Product Design using Value Engineering

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Lecture - 13
Value Engineering Applications in Product Design

Namaskar Friends. Welcome to session 13 of our Course on Product Design using Value Engineering. So, as you are well aware that we are in the process of discussing an important topic where the value engineering is being applied in the Product Design process. So, there can be a conventional product design process in which we use the conventional step by step approach for designing a product. And that approach we have already covered in detail in our 10 hour course on product design and development. Here we are trying to integrate the concepts of value engineering in the product design and development approach.

So, basically our idea is to focus on the functions of the product, and try to achieve those functions at the minimum overall cost. And in today's class, we will try to see an example which is freely available on the internet and the source is also provided. You can go through the presentation. We have done minor modifications in the presentation in order to make it more general, and more we can say applicable to all of us. So, basically the value engineering applications, we can see are all around us.

We do value engineering in our day to day life also. I think I have given this example earlier also in this course. That whenever we go to market, we want to purchase a particular product; it can be a shirt, it can be vegetables, it can be fruits; normally we do value engineering. How we procure or how we purchase? We try to find out the design, the product as per our specifications and then we try to look at the minimum cost at which we can purchase that product. So, that is the basic concept of value engineering.

But from a manufacturers point of view; once the manufacturer decides that this product has to be designed, the manufacturer has to focus on that needs and requirements of the customers. And based on those needs and requirements, he has to establish that these are the functions the product must achieve. This is the intended function of the product. This is the primary function of the product for which the customer is going to buy the product. And based on that he then, tries to look at alternatives which can help to achieve that

function achieve the intended function reliably with good performance, good quality, good reliability, good durability; but at a very reasonable cost.

So, once the desired function is achieved reliably at a reasonable cost, the product that comes out of that will be a very value added product or valuable product of worthy product for the customer. And today, we are going to take an example in which sword is being designed. It is being worked on the materials are being selected, the manufacturing processes are being selected, there are modifications in the design of the sword in order to reduce the cost; in order to optimize the cost of the sword. So, let us take this case study; it is available on internet.

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So, this is the source. You can note down the source, freely available, https//www slideserve.com So, here we can see that this is a case study of a king who is faced with the peculiar problem which he puts forth to his ministers and the case study goes like this. The king has a peculiar problem that is he says that noble man; there is a very important matter before the court today.

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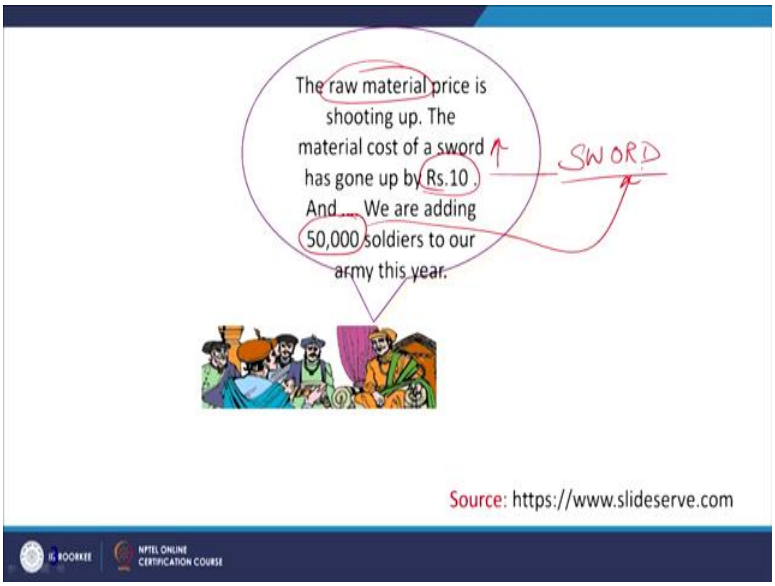

Now, what is that peculiar problem? The problem is that the raw material price is shooting up, the raw material cost is increasing. The material cost of a sword has gone up by rupees 10. So, the product in question here is sword and the issue is the material cost has gone up by rupees 10 and the king is adding 50,000 soldiers to the army who have to be provided with this product which is sword. So, now, what is the source of revenue for the king? Normally the source of revenue for the king are the taxes.

