Product Design using Value Engineering
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Lecture - 16
Value Engineering Tools and Techniques - I

Namaskar Friends! Welcome to session 16 of the course on Product Design using Value Engineering. So, we are today going to start the last week of our discussion. So, already we have finished 3 weeks of discussion, and in these 3 weeks we have tried to mature from fundamental aspects of value engineering to the applied aspects of value engineering. And in the last week our focused primarily was to understand the case studies which have already been published mostly by Indian authors in different journals.

And we have tried to find out that how value engineering can be applied, we have taken examples right starting from a pencil to a divan to a universal testing machine, also we have seen an example of a focus adjusting knob. So, if you remember now we know by now that how to apply the concept of value engineering in problem solving. Now, once we have a course of a very short duration like a 10 hour course we must have some rules of thumb or we must have some basic guidelines that we must always remember when we are applying the concepts of value engineer.

So, there are tools and techniques which have been listed out by the authors of various books which have been published in the area of value engineering. So, these techniques can be applied by a common man, and can help the common man to design products or to come up with product ideas which will be better than the existing products. So, we will try to focus on these tools and techniques which are relevant for each product designer which are relevant for each engineer who is involved in the process of product design.

So, these techniques are really helpful, and this must be kept in mind by each and every designer when he or she is designing a product. So, our target today and in the next session will be to understand these techniques with the help of case studies or the relevant examples that we can take.

So, that we remember these techniques and finally, in this week, we will try to cover the roadblocks that are the behavioral roadblocks which do not allow various engineers and designers to come up with innovative solutions, what are the problem areas and how these problem areas must be addressed. So, that we are able to use these techniques for better product development or for effective and efficient product development.

So, we will try to first see, the techniques and then, try to see that what are the problems with these techniques why we are not able to apply these techniques, we will try to take two or three case studies related to the behavioural roadblocks and finally, we will conclude in the 20th session So, today our target as you can see on your screen is value engineering tools and techniques. So, today is the first session and we will have another session on tools and techniques. So, let us start our discussion.

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Value Engineering Tools and Techniques

Behavioral Based	Technical Based	Functional and Cost based
Use Good Human Relations	Apply Good Business Judgement	Determine the Cost, Evaluate by comparison
Avoid Generalities	Secure Facts	Fix Money Value for all specifications, Tolerance, Fits and Finishes.
Overcome Roadblocks	Constructively Challenge Everything	Define and Classify Functions Spend Money as if it is Your Own
Inspire Team Work	Simplify	Blast and Create Recommend Solution with enough data for decision-makers to decide
Refine and Combine Ideas	Use Standards	Establish Cost for all ideas
Use Ground Values	Consult Specialists, Vendors, Customers etc.	Develop Function Alternatives Use Specialty Products, Processes, Procedures
Acknowledge Assistance	Develop Two Solutions, if Possible	Use Independent Audit to Verify predicted Savings.

Source: Book – Value Engineering A How To Manual (Third Edition) by S.S.Iyer New Age International Publishers

Value= Function/Cost

So, you can see, we have made a table, and this table has been made based on the techniques which have been listed out in the book. So, the book is written here, we can see, the source is a book and this is Value Engineering A how to manual 3rd edition by Mister SS Iyer published by new age international publishers.

So, these techniques are available in this book, and you can refer them for further reading. So, these techniques we have tried to classify them into three broad

classifications or three broad categories or three broad classes. So, we have tried to classify them as behavioural based, technical based and function and cost based. So, if you see that these are the three important thing, this is the area which we have already addressed in the last three weeks. We have tried to establish a relationship between function and cost and these two define the value of a product, this is known to all the learners by now.

So, we have already focused on function and cost, now we will see that what are the other techniques or the other areas of concern when we are going to apply the tools and techniques of value engineering. So, let us see, one by one. From behavioural aspect we can see that there are few good rules that we must follow as a value engineer or those we must follow as an engineer when we are applying the technique of value engineering.

