Product Design and Development

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Lecture – 07
Problem Identification and VEJP

Friends welcome to this lecture 7 on the course product design and development, we are currently in our week second or week 2. In week 1 we have cover the fundamental aspects of product design and development and week 2 we are focusing our attention on the basic as well as the applied aspects of value engineering. If you remember in lecture number 1 on value engineering, we have seen yesterday the brief historical over view of the concept of value engineering, the applications of value engineering in different fields we have seen it can be applied across diverse fields of engineering as well as diverse fields of service industry.

We have also seen what are the basic issues in which value engineering can help us and we have try to understand it with the help of certain examples that I have given regarding the functions of the product, because value engineering is related to the functions of the product and it relates the functions of the product to the cost of the product. And we have seen the definitions and the basic underlining definition or the fundamental definition is to achieve the desired function reliably at the minimum possible cost, without compromising the quality performance or efficiency of the product. Now today our focus will be on problem identification and value engineering job plan, it is written here VEJP value engineering job plan.

So, problem identification and value engineering job plan is our focus of attention today, in this lecture second or lecture number 2 on the concept of value engineering. Now let us see that how problem identification can be done. So, you can see there are 5 W's which are well known in engineering that is who? What? When? Where and why?

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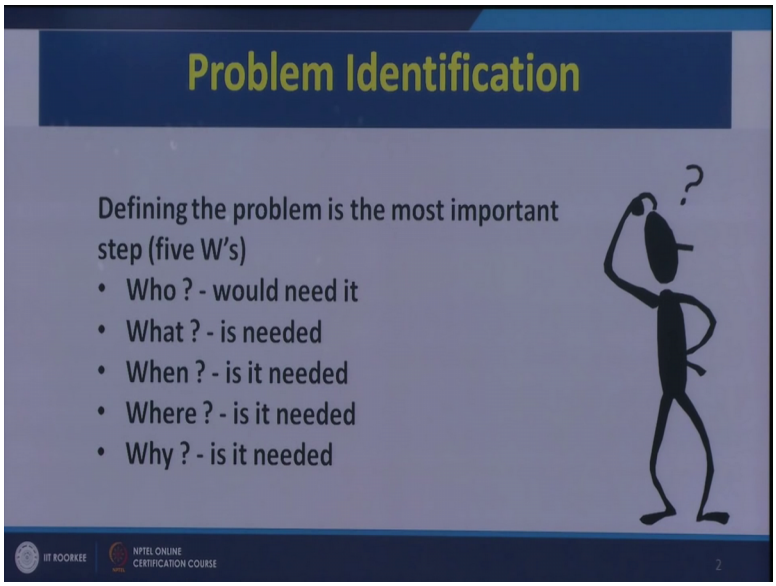

So, for any value engineering problem also we have to find answers to all these questions that is, who means it is customer focus would need it, we need to understand that if we are going to do a value engineering study who are going to be the beneficiaries, who are the stakeholders and what benefits this study is going to accrue or what benefits this is going to give or pass onto the people who are involved in this process.

For example if we are doing a value engineering analysis on the steering wheel of a automobile, who are going to be the beneficiaries? The beneficiaries are going to be the drivers who are going to drive that steering wheel. So, first point that we need to identify or in defining the problem is who are going to be the beneficiaries of the value engineering study or on the other hand we can say that who are the people or the customers who are having some problem or a need or a requirement which has not been met by any of the existing products.

So, it is kind of focus on the customer that customers may give us a feedback or a value engineer may take feedback from the customers or the probable customers regarding their needs and requirements and then finally, work on the basic concept of achieving the functions which are desirable or which are given as a requirement by the customer and then he can use the concepts of functional analysis to come up with the tangible product.

So, first is who? Who would need and that is the most important point, then what is needed? That also I have explained I think briefly that the customer will specify his basic

requirements he has no knowledge of engineering a customer may tell that I need a mobile phone which can do this thing also or which can do a particular task for him.

Now, for example, a customer says I need a mobile phone which can calculate how many steps I have taken in the whole day when the mobile phone was in my pocket, the customer does not know anything regarding the sensors, but he has put his requirement to the product designer or to the company or to the marketing professional. Now it is for the professional or the engineer or the product designer to see that how technology can help this to meet this specific requirement of the customer. So, first thing is who is the customer, second is what is needed that is what is the function that has to be a accomplished or what is the requirement that has to be met.