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Now, he wants to handle this situation without increasing the taxes; without increasing the taxes. So, this is what the thing wants that he does not want to trouble his people, he does not want to trouble the people living in the kingdom, he does not want to increase the taxes on the common man, but still wants to add army or soldiers of 50,000 in number. So, he wants that advice that suggestions by the ministers that how this problem can be tackled. So, that is we can say challenge; this is the challenge with the king that he wants to increase the number of people serving in the army that is his challenge and he does not want to increase the taxes on the common man. So, this is the problem.

Now, we have to find that what can be the solutions. Now he asks suggestions from his ministers. Ministers are majorly quite. So, then he comes up there is there ministers are just thinking of what can be done.

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Then why everyone is quiet? He is also we can say not very happy with the ministers because he has posed the problem. The problem is he wants to increase the army by 50,000; 50,000 more troops have to be added. He does not want to increase the taxes on the common man, but still wants to equip the soldiers with the swords. The raw material cost of the swords have gone up, now how to tackle this problem? So, he surprised why everyone is quite, and he has a very famous minister in his court. So, he says minister, I am surprised that you too have become silent.

So, now, the minister the onus is now on the minister. Now, the minister says we can see, the minister will come up with now the solutions.

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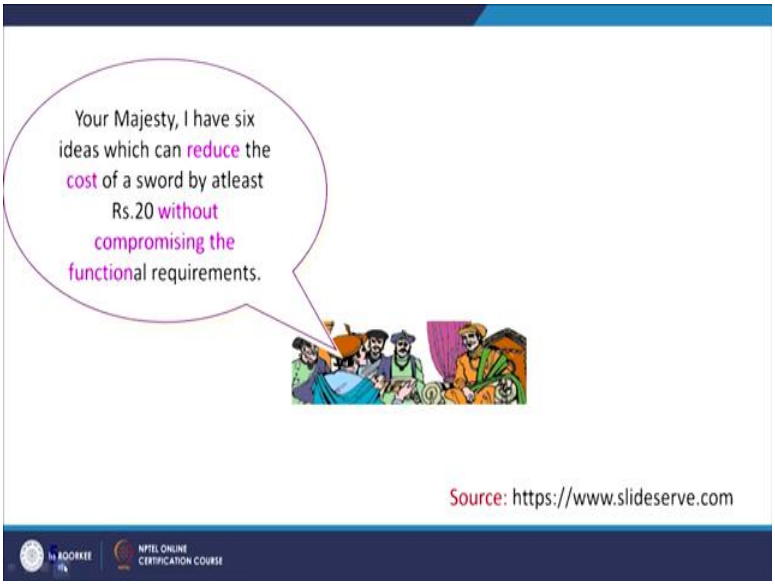

So, minister says now your majesty, I have six ideas which can reduce the cost of a sword. Now, we can say, six ideas which can reduce the cost of the sword, how much by at least 20 rupees. Now, the raw material cost has increased by rupees 10, but the minister is coming up with innovative ideas, creative ideas, technological ideas which can reduce the cost by rupees 20.

On top of that without compromising the functional requirements so, that is our target if you remember, we have seen that we will not compromise on any of the functional requirements and you have seen in the previous case study also in which we have tried to change the material, and the design of some of the components of the universal testing machine.

And we have found out that without compromising on the functional requirements of these components, we were able to save a substantial amount of money per unit for a universal testing machine. So, similarly here also the minister says that he has six ideas which are based on change in material, change in process, change in design and which will be able to save rupees 20 per sword, and the king will not have to raise the taxes on the common man. So, what are those ideas?

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So, the king is very happy. He says brilliant tell us those ideas. Now what are those ideas? One by one we will try to see. The first idea is presently the hilt has 7 parts.

