteria and finally, these are the short listed ideas or finalized idea.

First idea is change the material to steel maybe 1st idea, use the nylon unit this is 2nd idea, use the existing material this is the 3rd idea. Now these three ideas were taken further they were evaluated on another set of criteria and finally, you can see the cost evaluation was done.

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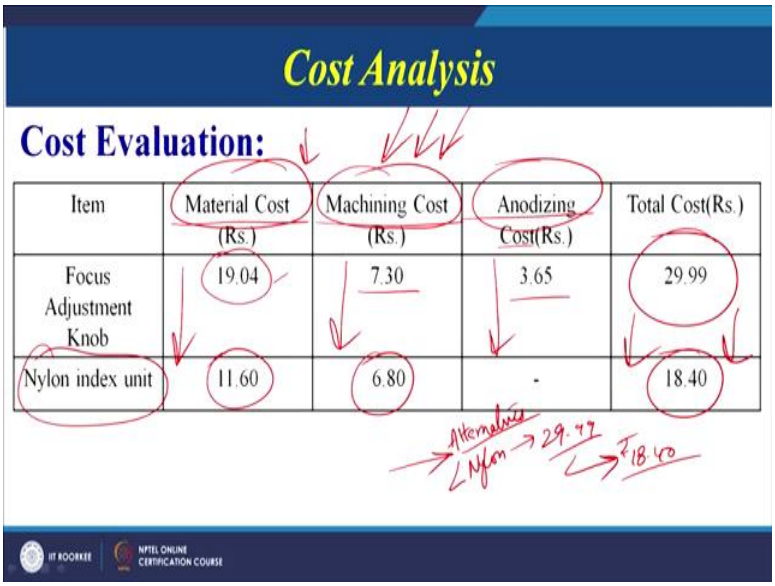

Once, we have all number of alternatives as we have seen the authors have identified three alternatives, change the material to steel, use nylon unit and use the existing material. So, after the three alternatives have been decided, the cost evaluation here is shown only for one alternative, which was found out to be a feasible alternative that is nylon indexing unit, and we can see the material cost which is the already being used alloy is costing us 19.04 that is the material cost, the machining cost is 7.30 and the anodizing cost is 3.65.

So, here we can see that once, we change the material from the current alloy to nylon indexing unit, the cost is significantly reducing, machining cost is also significantly coming down, anodizing is not required once you are changing the material. So, therefore, we can see that the current cost is rupees 29.99, but it is significantly reducing to 18.40.

So, with this case study what we can see that, once we have developed a large number of alternatives, finally, when we orient our thinking with these alternatives one alternative that we have taken is the nylon indexing unit or nylon index unit through which we were able to see change the price from 29.99 to 18.40. So, we can see that there is a significant approximately 40 percent reduction in the cost only, by changing the material, why because when the material is changing the machining cost is also changing and anodizing or the further treatment is not required because the material is a polymeric material.

So, we can with this conclude that within a bigger instrument like a microscope we are only focusing on one particular element or sub component or a part of the bigger product. So, if one part can help us to save so much of money, we can think that what is the opportunity. So, there is a lot of opportunity to focus on individual components, try to change the material, without compromising the functional requirement, try to change; try to change the processes that are used here, the processes also changing, and the cost is less.

Also sometimes as per the case study we have taken machining is required but it may so happened that the machining is not at all required one we change the material. So, the process is also changing, material is also changing, and once if you are able to change the design also we can come up with a better alternative or a better solution to the existing product. So, if we start looking around us there will be so many products in which a modifications can be done in terms of materials, in terms of processes, in terms of design.

So, major focus is on the design and why the major focus must be on design? Because we can completely eliminate the product or a part by combining the function of that part or a product with some other part or a product. So, in tomorrow's session we will try to see, in our session number 15 at case study related to the Mumbai local train in which we will see that a part can or a product can be completely eliminated by a little modification and it can save a lot of cost.

So, with this we can conclude the today session, the source is given on the very first slide for more details, you can refer to the article and get the information. Our target was just to find out the applications of value engineering in the diverse fields of engineering and therefore, today we have taken an example of a surgical microscope and try to identify a part which was modified using the concept of value engineering.

Thank you.