Then it is when? When is it needed may be there can be a time spend, time domain which can be satisfied in may not be that important in break through innovations because in break through innovations you may take your own time, but the product will be a breakthrough in the field of science and engineering. So, when are important in case of may be incremental innovations where you are modifying the product slightly to suit to the customers requirement. So, you have a 3 things who needs, whose the customer, whose the beneficiary, what does he need, when does he need it and the next is where it is needed means, there can be as explanation regarding the where means, sometimes the product may be required in a particular region only.

For example, if we are talking of something kind of a snow jacket or a snow wear it would be required in the areas where there is lot of snow. So, where or the location domain is also important when you are thinking of identifying a problem for value engineering and why it is needed may be this is again clarifying the scope of the problem that why this particular product or why this particular study value engineering study is required or why a particular product requires the analysis using the value engineering approach.

So, these are 5 W’s which we will help us to formulate our problem that why do we need to analyze this product or why do we need to use the concepts of value engineering in product analysis. So, that is, this is a common strategy for looking for problems many times we also think of alternatives for example, we have a product at hand suppose I again take the example of this pointer. So, we have this product at hand we can many

times question that why is the shape is like this, why the size is like this, why only black color or many times from value engineering point of view we can even go to the extent of saying why do we need this pointer? Cannot we have any other option for pointing at the screen or what can be the other options which can be useful for pointing at the screen for example, there can be motion sensors in the our led display and if I move my hand the pointer should automatically move there can that type of technology be developed.

So, all those questions or all these questioning technique will help us to identify the problems and to modify the designs, which is the basic concept of value engineering approach. So, problem identification you can see can be done with the help of questioning technique and we will see during this 2 and a half hour of discussion on value engineering we will see a technique called fast technique, in which how and why type of questions will help us to solve our problem.

So, the questioning technique is a very very important well established technique for finding out the problems for which the solutions can be provided. Now, what are the steps in defining a problem now I have told we can go for a questioning technique, we will learn some of the techniques this fast technique may be in the subsequent lectures.

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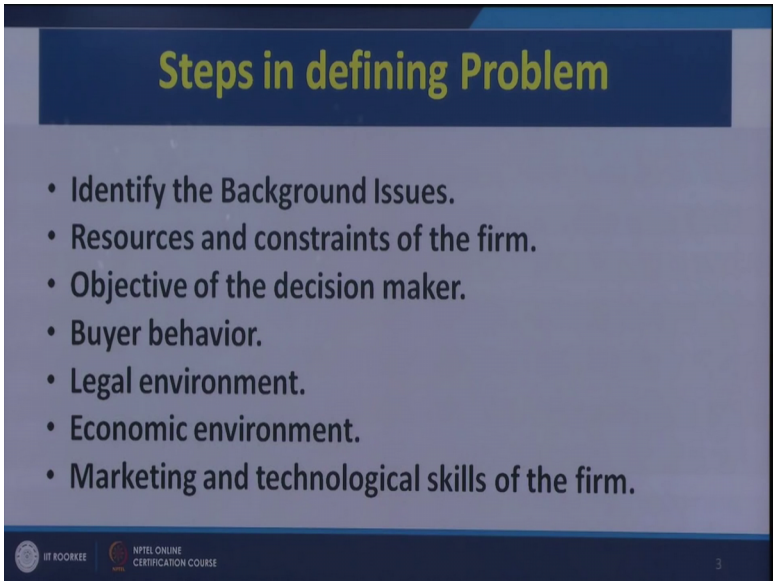

Now, steps in defining a problem, very very standard method there is nothing new in these steps, number one is identify the background, issues number 2 resources and constraints of the firm as we have if you remember in product design and development

week one we have seen one type of analysis which was sought strength weaknesses opportunities and threats. So, here we can see resources and constraints of the firm that is resources may be, if they are adequate in number can be the strength of the organization, if there can be certain constraints for the organization. So, all these opportunities, threats, strengths, weaknesses have to be taken care during that if definition of a problem, objective of the decision maker may be that is also equally important. Buyer behavior, customer behavior, legal are we infringing into anybody's domain, are we violating any copyright issues or are we challenging somebody's IPR.

So, all those things are also important while defining the problem that is the legal environment also taken care of economic environment also, what is the market segment we are targeting, who are going to be the probable customers of that technology that we are going to develop or that we are going to change using the concepts of value engineering. So, consumers also the economic environment also has to be taken care of, what is the target segment of customers that we are targeting and marketing and technological skills of the firm which can also come in the resources also the technological skills can be considered as a human resource. So, that is also equally important.