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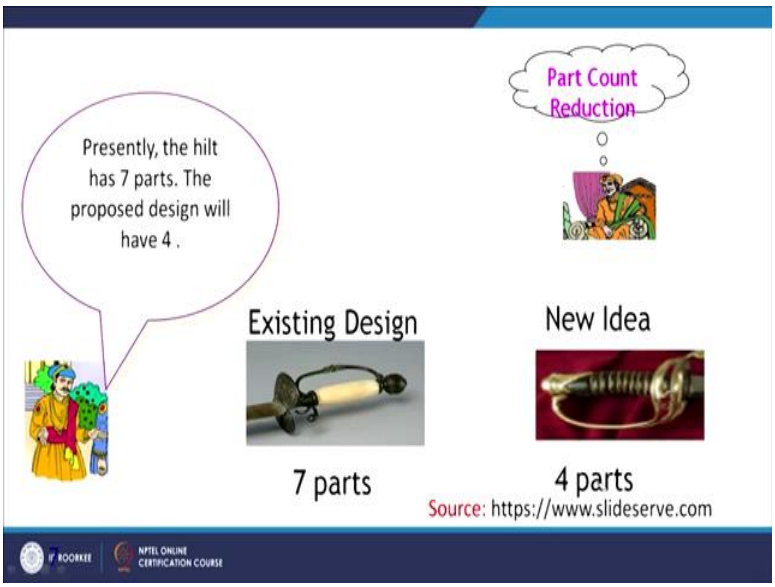

The proposed design will have 4. I can understand many of the learners may not be able to figure out what is a hilt, but with we will be able to try understand it with the help of an example. So, this is the hilt and this is the existing design in which there are 7 parts. But as per the change, a new design is suggested in which there are only 4 parts, we can see there are only 4 parts here. So, this is we can say, one change. Now, what this change

is going to help us or what is the idea behind this change? The idea behind this change, is the part count a reduction.

So, whenever we are doing a value engineering approach, we must try to see that what are the number of parts being use for making the product and if we can modularize, if we can try to make the parts sub assemblies or in a modular fashion; we can certainly reduce the cost of our product. So, first idea that comes to our mind is that we must try to design our product which has the minimum number of parts which is also one of the guiding principles of design for assembly which we have already seen in two of our previous courses that is product design and development and manufacturing guidelines for product design.

So, first target and the first idea which the minister is giving is that, the current hilt or the current design has 7 parts in the hilt, but the new design of the hilt must only have 4 parts which are essential and which we will not compromise on any of the functional requirements of the product.

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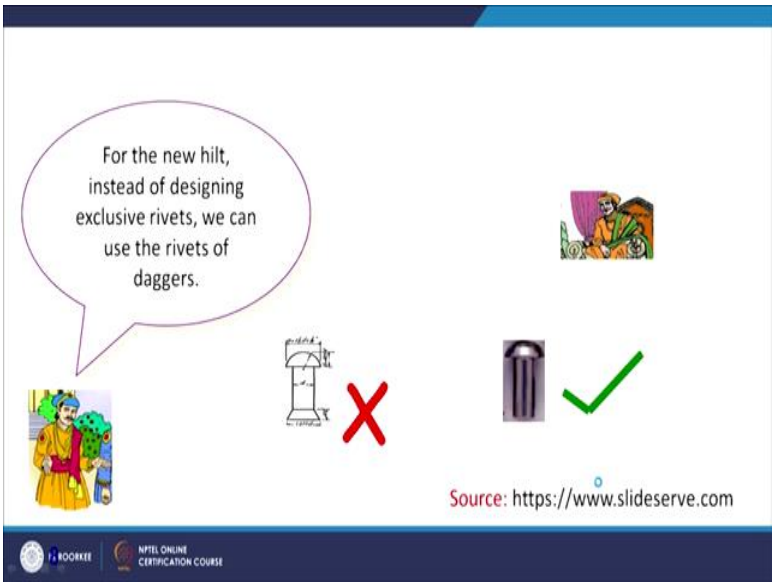

Now, the second idea; for the new hilt instead of designing exclusive rivets, we can use the rivets of the daggers. Now two things are coming here. Hilt is now known to you, the dagger is another type of weapon, and the rivet is a fastening element like a nut and a bolt or a screw; we have a rivet which performs permanent type of joint. So, this is the designed rivet which is not recommended. So, we say that for the sword, we must on use

the rivet which we are already using for the daggers. So, this is the rivet which is used for the daggers. So, you can see that specialized component is not the requirement; if we can achieve the function with the standard component.

So, what is the idea here? The idea is the part commonization. So, wherever common parts can be used in our product design, we must focus on part commonization, why? Because the processes for making those parts have already been optimized, and for mass production the cost automatically comes down. So, if we focus on part communization, we will not be required to make specific or specialized parts which may be costly.

So, with part communization, we are using the standard parts for which the processes are well developed; the mass customization or the mass production of these parts are being done, and these parts are being produced in a bulk. So, we get the economies of scale also and we are able to save a significant amount of money by adopting this principle.

