

Operations Management
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Lecture – 07
Value Engineering Concepts

[FL] friends; so currently we are discussing week 2 that is focused on product design and development. If you remember in our first session in week 2 that is on product design and development, we discussed the product life cycle. And in product life cycle if you remember we have seen what are the various phases of the product life cycle. We have seen starting from product development to introduction or launch of the product into the market then growth maturity and finally, the decline. If you see that the product goes through or the sales of the product go through a particular cycle and that cycle we call as the product life cycle and we have seen that for each and every stage there are certain decisions that have to be taken.

So, as a learner it is not important that we are able to draw a product life cycle and we mark the various faces that first is the introduction then the growth stage then maturity and finally, the decline. Most of the students understand the product life cycle from that point of view only that is from the examination point of view. But as a good learner we should try to understand that if we see a product life cycle of a particular product or a related product in the last class I think I have not addressed this point that how we will construct the product life cycle.

So, based on a similar type of product or based on forecasting or based on the diffusion curve we are having basic information that how similar products have behaved in the market or how the sales of the products have varied or similar products have varied or competitive products have varied over a period of time. So, from that we get an idea that how the product sales are going to behave over a period of time. So, as a good learner our focus must be to understand that what type of decisions can be made by engineers or managers for the success of an organisation based on the product life cycle. So, it is not only the information or the knowledge that we gain that what is a product life cycle, but we should try to understand that how we can use this product life cycle for decision making during our job or during and for ensuring success of an organisation. So, during

our job profile we have to deduce the information and knowledge from the product life cycle and use that knowledge for making judicious intelligent decisions for ensuring the success of an organisation.

Now, today we are moving slightly further in ensuring a particular word that is value engineering that we have information related to value engineering also, why it is important, we have seen in the previous session that new product design or innovative product design or creative product design is very very important. Currently we are focusing on that what the organisation must produce in order to be successful. We have seen in the first week the fundamentals of operations management and now we are trying to understand that what the company must produce.

Then we will see may be in the next week how much the company must be produce that is the sales forecasting or the demand forecasting now when we try to address what the company must produce we have to answer a very pertinent question that is what should be our product design what factors we should keep in product design when we are designing a product. We have recorded a complete it was run successfully a course on product design and development where we have addressed all these points in much more detail. But in this course on operations management our focus is to align our students or learners in a direction in which they are introduced the specific tools that are used for product design or the tools that help us in making a successful product design. Value engineering is one such tool which must be used during the product design process in order to ensure the success of the product.

Now, what is value engineering, what are the historical perspectives of value engineering and sorry what are the advantages of value engineering that we are going to cover in today's session.

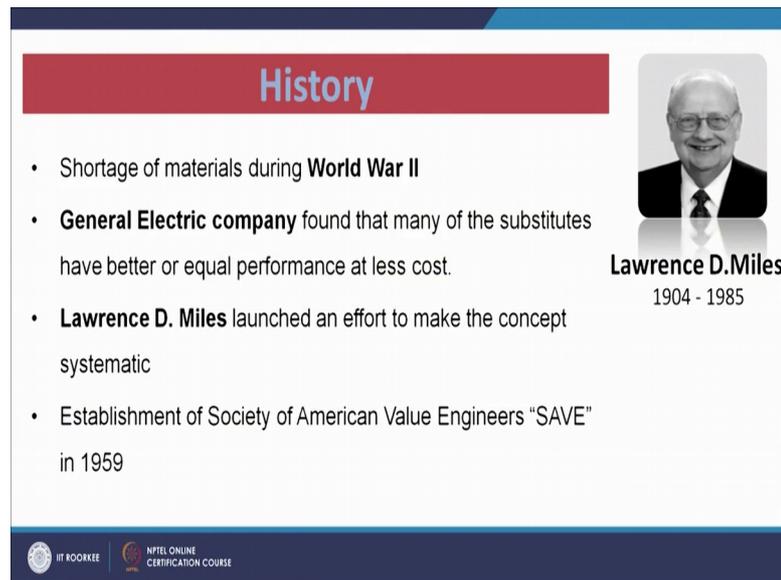
I must, maybe I am compelled to make this point that value engineering is a complete course which can be taught as a 35 or a 40 lecture course in any UG curriculum, but here we are trying to understand only the fundamentals behind value engineering because what I see in most of the UG curriculum value engineering is not taught as a subject. So, the learners must have an idea about this wonderful concept which helps or which has helped over the years number of engineers and product designers to make successful products. So, we will try to understand that what basically value engineering is.