So, when we are defining a problem answers to all these queries or questions or points or factors or characteristics have to be given, then you can define your problem. So, in value engineering the definition of the problem has to be very very crisp, it has to be too the point and it should incorporate all these factors that which are listed on the screen in order to solve the problem successfully. Many a times it happens that we ignore 2 or 3 parameters or factors and later on when we come up with the solution there are legal complications associated with the solution, there are environmental complications associated with the solution.

So, it is always advisable that when we are designing a new product we should focus our attention on all the possible complications that can come when we come up with the final solution and therefore, the concept of project teams has evolved over a period of time in which there are experts from different dimensions of engineering science technology legal, marketing professionals, management. So, you have a group of team a plethora of experts who work as a project team to find a solution to a given problem. So, therefore,

all these factors have to be taken into account when we are identifying a problem to be solved using the concepts of value engineering.

There are other tools also maybe 2 or 3 mathematical formulations also which help us to identify that which product should we value analyzed and in the course of our discussion we will come to those specific formula or specific methods also for finding out a problem to be value analyzed. But here these are the general steps which should be taken into account not only for any problem which is specific to value engineering, but also to the problem of product design in totality. So, that also has to be taken care of I think in the product development process in week one I have addressed that all these parameters should be taken care of when we are evaluating the various ideas which we want to be converted into the feasible products or the tangible products.

Now, coming on to the second part of our discussion today that is value engineering job plan you can see on your screen there are the list of various steps that you have to follow in order to successfully solve any problem or in order to successfully implement. the concept of value engineering for any problem it may be it is redesigning of existing product or it is a new building that is coming up you are constructing a new building. So, if you want to apply the concept of value engineering these are the various steps that you have to follow systematically in order to solve the problem or in order to find the solution here in order to come up with a solution.

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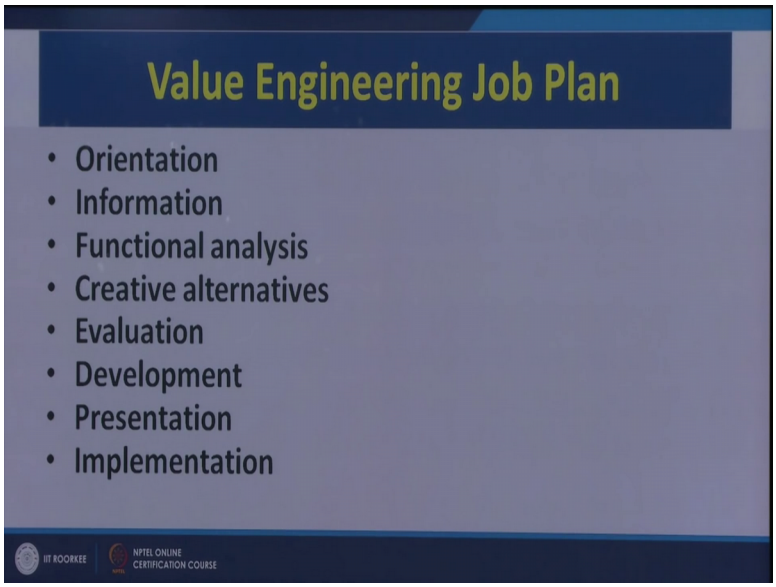

So, first is I will just read all these points for you, first one is orientation, second is information, functional analysis, creative alternatives, evaluation, development, presentation and implementation.

So, let us take a very simple example first is orientation, whenever we join an engineering institute or any new company after completing our studies first thing that we are you can say exposed to is orientation that is we are taught about the principles, the culture, the working ethics of that particular organization where we have joined. So, orientation in case of value engineering job plan is also may be training or kind of a customization of group of individuals with the problem. So, first orientation we will let us see what we have on the slide.