So, two ideas we have seen here. First thing is we must try to reduce the number of components in the hilt. The second is we must not design specific fasteners, we must focus on the standard rivets which are being used in the daggers.

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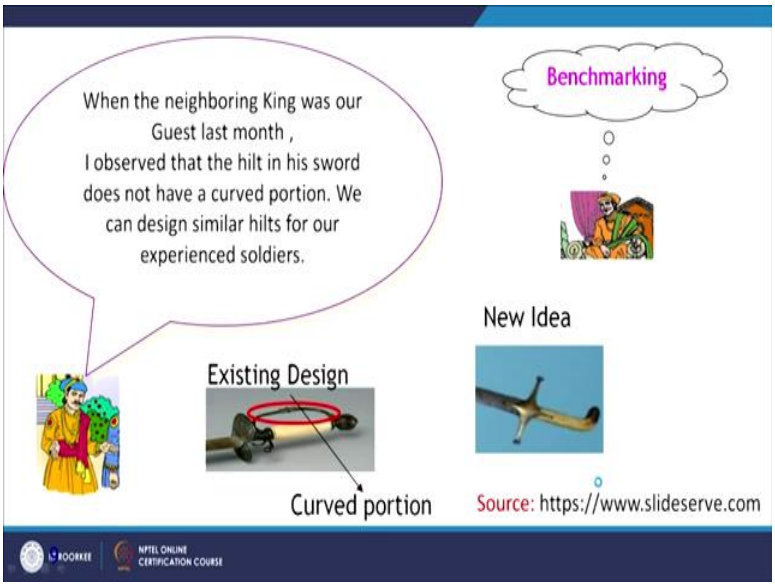

Now, the third is when the neighboring king may be the king had a guest a neighboring from a neighboring kingdom. So, the neighboring king was our guest last month. I observed that the hilt in his sword does not have a curved portion? Again, the focus is on

the design of the hilt than the sword of the neighboring king was not having the curved portion in the hilt.

So, we can design similar hilts for our experienced soldier. So, this is the design, this is the curved portion you can seen on your slide. So, this is this curved portion can be done away with and we can have a new idea. We can see that here the curved portion is not required and these type of swords can be given to the experienced soldiers who do not require or protection with the help of a curved portion because they are experience their grip is better, and the old designs can be given to the newly recruited soldiers who need experience of handling a sword.

So, what is this idea? This idea is benchmarking, we must try to see that what the competitive product is all about, what are the best practices of the competitive product, what are the best design features of the competitive product, what are the best functional requirements that are being met out by the competitors product. So, benchmarking means we have to see that how we are performing in comparison to our competitor's products.

So, three basic ideas we have got till now. The first one is part count reduction, we must try to focus on lesser and lesser number of parts. The second one is part commonization and the third one is benchmarking. Now coming on to the fourth one.

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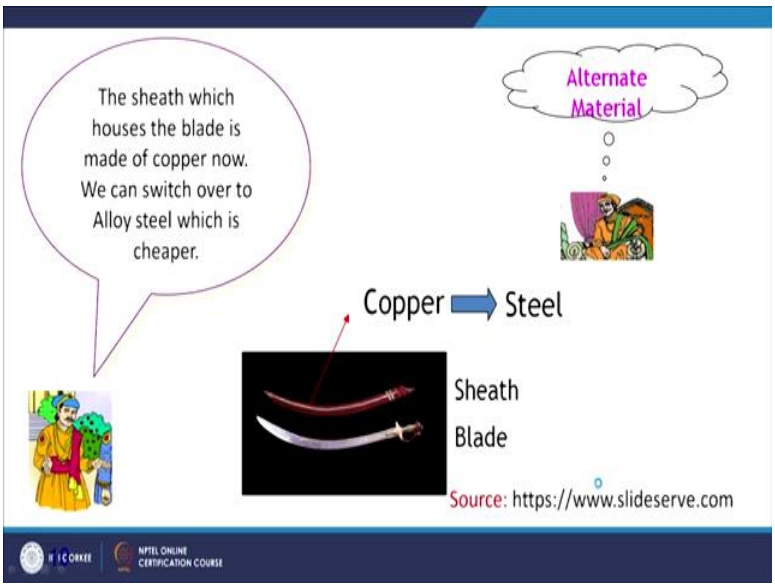

The sheath which houses the blade is made of copper. We can switch over to alloy steel and in the previous session, we have switched over from cast iron to nylon. So, from metallic part, we have converted into a plastic part. So, here we can see the sheath can be which houses the blade, the covering of the sword is made up of copper which is certainly costly. So, we can switch over to alloy steel which is cheaper.