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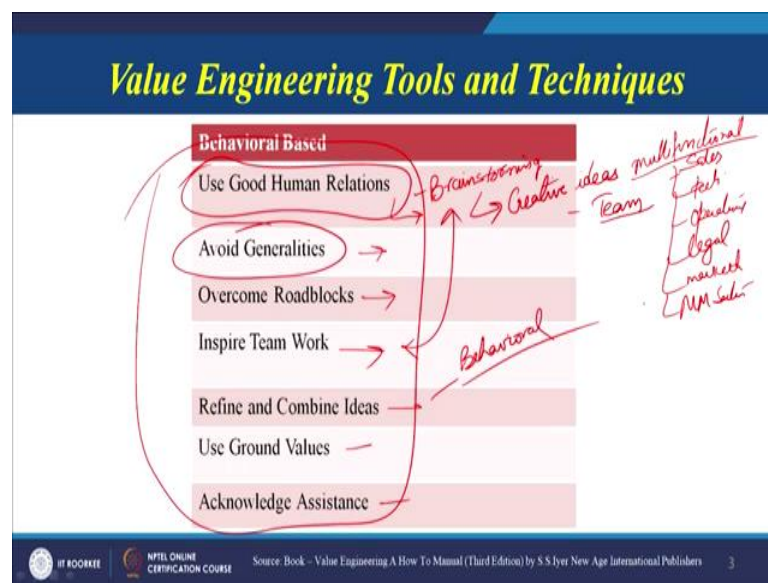
So, behavioral based, let us see the first is, use good human relations. As we have already seen in one of the previous sessions that was session number 14, we have seen a basic technique of brainstorming, and in brainstorming we have seen that what is the outcome, the outcome are the creative ideas or creative solutions to the problems.

So, when we use good human relations we make a good team, and the team is able to come up with innovative and creative ideas. Moreover there are teams which are multifunctional all of you know the meaning of multifunctional. So, we have people

coming from maybe the sales department, from the technical department, from the operations department.

Then, there can be people from the legal cell of the company, there can be people from the marketing team of the company, there can people from the materials management section of the company. So, it is a multi functional team. So, first and foremost is good human relations when we are applying the technique of value engineering and the second is Avoid generalities.

Normally, we have seen one case study earlier also that we have general opinion about certain things. We feel that when a light source has to be used, this is the only light source available. We see if a shirt has to be worn, this is the only colour that I would like. So, those kind of generalities we must avoid and similarly today also, we will try to see a case or an example where a generality can be avoided by proper information. One case study that we have taken was conducting current through steel.

Normally there is the general opinion that who are carrying the current we must use the best conductor of electricity and that is copper, but in the case study it was proved that instead of copper we can sometimes use steel also where, the strength of the current carrying conductor is also equally important. So, in specific cases, we can avoid the generalities and go for specific information and go for alternate materials also. So, that is the second concept that is, avoid generalities

Then overcome the roadblocks, we will have a case study on this also that what are the roadblocks to the successful application of value engineering in our subsequent session. Inspire teamwork which is overlapping with our first thing used good human relations, refine and combine ideas, use the ground values, acknowledge the assistance.

So, all these techniques if we start discussing each one of this in detail, we will not be able to cover all the techniques, but these are the techniques focused on the behavioral aspects and I must share with all of you that some of the techniques may have a overlapping with the technical based techniques also with the function and cost based technique also this is just our understanding of the overall techniques. So, this we have tried to classify into three broad categories.