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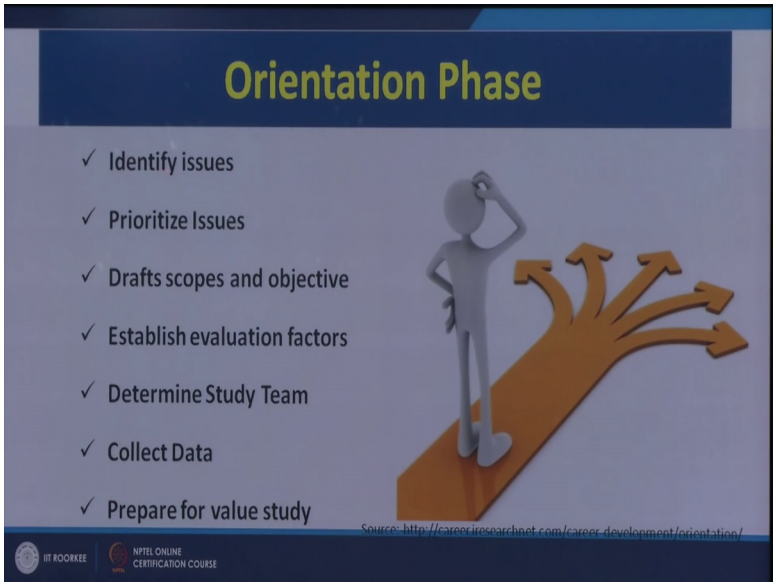

In orientation phase the value engineering team will identify the issues prioritize the issues you can see identify the issues, prioritize the issues then they will draft scopes and objectives draft scopes and objectives establish evaluation factors, determine study team, collect data prepare for value study. So, I have read this all for you. So, if you see first is as we have already seen in the previous slides problem identification. So, identification we have to do and problem definition we have to come up with.

For example one of the definitions can be to improve the fuel efficiency of a petrol four-stroke petrol engine this can be a problem definition that we are focusing our efforts towards improving the fuel efficiency of a four-stroke petrol engine what will be the

bottom line the bottom line is without compromising with the performance as well as the cost of the product. So, it may so happen that the cost may increase initially when the efficiency is increasing, but the value of the overall product is increasing why because the efficiency is increasing, it to be the fuel consumption will go down and your cost even if it remains same the lifecycle cost of this of this engine will be better as compared to the existing one.

So, the definition has to be very very crisp. You can look around you, so many products are there so many issues or problems are existing you can give a very crisp one line definition of the problem. So, in orientation phase our target is to identify the issue and give a problem definition that what we are going to achieve.

Then prioritize the issue scopes and objectives means we have to come up with the problem definition will be one line definition only for example, a bachelors project or a Master's thesis or a PhD thesis what is done you define a problem and then you give the objectives. That in order to solve this problem these are the objectives that will be satisfied or met or experimentally proved then only the overall problem definition will be solved, overall problem definition will be achieved. So, you can see scopes and objectives are equally important then establish the evaluation factors in the example that I have given what is the evaluation factor evaluation factor is the efficiency.

How you will improve the efficiency you may be working with if you have a mechanical engineering background you will be able to appreciate it better you may be working with the firing order you may be working with the changing changes in that design may be material of the piston or the piston rings, so many changes you would incorporate, but what is the overall evaluation factor after doing all these changes what should improve efficiency fuel efficiency should improve. So, your evaluation factor or compare comparable factor or you can say comparison factor is efficiency, but making some changes in the design of the engine you will see; what is the effect on the fuel efficiency of the engine.

So, that is what you have to determine that after solving this problem or after redesigning the product what is going to be your evaluation factor. So, evaluation factors can be the weight for example, you want to reduce the weight of the aircraft and you use alternate

materials for that what will believe I evaluation factor that initially the aircraft the weight was maybe whatever number of tons x tons.

Now, after we can say changing the material what is the weight of the aircraft x minus delta x. So, it means delta x weight has been saved because of the change in the material. So, what is your evaluation factor here? Yes, it is weight. So, it can be weight it can be time saved it can be cost saved, it can be efficiency improvement, it can be reliability improvement, it can be ease of service, it can be ease of maintainability. So, anything can be your evaluation factor, but it has to be identified in the very beginning of the problem solving because you should know that what is your final target.

So, you have to establish the evaluation criteria or the evaluation factors then you have to go for determining the study team. So, the HR part is also being played here you need to identify that who are going to be the team members in your orientation phase only. So, that the team effort leads to the success of the project. Then fundamental data or basic data is collected about the problem and then we are ready with the basic our team is ready, the basic data is ready with us, we know the problem, we have defined the problem, we have set the objectives for the problem solving, we have identified the evaluation factor base or the comparison factor. So, we are now ready to solve our problem.

So, our orientation phase is now over next phase is the information phase now you know what you want to do, but now you have to do maybe kind of a literature review or a literature survey or the state of the art investigation you have to do, you have to find out that what all the technologies or what is the information that is available with you or what is the existing knowledge that is already available and what we need to do to further enhance this knowledge in order to bring it to a solution level for the problem that we have identified.