So, this is the sheath and the blade shown in the diagram and you can see the sheath is made up of copper. So, we can change from copper to steel. So, this is we must focus on the alternate material. So, the four ideas that have come by now is we must try to focus on part count reduction, we must focus on part commoniztaion, we must focus on benchmarking, and we must focus on alternate materials.

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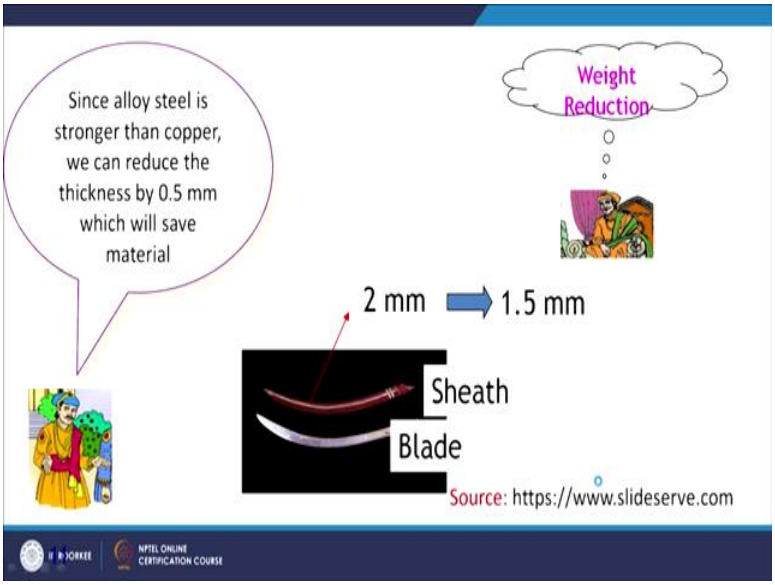

Now, the next idea is since alloy steel is stronger than copper, we can reduce the thickness by 0.5 millimeter which will save the material.

So, when we are switching the material, we can also optimize the thickness of the sheath that we are going to use. So, basically the sheath is made of copper. Earlier it was 2 millimeter since we have changed to alloy steel, we can reduce the thickness to one point five millimeter, and this will further reduce the weight of the sword including the sheath. Then, we can see. What was the idea? The idea was that we can focus on weight reduction.

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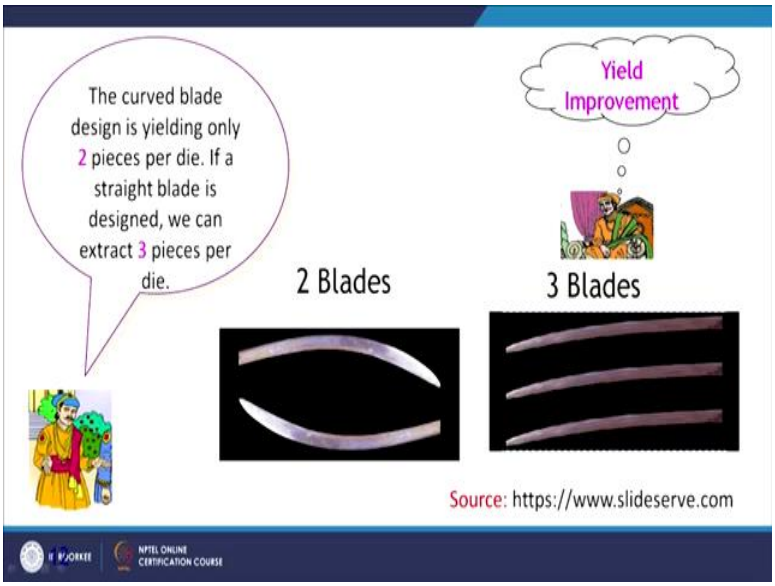

Now, coming on to the next idea, the curved blade design is yielding only 2 pieces per die. So, in a sheath metal operation of the curve blade design is yielding 2 pieces per die during the manufacturing process.