And we have seen that initially in the product life cycle during the growth stage the cost of the product is high. At the maturity stage when the state sales get stagnant at that time the company has to focus on competition and competition has to be ensured with cost efficiency. If you remember in the previous session we have used this word cost efficiency in the product life cycle now that cost efficiency is very very important we have to ensure that our product is cost efficient, our product is competitive price wise the selling price of our product is competitive as compared to the price of the competitors products. So, that cost efficiency is achieved using the concept of value engineering.

Now, value engineering can be applied at various stages of product design as well as manufacturing. We can apply value engineering just at the start of conceptualization of a product, we can apply the principles of value engineering during the manufacturing stage also, we can apply the principles of value engineering during the marketing stage or during the logistics management of the product when the product is travelling from warehouse to the retail market. So, this are to the universal concepts and can be applied at various stages of the product development cycle.

So, we will try to understand what basically value engineering is and I have already recorded few lectures on value engineering which are already available on YouTube for details on value engineering you can refer to those lectures also which are freely available on YouTube. But today we will only try to introduce the concept of value engineering that what value engineering actually is. So, let us start our discussion with the very basic essence of value engineering trying to understand the historical perspective of value engineering now on your screen you see the historical perspective of value engineering.

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History

- Shortage of materials during **World War II**
- **General Electric company** found that many of the substitutes have better or equal performance at less cost.
- **Lawrence D. Miles** launched an effort to make the concept systematic
- Establishment of Society of American Value Engineers "SAVE" in 1959

Lawrence D. Miles
1904 - 1985

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So, basically during the world war two there was shortage of materials shortage of materials in terms of repair maintenance of the army equipment or the defence equipment. So, the general electric company found that many of the substitutes have better or equal performance at less cost.

Now, first thing the one word that we have to focus till now is the substitutes. There was shortage of material during the war there is damage their defence equipment gets damaged because of one reason or the other reason. You have to substitute it with different equipment. For example, we are using a car one of the component or a part gets damaged what do we do we get another part and replace the old part, but here those materials were not available that designs were not available then what was done. Substitutes were found out, substitutes in terms of materials, substitutes in terms of design changes, substitutes in terms of the manufacturing processes that were used for making these parts or components and finally, it was found out that they are equal in performance, but their cost is less.

So, you can see that when substitutes are used with less cost at same performance everybody would be more than happy to adopt the substitutes, why because substitutes are giving a similar performance, but at a relatively less cost. And with this background this concept of value engineering was developed further and finally, it became a completely new subject which is now taught in many engineering institutes as well as

management institutes. So, Lawrence D Miles, L D Miles most more popularly known as launched an effort to make the concept systematic.

So, earlier it was in bits and pieces for some particular defence equipment some changes are done and then the substitute has been found to be better or at least of equal performance then in some other component some changes were done and that was found to be better as compared to the original ones. So, finally, Lawrence D Mile thought that this is a good concept let us make it systematic and in that process only a society of American value engineers SAVE, the Society of American Value Engineers was established in 1959.

So, this is the background now I think the whole purpose of showing this slide is that what was the basic concept. The basic concept was that if you change the design, if you change the materials, if you change the manufacturing processes for making a particular part component or a particular product you may achieve a better performance or at least equal performance, but at a relatively lower cost. So, the performance has to be same, but the cost is lower so that is the basic concept behind value engineering.