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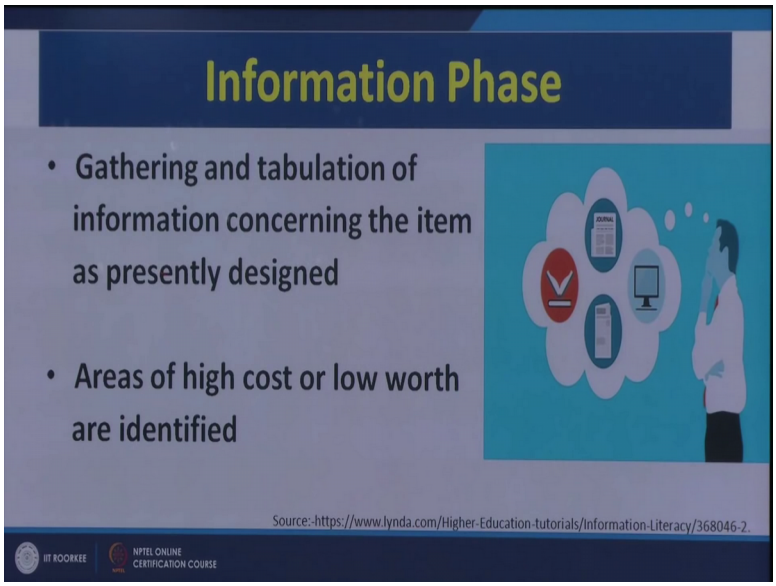

So, you can see, gathering and tabulation of the information concerning the item as presently designed areas of high cost or low worth are identified. Now whatever is the existing product suppose you are doing value analysis it means the product is already existing. I have told in the last class the difference between value engineering value analysis and value management now suppose you are doing value analysis in value analysis you have need to gather all the information, you need to tabulate that information concerning the item.

So, as for the present design of the product you have to tabulate each and every data you have to tabulate all the information. We will see how to tabulate this information how to break down the complete product into its individual components, how to give the basic definition that is a verb and a noun definition for each and every component, how to relate it to cost that we are going to cover in our subsequent lectures.

So, for any product that you are going to value analyzed you need to gather all the fundamental basic information which is already available based on that only you will propose use your creative juices, you will use your innovative band of mind to come up with solutions which are better than the existing design. But that is only possible if you have all the information related to the existing design of the product and that is essential part of the information phase where you may use standard templates for recording down the information related to the existing design of the product.

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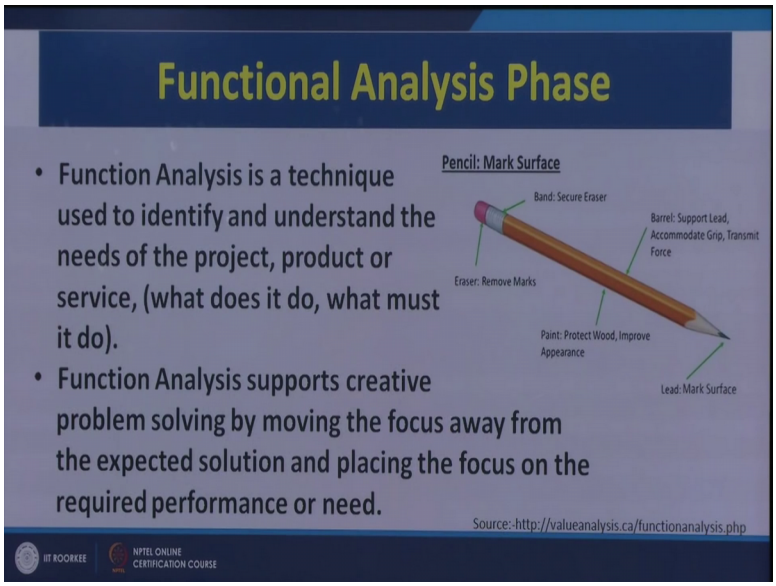

Then is a functional analysis phase in which we will see on this screen you can see there is a pencil which is shown just as an example in functional analysis we will see what is the function of this lead, what is the function of wood, what is the function of the barrel, what is the function of the band this metallic band, what is the function of this pink color eraser. So, we will see in functional analysis it is a technique used to identify and understand the needs of the project product or service what does it do, what must it do.