If a straight blade is designed, we can extract 3 pieces per die. So, we can try to improve our yield based on the design of the sword. So, we can see that if we are making the sword depending upon the size of the sword, we can say that per unit area we are getting 2 swords only but if we for the same given area; if we change the design of the sword, we make it less curved, we can improve our yield, we can get three swords. I think it will become clear for with the help of the diagram on the screen. Here you can see the two blades, we are getting currently.

This black area is the raw material out of which we are creating the sword. So, you can see here, we are creating or we are cutting the sword, but if we change from the same area of the sheet or the same raw material, same area of the raw material if we change the curved; curved design of the sword to a slightly straighter design, we can get 3 blades out of the same area of the sheath from which the sword is being cut.

So, basically you can see per die we are producing 2 swords by changing the design to a slightly less curved design, we are getting 3 swords from the same area of the material. So, we can see this is the yield improvement. So, we have seen that different aspects of product design can help us to reduce the cost of our product without compromising the

functional requirement and this is the very good idea, very good case study in which we have seen that if we modify the product design. Here this is a design modification as well as it is a manufacturing modification also. So, it is a combination of design modification and a manufacturing modification in which we are able to get more yield.

So, the idea here is you can see here, the idea is yield improvement. So, we if we focus on these 6 ideas, the ideas we can summarize the first idea is related to part count reduction, the second idea is related to part communization, the third idea is related to weight reduction. We can have yield improvement, we can have benchmarking.

So, similarly, if we go back into the presentation and see all these six ideas; all these ideas will be able to help us in modifying the design of our product. In modifying the material, one of the ideas I have missed is the alternate material. So, if we there are three important things; change the design as per the functional requirement, change the material and as well as change the manufacturing process.

So, these are the three pillars on which value engineering study will be based. The first pillar will be the design. The very important aspect is the design of the product. The second one is what are the materials being used for making the product. The third one is what is the process being used for converting the raw material to the final product. So, if we focus on these three important aspects, we can certainly get a product which is satisfying the intended function reliably, but at an overall reasonable cost. So, this is now, these are the ideas, we can see here.

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So, once we have realized that there are significant chances of improvement, but then comes the biggest challenge. As all of us must agree, and we will definitely agree that if we bring about all these changes in terms of materials, processes and design in our product.

We will certainly be able to save a lot of money, but then there is an important aspect that is the behavioral roadblock. So, here we can see that a senior minister; he says, your majesty the present design is being used since the time of your grandfather. So, change is a very difficult thing. Change management has to be taken care; change management has to be handled very carefully.

And here since the swords are being used for the last two, three, four generation; the senior minister says that these swords are being used without any failure. We should not risk any design change. So, there is always degree of skepticism, people are skeptical that whether the new design will be able to satisfy the functional requirements of the product, but in order to change, you require the willpower of the management.

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So, the king is really impressed by the ideas given by the minister. So, he says to the older minister that Saheb, there is no doubt that the president sword designed by you for my grandfathers army is superior. However, let us test this new design in our barracks. If they pass the test, we will deploy them in the battlefield. So, the top management support is very important, and once the top management support is able to generate a degree of confidence among the employees, they can certainly come out with a number of creative and innovative ideas.

But yes, as the important requirement for any value engineering study, you cannot just compromise on the performance of the product and therefore, the king is also he wants to be sure the king is also going to ensure that the test are done, the soldiers test the new design in the barracks, they try to work with these swords to fight with these swords to practice with these swords and if they pass all the tests only then the changes will be implemented otherwise the older swords will only be used. So, that is the gives an idea about the prototyping as well as first testing of the product.

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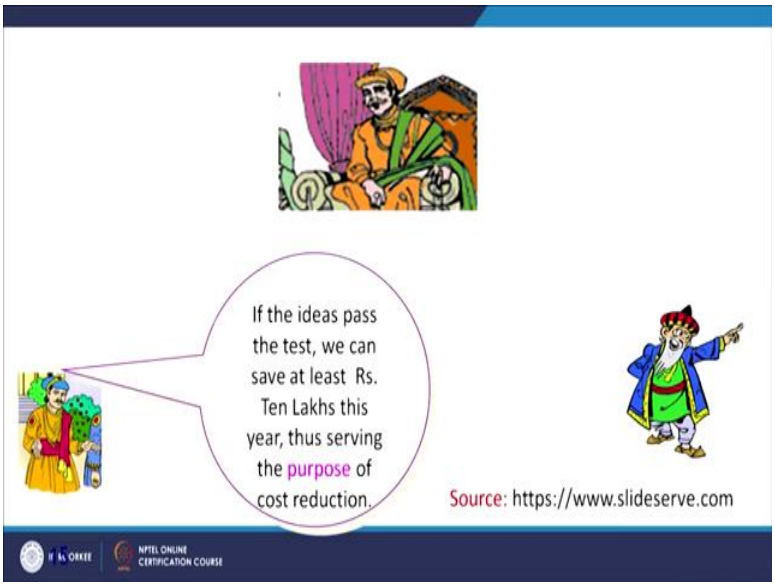