When I first heard of this term value engineering maybe 10 years back I thought this topic has to do something with the moral values and that is what the most in about value engineering. If you ask somebody what is value engineering many engineers will not have an idea that what value engineering actually is. But after this session or after attending various other sessions which are freely available on electronic media you can very easily try to understand this concept. And the basic concept is again I am highlighting we have to ensure the performance by change in materials, change in processes is, change in design without compromising the cost part maybe we have to focus on the course cost also we have to ensure the performance ensure the function is achieved, but at a relatively lower cost. So, that is the basic concept of value engineering we will read one or two definitions also today, but the theory part maybe explained or can be understood from different text books and from different other media, but the basic understanding that what value engineering actually is must be clear to the learners.

Now, what value engineering is I have tried to explain, what is not value engineering that also you need to understand, now value engineering is not cost cutting. Some of you may be wondering that we are reducing the cost of the part or the component therefore, it is

cost cutting no in cost cutting we sometimes compromise on the quality, on the performance, on the serviceability, on the maintainability, on the reliability of the product, but in case of value engineering.

We are not going to compromise on any of these aspects the performance of the product has to be ensured we have to ensure that the product that we are designing must be reliable easy to service, it should be easy to maintain, life cycle cost should be low. So, we have to ensure everything in value engineering, but still we focus on reducing or minimising the cost of the product. So, therefore, there is a difference between cost cutting and value engineering value engineering is more design focused we will try to achieve the function at the minimum possible cost whereas, in cost cutting we just look at producing the product in a way that the cost gets reduced.

So, design based value engineering manufacturing based cost cutting in cost cutting we may change in cost cutting also we will look for alternative materials, we will look for alternate processes, we will look for alternate designs, but in cost cutting the focus on alternate designs is minimal. Whereas in case of value engineering we will only focus on design and we will see that what is what the design modifications can be done in order to ensure that our function is achieved.

So, value engineering is design based cost cutting is production on manufacturing based where we focus on reducing the cost or cutting the cost of the product. So, cost cutting and value engineering is very very different and you must be able to answer very simple question that what is the difference between value engineering and cost cutting. Then some people say that value engineering is design review now from this two words design review very literal meaning comes to me that once first we design and then we review, it no, the this is not design review we will use the concepts of value engineering during the design process itself.

We are not going to review the already designed product we are going to focus on the design only that what should be the ideal design for this product or what should be the ideal design that will satisfy the desired function. For example, the function of this wrist watch is to show time. Usually if you go into detail of value engineering for indentifying a function usually use a two word verb and noun definition now verb and noun definition means verb is show time is noun. So, we use verb and a noun type definition that is show

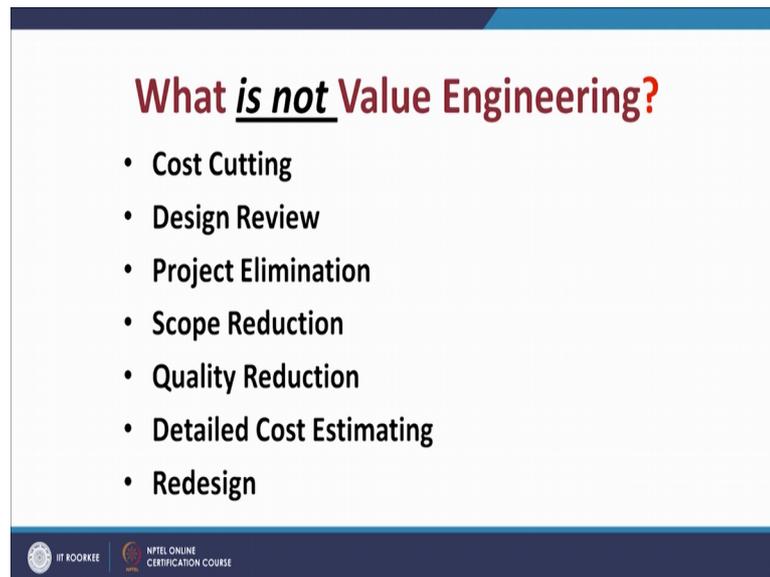
time for a shaft it can be transmit torque, for a fan it can be circulate air, for a newspaper it can be provide information. So, for different products we will have a two word verb and a noun type of a definition.