So, we will see in the next lecture the complete discussion on the functional analysis aspect of the various products and we will break down the product into its individual component and see how functional analysis is done. But functional analysis is the most important part of any value engineering analysis or value engineering study. So, this is we have to see for any product that we are solved with any product that we are analyzing using concepts of value engineering that what function that product has been designed for and we need to see that how that function can be achieved without the existing design and what can be the other forms or other designs or other materials or other processes which can help us to achieve that function. For example, here pencil is used for making marks on a piece of paper.

Now we can see what can be the other alternatives for doing this, but at a relatively lower cost has compare to this pencil and then we will see how much contribution this lead is making in the overall cost of the pencil so that we can focus on certain areas

which will help us to reduce the overall cost without compromising the performance of this particular this simple product which every one of us makes use of.

Functional analysis supports creative problem solving as you know that we have to find out the alternatives which can provide us the same function, but at a relatively better cost effective manner. So, functional analysis supports creative problem solving by moving the focus away from the expected solution and placing the focus on the required performance or need. So, our focus is not on the existing design this pencil existing design everybody knows that now as a value engineer my focus is on the function that is required that is to assist somebody in making marks on a piece of paper and how this function can be achieved. So, in value engineering our focus is not on the existing design our focus is on establishment of a mechanism to achieve their function which is the performance or the requirement of that product.

For example the camera that is recording this complete discussion basic function is to record information whatever I am speaking it has to record the audio it has to record the picture. Now when we value analyze our focus should not be on this camera design our focus should be on the technology which can capture my audio and video maybe without even this camera being placed in front of me. So, that kind of technologies our thought is solution oriented not the product oriented, it is function oriented not the existing product oriented. So, how that function can be achieved by using alternate arrangements that is the focus because it has been proved that if you go for alternatives you save lot of money.

In yesterdays class we have seen that ld miles from where value engineering started he came up with a systematic approach of problem solving where the new solutions, the new designs, the alternate materials the alternate processes, yielded better products as compared to the existing products. So, it is always advisable that we look for alternatives and functional analysis is the most important stage of value engineering job plan and therefore, I have spent a little more extra time on the functional analysis. So, on this we will have a further discussion on the types of functions and the different you can say examples of the functional analysis maybe in the next class. So, let us first complete today the systematic approach of problem solving that is the value engineering job plan.

Next is the creative alternatives that is once you know that what is the functional requirement the next stage is that we have to look up for the alternatives.

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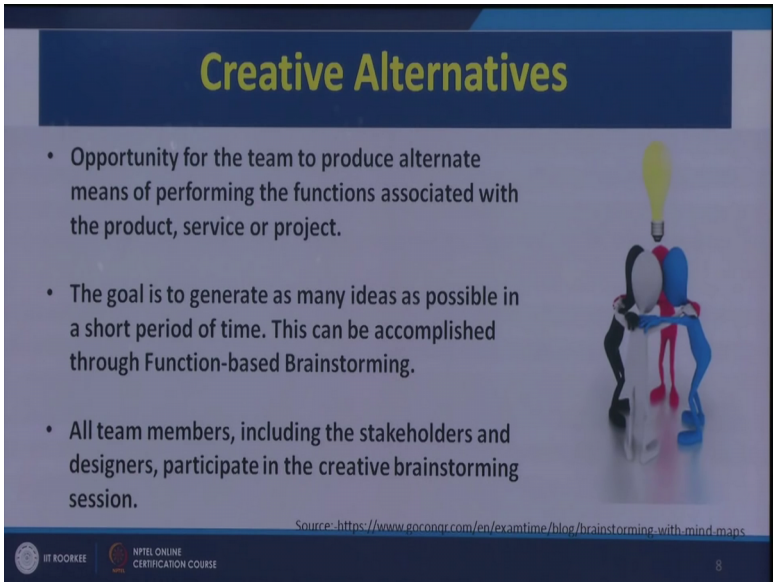

Now what are the alternatives available let us see. The opportunity for the team to produce alternate means of performing the functions associated the product service or project.

So, here during this stage that project team or the value engineering team has to look up for the various alternatives for solving the desired function. The desired function has been listed already in the previous phase that was the functional analysis phase. So, here we have to look for alternatives. The goal is to generate as many ideas as possible in the shortest possible time this can be accomplished through function based brainstorming, everybody may have heard the term brainstorming, but here our focus during creative phase is function based brainstorming our only target is our birds eye is function based.

We have to see that how the desired function can be achieved or what are the alternatives possible to achieve the desired function keeping the cost also at the back of our mind. So, all team members including the stakeholders and designers participate in the creative brainstorming session. So, there can be number of brainstorming sessions to find out the alternatives for solving that desired function.