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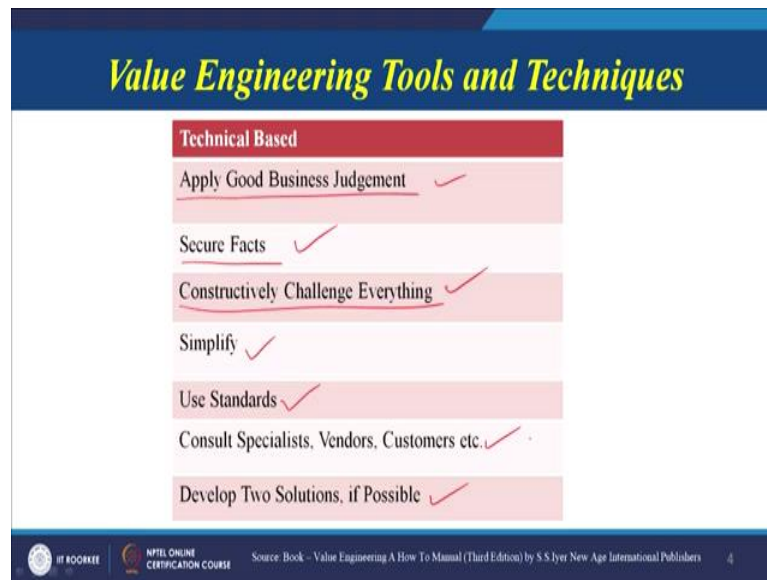
Though the technical based techniques are apply good business judgement, secure the facts and if you remember in all the examples and case studies we have taken till today, in the previous session specially in week number 3. In each and every case we have tried to collect as much possible information as required or as is relevant or available in the public domain.

So, whatever problem we have at hand, we must try to secure as much information as possible because then only, we will be able to develop a better solution than the existing one. So, we have to secure the fact, then constructively challenge everything, we have to be innovative, we have to ask questions like why this is being done in this particular manner only, how it can be improved, who else can do the job, why he or she is only involved in doing this job.

So, constructively we have to find out that what we can improve. So, we can challenge each and everything by the questioning technique and if you go back to the fast diagramming approach, we are questioning why and how and that helps us to find out the reason or the function of each and every component of the product. Then, we must try to simplify the things we must, use standards; standard it tools and equipments standard sizes of parts.

Consult the specialist vendors and customers, develop two solutions if possible, because one of the solution may be discarded at a later stage because of scrutiny on a number of

criteria. So, we must instead of two we can even go for more number of solutions finally, we have to come up with the best solution which can help us to satisfy the function at the minimum possible cost. So, these techniques are technical based.

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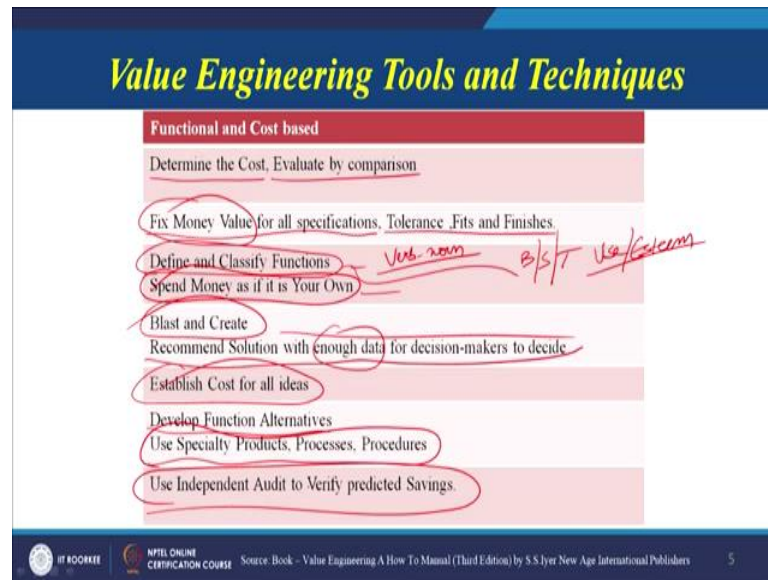
So, the last two are the function and the cost based. So, all of us know that value engineering is focused on functions and costs. So, these are the techniques which are functional and cost based. So, first thing is, determine the cost evaluate by comparison. So, first thing is, we have to determine that what is the cost of the product.

Fix money value for all the specifications such as tolerance, fits and finishes. So, whatever processes, we are going to do on our product, we must try to fix the money value for them because then only, we will be able to find out that whether this particular finishing process of, this particular tight tolerance is adding some functional value to our product or not.