So, we will try to see that when we are designing a product how the principles of value engineering can be used to achieve the desired function. Now, desired function I have already told you that for this wrist watch the desired function can be show time. Now, I have to ensure that whatever product I design it should be able to satisfy this function of showing the time, I will not start my design from this watch, I will start my design from the basic function that is show time.

So, this wrist watch is completely ruled out I will think I will use my creativity to design a product which will satisfy this basic function of showing time it can be a completely new design completely eliminating the use of the wrist watch whereas, in case of cost cutting I will just take this watch and try to see that how I can change the dial how I can change the various components of this watch. So, that the cost gets reduced whereas, in value engineering I will focus on the design of a product in such a way that the use of this band and this watch is completely eliminated and I am still able to satisfy my desired function of showing the time or seeing the time. So, during the design only we will focus that what is the desired function and how it can be achieved with modification in the design simultaneously ensuring that the cost is also minimal similarly value engineering is not project elimination.

So, we are not going to eliminate any projects or it is not a criteria for evaluating the projects and then eliminating those projects based on value engineering no it is not project elimination. It is not scope reduction many times people feel that if you use a well concept of value engineering the overall scope of the product will get reduced no the scope of the product may further increase quality reduction I have already told we are not going to compromise on quality when we are using the concept of value engineering.

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What is not Value Engineering?

- Cost Cutting
- Design Review
- Project Elimination
- Scope Reduction
- Quality Reduction
- Detailed Cost Estimating
- Redesign

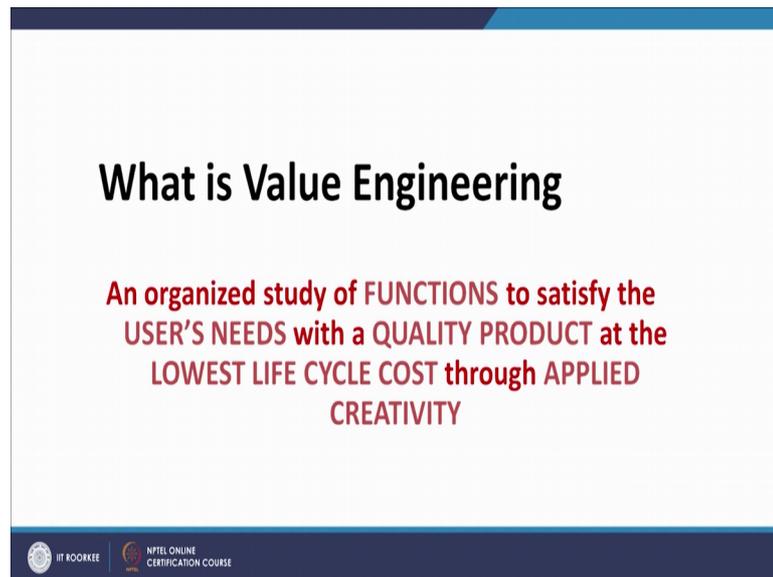
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Similarly this is not detailed cost estimation, so we are not going to do cost estimation definitely we are you going to see what is the cost of the new design, what was the cost of the old design, whether we are saving some cost in many cases the cost may further increase also, but the overall performance of the product is increasing. So, it is not cost estimation it is the design philosophy in which we design a product in such a way that our intended function or the intended function of the product is satisfied at the minimum possible cost.

So, it is not only a cost estimation technique it is basically a design tool which helps us to focus on the basic function of the product and try to achieve that function at the minimum possible cost without compromising the quality performance reliability and service serviceability of the product. Moreover it is not redesigned it is a design tool which can be used by the engineers.