So, if the ideas pass the test, we can save at least rupees ten lakhs this year plus serving the purpose of the cost reduction. So, we can see that 50,000 soldiers are being added, rupees 20 saved per product we can say that there is a huge amount of saving for the kingdom or for the king.

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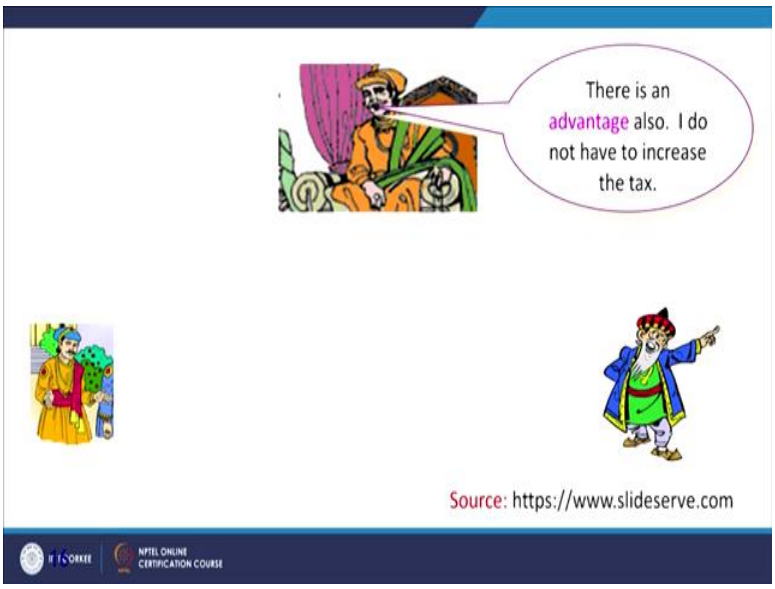

There is an advantage also I do not have to increase the taxes, so we started with the problem that the king is adding 50,000 soldiers in the army, they have to be equipped with the swords, the king does not want to increase the taxes on the common man, and

the raw material cost of the sword has gone up by rupees 10. So, with this objective 6 ideas were generated by the minister and it was shown that if these ideas are implemented, huge amount of cost can be saved.

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Now, minister! I wonder how you developed these ideas is there a systematic way by which others can also be trained to generate such ideas. So, now the king wants to understand the logic understands the science and engineering behind the generation of these ideas.

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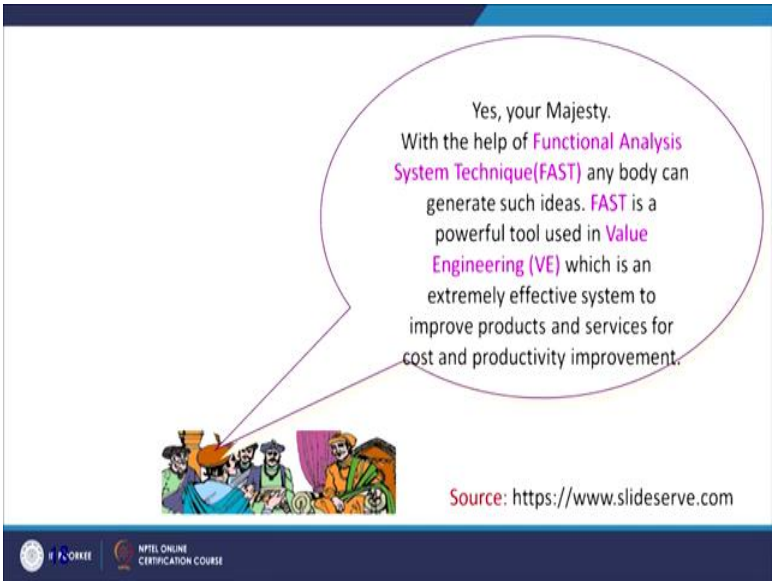