Because; if we have not fixed up the money value for each and every operation that we are doing on our product we will not be able to find out the areas where the improvement can be done. Then define and classify functions, how do we define the functions all of you know by now we define the functions as verb and noun, and we can classify the functions as basic and secondary or tertiary, as well as we can also classify the functions as use function and the esteem function. So, it is also important that we define the

functions and we classify the function. This is the most important close to my heart that spend the company's money as your own money.

Because most of the time when we are taking a decision that it varies and it is a human nature, if I am spending my money my approach maybe slightly different, if I am spending companies money they approached automatically changes. So, therefore, it is a special technique for every value engineer. In fact, I must say for every engineer or I can further journalise it for every employee of an organisation.

Each one of us must try to spend the public money, the government money, the organisations money, the institutes money as we would have spent our own money because there we will do all possible permutation combinations, we will try to explore all possible alternatives where we will try to save some money for our family or in the contrary when we are spending the money for the organisation. We will try to save the money for the organisation by exploring all possible alternatives.

So, this is very important, spend the company's money as you would spend your own money. Then, blast create and refine is another important approach or tool or technique of value engineering we will see that already, we have seen that blast create and refine how it is done. If you remember the functional analysis of a lamp post; a lamp post we have divided the complete, lamppost into the individual components then we have defined the function for each and every component in the form of in the term in the terms of verb and noun.

Then we have classified these functions as primary, secondary and tertiary functions and then, later on, we can further add the cost value to each one of these functions and try to make a understanding or make a compromise between the functions and the cost. So, blast create and refine today also we will try to take one example which we have already taken in one of our previous sessions. Recommend the solution with enough data for decision makers to decide.

So, once we are done with the functional analysis, we have done the functional cost analysis, we have generated a large number of alternatives, we have evaluated the alternatives we have found out one best alternative which is going to solve our problem. So, once we are proposing that alternative, we must come up with all possible data information knowledge that is required for the decision makers to take a decision. One of

the simple information can be that how this particular solution or how this specific solution is better than the existing technology or existing process or existing product or existing material.

So, we have to come up with a comparative assessment of our new idea with the existing idea or the product. So, one thing can be the comparative assessment in terms of cost, other can be comparative assessment in terms of performance, another can be comparative assessment in terms of serviceability, another can be comparative assessment in terms of the weight, another can be comparative assessment in terms of efficiency. So, there can be number of criteria based on which we can compare, what we can compare, the existing solution to the proposed solution.

So, the proposed solution must outweigh in number of criteria the existing solution then only the output of value engineering will be visible, and the management or the higher authorities would be more than happy to accept our solution. So, therefore, recommended solution we must have enough data, enough information, so that the decision makers can take a final decision. Establish cost for all ideas this will be done before we recommend our solution. Develop the function alternatives, use speciality products, processes and procedures, wherever possible.

Because in one of the previous techniques we have seen that we must try to simplify our solution, but wherever the solution demands, wherever the situation demands, wherever there is a specific requirement we should not shy away from using special processes, special products or special procedures. Use independent audit to verify the predicted saving. So, we can even take a third party opinion, the people were not directly involved in the value engineering study.

So, we can take away independent audit to verify that whether, we are really going to get some savings out of this value engineering and ever or not. So, basically we can see that all these are techniques which can help us to solve our issues related to value engineering. So, let us see there are other tools and techniques also.

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So, these tools are and techniques source is coming from the book Techniques of Value Analysis and Engineering by Lawrence D. Mile, second edition, McGraw Hill book company publications. So, this is another source this is our maybe source for these tools and techniques.

So, here also we can see the first technique is avoid the generalities, get all available costs, use information from only the best source, blast create and refine, use real creativity, identify and overcome the road blocks, use industry specialists, to extend specialised knowledge.

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So, there are other techniques such as, get a dollar sign for key tolerances which we have also seen in the previous techniques also that for each tolerance, limits and whatever finish that we are trying to produce on the part, we must have a cost value associated with them. So, whatever are the key tolerances we must related with the cost associated with those tolerances.