Now, I think with this background let us go through one or two definitions of value engineering. What is value engineering? On your screen you can see, an organised study of functions now all of you know function I have told the function of this wrist watch can be show time the function of this tube light can be illuminate, the illuminate room the function of glass can be store water.

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So, you have you can see products around you and you can identify the function of the product. Now, value engineering is an organised study of functions. Why do we need to study the functions? To satisfy the user needs now I am using this wrist watch I am the user my what is what is the function for which I have bought this watch I want to see time. So, I have that find the watch should satisfy user's need it is satisfying my need I am able to see the time in this watch.

So, an organised study of functions to satisfy the user needs with the quality product no compromise on quality, at the lowest life cycle cost yes, without compromising the quality cost should be less through applied creativity. Now, how that is possible we have to use the creative uses of our mind of our brain to come up with modified solutions. So, this is the basic concept of value engineering to satisfy the desired function reliably at minimum possible cost.

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Definition of Value Engineering

- An analysis of materials, processes, and products in which functions are related to cost and from which a selection may be made so as to achieve the desired function at the lowest overall cost consistent with performance.
- An Organized, Creative, Cost Search Technique for Analysing the Function of a Product with the purpose of Value Enhancement without Compromising with it's Quality, Performance & Efficiency.

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These are the other definitions of value engineering. I will just read this definitions for you.

An analysis of materials, processes and products in which functions are related to cost and from which a selection may be made so as to achieve the desired function at the lowest overall cost consistent with performance. So, I have already explained everything related to this definition.

Another definition can be it is an organised, creative, organised systematic it is not maybe (Refer Time: 22:05) or philosophical it is organised step-by-step approach systematic approach an organised, creative, cost search technique for analysing the functions of a product without the purpose of sorry with the purpose of value enhancement without compromising with its quality performance and efficiency.

Now, what is the purpose? The purpose is enhancement of the product or the quality of the product. So, purpose of value enhancement. So, value can be directly proportional to the quality, reliability, weight reduction or efficiency. Now, what is our focus in value engineering? Enhancement of the value of the product without compromising with the quality performance or other parameters of value.

Mathematically also the value of a function is defined as the relationship of cost to performance.

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Definition of Value Engineering

- The value of a function is defined as the relationship of cost to performance

$$\text{Value}^{\max} = \frac{\text{Performance}^{\max}}{\text{Cost}^{\min}}$$

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So, we need to maximize the value on your screen you can see we need to maximize the value performance and cost are two things that we need to take care. Now value is directly proportional to the performance and inversely proportional to the cost. So, if the performance of the product is increasing value is automatically increasing. If the cost of the product is reducing the value is automatically increasing. So, therefore, we see that enhancement of value at a lower cost or by increasing the performance of the product both ways we can enhance the value.

Many a times it may so happen that the performance is remaining unchanged, but the cost is reducing still the value of the product increases. Sometimes it may so happen that the performance is increasing, but the cost is remaining same still the value is increasing in the last case it may also have that the performance is increasing at the same time cost is also increasing, but the relative increase in performance is much more than the increase in cost still the value is increasing.

So, we can adopt different strategies to ensure that how the product value can increase or how the product value can be enhanced and that is the, you can say place or situations where our creativity will come into picture. We can come up with different solutions of increasing the performance or the functions of the product without changing the cost or by reducing the cost of that is the major maybe. If today's lecture you want to summarise or you want to just remember one particular thing from today's session that is value is

equal to performance by cost or value is equal to function by cost. We need to maximize the functions and we need to minimise the cost or we need to maximize the performance and we need to minimise the cost. So, this equation can be helpful to you for understanding the basic concept of value engineering.

Now, why there are poor values in the product? I just read these points for you lack of poor coordination among designers.

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Reasons for Poor Value...