And the minister then comes up, yes, you are majestic with the help of functional analysis system technique which we have already covered anybody can generate such ideas. FAST is a powerful tool used in value engineering which is an extremely effective system to improve products and services for cost and productivity improvement. So, we can see two terms are coming here fast and value engineering and therefore, we have conceptualized this 10 hour course to basically introduce the learners to this important aspect which normally is missing in our UG and PG curriculum.

So, basically if we try to do a systematic study of the functions of a product, and then try to correlate them with the cost, and try to eliminate the redundant functions from the product; obviously, we are going to save a lot of money. And as is clear from today's case study that if we use common sense judgments related to the change in material, related to the change in the manufacturing process, related to the change in the basic design of the product without compromising on the functional requirement, we can save a huge amount of money.

So, this is we can say going to help, make as more cost effective and is going to improve the overall productivity and next thing is very important this course is a 10 hour course, but this is just the beginning of the thought process that we want to develop among the learners, among the engineers, among the managers who are completely unaware of this concept.

So, if only one sword an example of a sword can save so much money for the king, what can happen if these ideas are duplicated multiplied or may be applied in other defense equipment also?

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So, if six ideas for a sword itself can save rupees 10 lakhs, imagine how much money we can save on other weapons like spears, arrows and cannons. So, what can happen you can see army is equip will so many different types of weapon. So, if we apply the same concept on other equipment tools and machines also how much money can be saved?

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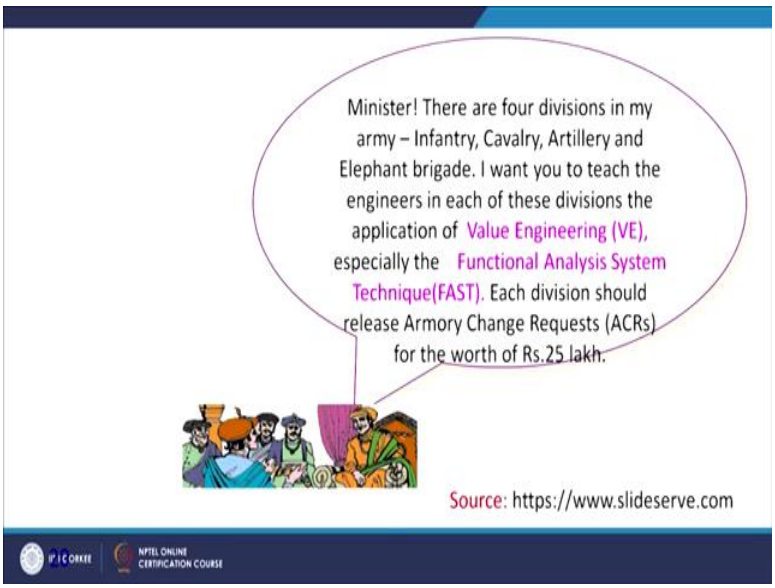

So, now let us see, what is the target or scope of future study from the kings point of view. Minister, there are four divisions in my army infantry, cavalry, artillery and elephant brigade. I want you to teach the engineers in each of these divisions the

application of value engineering especially the functional analysis system technique. Each division should release armory change request for the worth of rupees 25 lakhs.

So, one case study of changing the design of the sword, changing the materials that are being used for making the sheath, changing the curved portion of the sword. So, design is changing, material is changing, there is the change in the manufacturing process per die now we are producing three swords per square unit of area.

So, basically we are producing more number of sword yield is getting improve. So, if the each and every division of the army focus on all these aspects of value engineering you can yourself imagine, how much cost can be saved, how much cost effective designs can come into picture and this saved money can be used for the benefit of the masses, the benefit of the common man.

So, basically, the example that we have taken today is just for a one particular product, but the approach is universal. So, if we apply this universal approach to all the products that we are using; obviously, we can come up with innovative and creative solutions to the existing problems which can be more cost effective as well as profit making for the organizations. So, with this we come to the end of today's session, we will carry forward our discussion focusing on all the different aspects of value engineering which are related to the product design process.

Thank you.