Utilize and pay for the vendors skill and knowledge. So, wherever possible we must try to involve our vendors in the decision making process and make use of their skills and knowledge. Utilize the speciality processes. So, in the previous classification also, we have seen that there are speciality, processes, products, procedures and wherever applicable, we must try to use them.

And, on the contrary, wherever, there are industry standards available we must make use of these standards. And the other criterion is that would I spend my money this way? So, this is what we have already seen in the previous techniques also the techniques given by Mister SS Iyer that spend the company's money as you would spend your own money. So, here also Professor Lawrence D Miles also says the same thing, would I spend my money this way. So, once we start questioning or finding a answer to this question obviously, we will be able to save a lot of money for our organisation.

So, therefore, if we apply all these techniques and try to assimilate as many examples, as many case studies indicating each and every technique our thought process will be

developed in such a way that we will be able to independently apply all these techniques in our problem solving approach. And since our course is on product design using value engineering, we will be able to apply all these techniques in our product design approach.

So, whenever, we are trying to design a product, we will see that what is the basic function for which this product is to be designed, and what can be the least or the cost effective manner in which this function can be delivered to the customer. So, that the value of this product to the customer is maximized. So, that is the target, and with that target once we start challenging at the design stage only that why so many components are required to satisfy this independent function or to satisfy this group of functions.

So, once we start correlating the functions with the components, and feel that so many components are not required why cannot be modularize them, why cannot we combine certain functions into a particular component or a part. Obviously, we will be applying all these techniques and these techniques will help us in further refining our product.

So, let us now take some of the key techniques, and try to understand them with the help of examples very quickly we will not going too much detail. So, these techniques if we can memorize and keep, in our memory in our understanding, in our thoughts while we are working obviously, we will be able to find better solutions to the existing problems.

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So, let us take one example which is most common, avoid the generalities which is common in both with which is given in mister LD Miles techniques also as well as in mister SS Iyers techniques also avoid generalities. Now, we must try to avoid the generalities, during the application of value engineering studies. Now, these one example we are taking normally it is believed that it is not practical to build dies for drop forging when quantities are less than 25,000 thousand per order.

So, here we are seeing that drop forging process must not be applied if the orders is less than 25,000. So, this is a general opinion in the industry, this is one generality. Now, according to this case, the generality was it is not practical to make dies for this quantity because parts may vary in complexity, they may vary in kind of material used, but we can see that this general opinion can be challenged. Why because in this fast growing economy technology related to die making machines are upgrading day by day.

Now, we can see that there are advanced tools and techniques for making dies, and once these techniques are being used we can certainly get the dies at reasonable cost, and these dies can be used for drop forging operation. So, this is example which is more related to mechanical engineering, within mechanical engineering also it is related to manufacturing engineering, and within manufacturing engineering also it is related to the farming of the metallic parts.

So, it is a very specific example, but as a general audience or as a learner we can see that there is a general opinion that we must not use drop forging operation less than for less than 25,000 pieces. So, if the pieces are more then only we should go for drop forging operation, but that is not the correct generality or a general opinion in today's scenario.

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So, different ways of heating the metal also developed according to the size and shape of the raw material. So, we can say that there are heating mechanisms also latest which can be there another thing is for die making also latest tools and techniques are available. So, why should we not take an order less than 25,000. So, if prior complete knowledge is available like precisely, what is it that is to be forced.

So, if we know that what is to be forged, what is the kind of heating arrangement that we can use, how much will be the cost of the die, what can be the latest techniques for which can be used for making the die? Another thing can be whether we have a die with is nearly same to the product that we want to make, that with little modification we can use the same die for making a new product.

All that information if we assimilate, if we gather, if we collect it may so happen that we may be able to take a order of less than 25,000 pieces also, and we may like to drop forge that order. Why? Because now; we have collected all possible information which is going to help us to take a decision.

Then, if we have that information then this generality can avoid can be avoided; can be avoided by proper selection of die making machine and the processes. So, this is just one example that we must not journalize the things, we must try to collect as much possible information and then only we should finally, decide that whether we should go ahead or we should avoid this order.