- Lack of and/or poor coordination among designers
- Failure to network with customer – poor definition of needs and wants
- Design based on habitual thinking or mistaken beliefs
- Outdated or inappropriate design standards
- Incorrect assumptions based on poor information
- Fixation with previous design concepts

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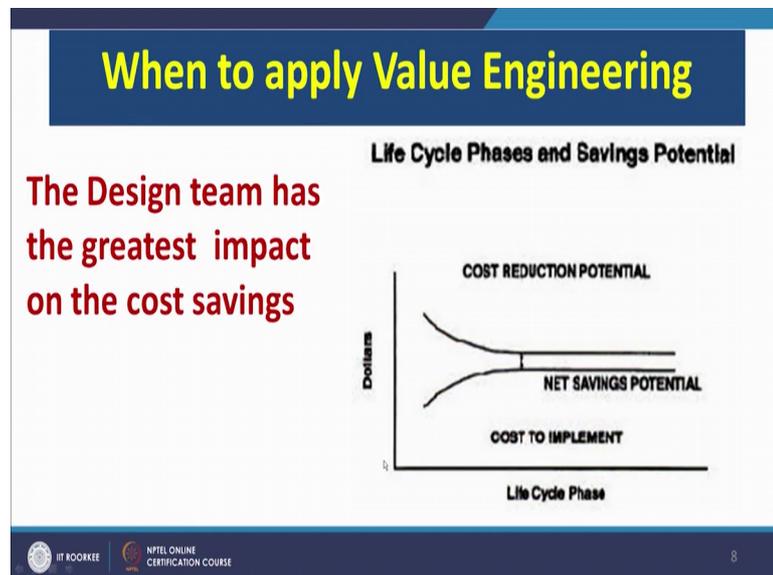
Failure to network with customer poor definition of needs and wants. So, sometimes you see different products all around you and you find out that this product could have been designed in a better manner, but why this has not been designed in that particular manner these are the reasons. There is lack of coordination among designers and then the design is based on habitual thinking or mistaken belief. Many times we just follow change is always not welcome by engineers or scientist many times we are doing a particular thing we are using a particular algorithm we are using a particular procedure we follow we want to follow the same procedure we do not want to change. So, design is based on habitual thinking.

Definitely it may not be the best design which could be done to satisfy that function. Outdated or inappropriate design standards there are number of design standard which have become completely outdated in today's scenario, but still many designers focus on those design standards only. In incorrect or inaccurate assumptions based on poor

information, sometimes a designers or engineers do not have the latest information therefore they design the products with whatever information they have and fixation with the previous design concepts.

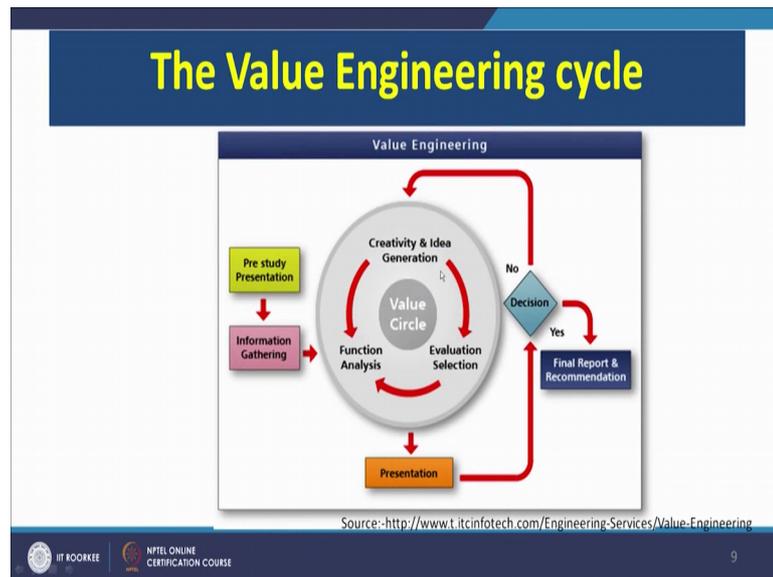
So, basically the summary is that our designers need to be innovative, our designers need to be creative they need to shed their inhibition they need to get away from the already established methodology of product design in order to design products which can satisfy the function at a relatively lower cost and there the value engineering and the creativity comes into picture.