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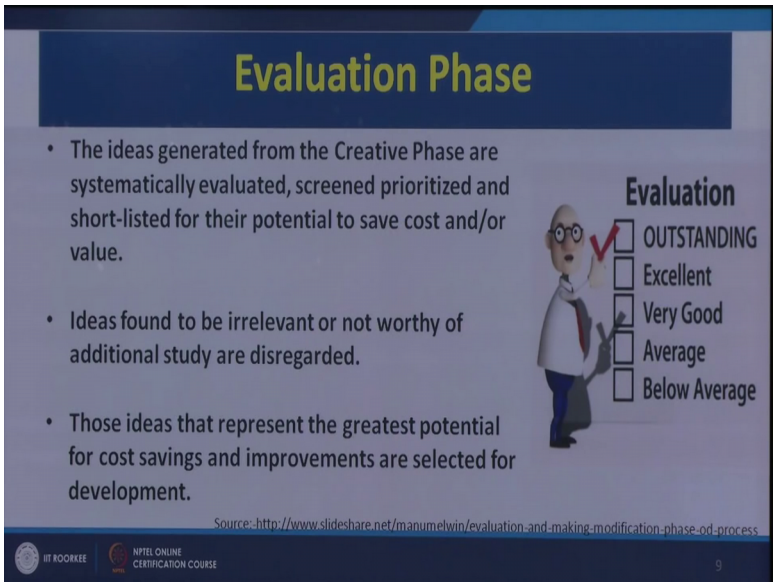

Then we go once we have 3 or 4 or 5 alternatives available we will go to the evaluation phase in which the ideas generated from the creative phase are systematically evaluated screened prioritized and shortlisted for their potential to save cost and or value. I have already told that the ideas are such that they may not be saving the cost in all the cases in many cases the cost may increase, but the overall value of the product should increase. So, we will maybe screen the ideas evaluate the ideas and see that how much money can be saved or how much value can be added to the product. Idea is found to be irrelevant or not worthy of additional study are disregarded.

Since this is the evaluation phase ideas which are not worthy of further investigation will be discarded. Those ideas that represent the greatest potential for cost savings and improvements are selected for further development.

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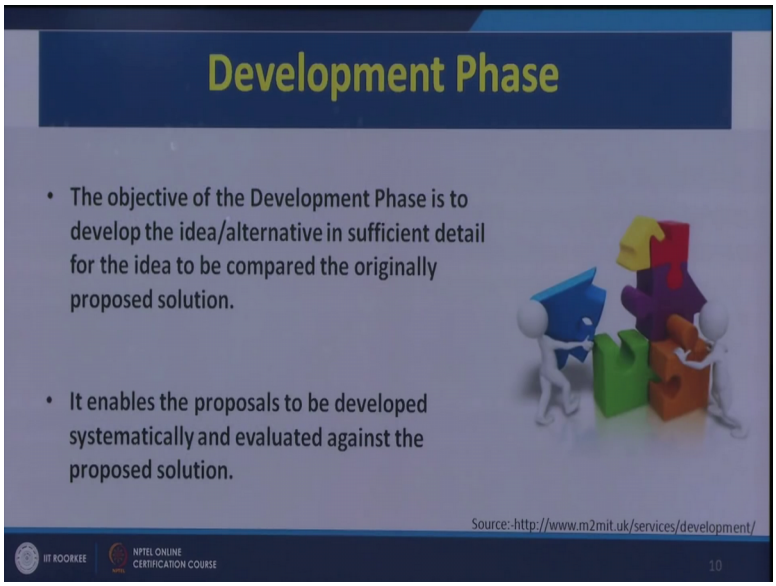

Then is the development phase the objective of the development phase is to develop the idea in sufficient detail for the idea to be compared to the originally proposed solution. Then it enables the proposals to be developed systematically and evaluated against the proposed solution.

So, there may be a solution already existing. So, our new solution will be compared with the existing solution and in many cases we may not be having a solution at the first hand. So, our value engineering solution can be the only solution for that existing problem. So, you will develop our idea, then it is the presentation phase where the teams opportunity to present the proposals is a better way than the originally proposed solution it you compare the new solution with the old solution and then a presentation is made comparing the cost and comparing the technical you can say comparison preparing the economic comparison and all those present things can be presented.