Now, the second point is, get all available cost data and in both the lists of tools and techniques you have seen that we must put a dollar sign on each and every part of the product, on each and every tolerance, on each and every surface finish. So, wherever possible we must try to relate the functions with the cost, the part and equipment with the cost. So, very important sentence meaningful costs bear the same relationship to good value as meaningful test bear to good performance.

Again I will read it for you meaningful cost bear the same relationship to good value. So, meaningful costs and good value; so, meaningful costs have a bearing on the good value as a meaningful test has a bearing on the good performance. So, if we have done a meaningful test on our part, it will ensure good performance. Similarly, if we have understanding of the meaningful cost that are going into our product we will be able to maximize the value or we will be able to provide a good value product to our customer.

But, still it is not uncommon to find that far reaching and important decisions are made without accurate and meaningful costs. So, we will try to include in our presentation a important point which we have missed till now reasons of poor value that, why there are poor value functions in the product? So, therefore, we can see here, in the second point also that many important decisions are taken without an accurate understanding of the meaningful cost of the product.

So, this is very important and for this we must get all possible information related to the cost that what are the costs or the cost components involved in our product. Right from the material to processing to finishing to packaging to selling it in the market or the logistics cost all possible cost components of the product must be known to the designer. So, meaningful cost data is vital, because cost is influenced by every decision on every part component or sub component of a product which I have already highlighted.

So, value of product will be secured only when meaningful cost is a criterion in each decision otherwise, it will not be achieved in the product. So, already we know that value is proportional to the cost although it is inversely proportional, but value of a product will be secured only if we have data related to the meaningful cost.

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Then, use information only from the best source, this is another, we can say tool and technique. So, we have seen two techniques by now avoid the generalities that was one, the second one was as you can see in the previous slide get, all the available cost. So, third one is, use information from only the best source. Lack of full information and use of misconception are frequently the cause of poor degree of value.

So, sometimes as we have seen that in the avoid generalities also, we do not have the complete information about the product to be drop forged, we are just taking a decision based on the general opinion that we should not drop forge a product why because the

quantities will not justify that cost of the die. 25,000 or more parts per order must be there if we want to justify the cost of the die.

So, this is a general opinion once, we collect all possible information, we will like to change our decision, we will like to use the process for a lesser number of components also which may be some significant less than 25,000. So, here also use information from only the best source. Now, we can see lack of full information leads to poor value in our product.

So, this is a case study already we have done this case study in one of our previous sessions, quickly I will read it for you; conducting the electric current through steel. The certain parts of control device are generally made by costly non ferrous materials which could be very economically made from ferrous materials.

So, this is something, which is being done. The designer of the control device replied that it is a poor practice to conduct electric current through steel, this is general opinion or a prejudice or a misconception that it is poor practice to conduct the electric current through steel.

The value engineer on the other end questioned, the designer on the basis of numerous applications of steel used as a material for electric current, and further suggested that it is not the first time the current is passing through the ferrous material that is steel by giving the example of the truck rails of an electric railway system. So, very simply we can put it in two sentences, the designer is of this opinion that only copper must be used for conducting the current. The value engineer is of the opinion that there is precedence that steel can also be used for conducting the current. So, here, there is a conflict between the two.

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Now, the designers were using copper based materials for easy conducting jobs which is a general conception, but, where such materials will not perform, they were using steel, which means that steel can also be used for conducting jobs or electrical conduction purposes. It means that for high temperature condition jobs, steel is preferred. So, wherever high temperature jobs are there, steel is our material of choice.