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Now, when to apply value engineering? If you see the cost reduction potential in the graph, the cost reduction potential is coming down as a life cycle phases are increased. So, during the design stage only the saving potential is more because everything is fixed at the design stage the shape, the weight, the materials everything is fixed at the design stage. So, the cost design protencial is maximum at the design stage. So, the design team has the greatest impact on the cost saving. Then the question is that when we must apply the concept of value engineering we must apply the concept of value engineering during the design stage of the product and therefore, we are covering value engineering in the product design and development process this is value engineering cycle it is available on Google images.

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So, creativity and idea generation is the backbone of value engineering, then we do the evaluation and selection of the ideas, and then we do the functional analysis that whether the desired function that the customer wants is achieved by our idea or not, if it is achieved then we go further and we do the final report and recommendation. So, maybe this is the value circle - creativity idea, generation, evaluation, functional analysis and finally, the decision whether the product will be successful or whether the idea can be taken further develop for developing it into a tangible product or not.

Now, what are the application areas value engineering has been, I am applying has been value engineering has been successful in construction projects, it has been successful in manufactured prod manufacturing industry or manufactured products.

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Application areas

- Business systems and processes
- Service organizations



Source: <http://www.posgroup.com.au/business-process>

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In business systems and processes also the concepts of value engineering have been found to be successful as well as in service organisations.

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Advantages of Value Engineering

- Helps in achieving an improved product design and quality.
- Suggests to eliminate the unnecessary functions in the organization that increase costs.
- Emphasizes on seeking the alternatives for achieving the function and on applying the best alternative among the various courses of actions available.
- Enhances the customers' satisfaction and sales by determining the exact need and expectation of customers.

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Now, what can be the advantages let us quickly understand. It helps in achieving an improved product design and quality. So, we are able to design a better product if we use the concepts of value engineering because now we are focusing on the basic function and we are trying to understand that how this function can be achieved reliably at the minimum possible cost and it suggests to eliminate the unnecessary functions in the

organisation that increases the cost. Not only in the organisation in the product also if you see all of us use mobile phones, smart phones, but many of the functions in the product we may not be using we may be using maybe 10 or 15 functions on a regular basis, but the product may be having or the mobile maybe having so many different functions now all those functions involve cost. And if the customer or the user is not using those functions the company can focus on those functions and try to eliminate those function in place of these functions they can bring in some additional functions which can add value to the product.

So, value engineering helps us to identify the unnecessary functions and we can focus on additional functions which can add value to the product, product. It emphasizes on seeking the alternative for achieving the function and on applying the best alternative among the various courses of action available. So, the backbone of value engineering is creativity, innovation.

So, it will help us to find out number of ways to achieve the same function and in that process it will give us the best idea that what can be the best product to achieve this particular function for the customer and therefore, it helps us to come up with the product which is better as compared to the competitors product. And hence is the customer satisfaction and sales by determining the exact needs and expectations of the customers. So, we voice of customers is taken the needs and wants of customers are you can say taken into account while designing the product and then we focus on the desired function and try to achieve the desired function at a minimum possible cost.

So, I think with this we will end today's session. I have tried to introduce only the concept of value engineering and that is very very relevant concept during the product design process and value engineering most of the times is not covered in the product design and development chapter so therefore, we thought of introducing this tool to the engineers or the learners so that engineers can further enhance their skills and focus on the product design keeping in mind the concepts of value engineering. And further information is available on various other sources so I request all the learners to look up for other sources and improve or increase their knowhow in this important aspect of value engineering.

In our next session we will see another aspect that is very very important that we usually call as d f x or design for x and it is important from the product design point of view.

Thank you.