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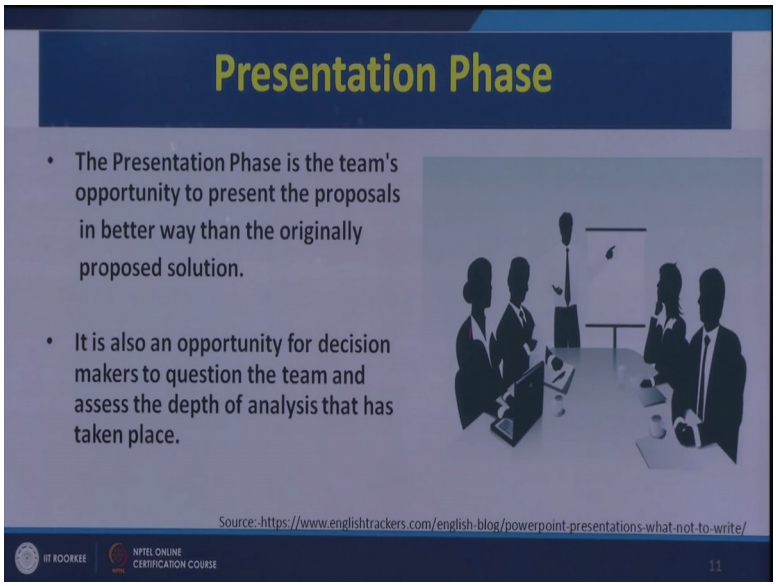

It is also an opportunity for decision makers to question the team and assess the depth of analysis that has taken place. So, maybe at presentation stage also further discussion can take place to improve the, you can say solution further using some expertise available with the expert team.

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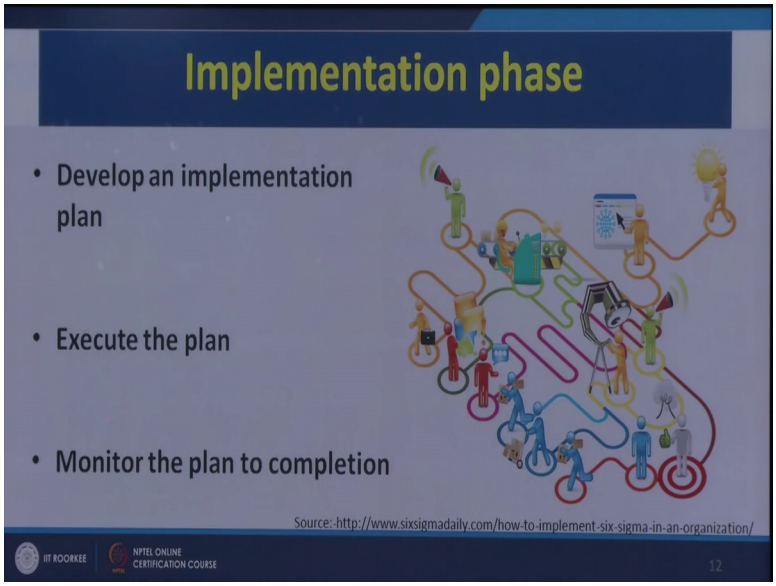

Then last is the implementation phase we develop an implementation plan that how it will be implemented in the organization execute the plan and monitor the plan to completion. So, systematically right from orientation then to may be problem definition

and then may be to evaluation genera sorry, create creative phase evaluation phase and then finally, the implementation phase there are 6 or 7 phases in which systematically if we move we are able to solve the problem.

So, in value engineering job plan if we go by step by step by step we will be able to solve the problem. So, I think this is all regarding the discussion today. So, today we have seen 2 important aspects of value engineering which are common. Second part value engineering job plan has some additional steps which are not covered in the normal product design process there those are the functional analysis phase and the creative phase.

So, if you see the major focus is on identifying the function of the product and providing 3 or 4 creative ideas to satisfy that function and other thing evaluation of the ideas and maybe selection of the ideas can be based on the standard approaches, but the important point is identification of the function and providing a creative solution to satisfy that function keeping in mind the cost of the product in mind. So, over all we can say that we know that how we have to solve any problem systematically using the value engineering job plan.

So, with this I will stop the discussion today tomorrow we will start the discussion with the basic concept of the functions and the functional analysis. We will see at least 2 or 3 examples in which a simple product has been analyzed using the functional analysis technique and it has been divided sorry into individual components and then for each component we have listed the basic functions as well as the secondary functions.

So, with this we come to the end of lecture number 2 on in week 2 and overall it is lecture number 7 on the course on product design and development.

Thank you.