So, we can see here that all possible information when it is available with us then the value engineer has this information that steel can also be used for conducting the current, he can use that judgement or use that information for helping the designer in taking a right call for the selection of the materials.
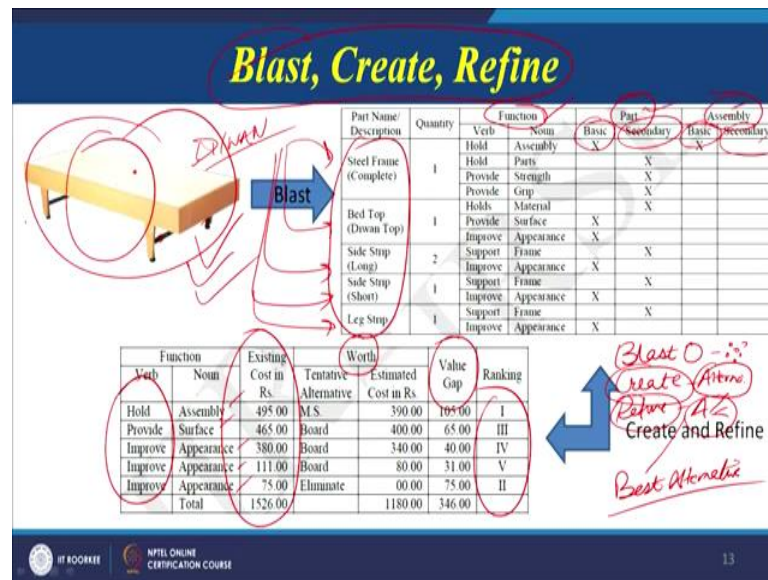
Then, the third approach, the fourth approach, sorry three we have already seen, the blast create and refine, and this case study also we have already done of the divan, I am again taking the similar examples which we have already done. So, that we relate them with the techniques, and these techniques are ingrained, these are maybe put forth into your thought process.

So, that whenever a product comes to you or whenever you see a product; obviously, some ideas or some tinkling is there that there can be some improvement in the product that we are using that is the sole purpose of this very small course of 10 hour duration. That whenever we try to look at a product we must look at the product from this perspective also that, how the function can be achieved.

So, here, we can see in blast create and refine, we blast the complete product, this is a divan. So, we divide it into its individual components. So, this, we can say is the blasting approach we are blasting it into 5 or 6 different components and then we are trying to write the functional definition, then, we are classifying the functions as basic and secondary function.

So, we can see here that we are doing the functional analysis for this part and then, there is a existing cost structure, and then we are finding the value gap and ranking the alternatives. So, these are the assembly surface appearance. So, these are the functions which one we want to achieve.

So, in most important here is blast create and refine. So, in blast what we are doing ? We are dividing the product into the individual components. Then, in create as the word suggest, we are trying to look for the alternatives which can solve the same purpose and in refine, we are putting these alternatives, we are subjecting these alternatives to different criteria and the criteria can be rigidity in this case another criteria can be lightweight in case of a divan, the another criteria can be a long life cycle cost of the divan.

So, we can create certain alternatives and if you remember what were the alternatives here we can change the thickness of the board, we can change the gauge of the pipe that we are using for the structure or for the frame.

So, we can change the gauge of the pipe, we can change the thickness of the board, these are the alternatives available with us which are result of the creation or the creativity face and when we refine these alternatives, we try to evaluate these alternatives against a set of criteria which I have already mentioned rigidity, weight reduction, performance. Then, we refine our alternatives and finally, we get one best alternative, which one will be the best alternative which is satisfying the functional requirement of the divan. Functional requirement is satisfied, performance is not compromised and we are able to provide a cost effective solution to this product.

So, in blast create and refine, it is one of the most important techniques which is applied in the field of value engineering. So, we try to divide the complex product into the individual components, define from functionally, classify the functions of each component as primary and secondary function, put a dollar sign on each component, find out the cost for each component, and then, try to create better alternatives, better solutions to the product. And then evaluate the solutions based on certain set of criteria, and once you find the best solution refine it and then implement it. So, that is the basic approach of blast, create and refine.

So, with this we come to the end of today's session, we will try to see some more techniques in our subsequent session, and try to relate these techniques with certain examples. So, that by the end of this course, you remember these techniques for a long duration of time may be these techniques get ingrained into your thought process that

whenever you are trying to solve even a domestic problem you try to apply these techniques and come up with better solutions.

Thank you.