Product Design and Development

Dr. Inderdeep Singh
Department of Mechanical and Industrial Engineering
Indian Institute of Technology, Roorkee

Lecture - 04
Product Design

[FL]. We are into the fourth lecture of week 1, and we are focusing our tension on the basic principles of Product Design. If we remember very briefly I will try to outline what we have done in the first 3 lectures. In the very first lecture I introduce the course, we had outline of the course divided into 4 weeks and what we are going to cover in the individual week that we have covered. In lecture number 2 we have seen in detailed the product life cycle and how it influences the product design and what are the various stages of the product life cycle

In lecture 3 if you have already gone through that lecture we will see that we have covered the basic concepts of product design; in that we have seen that what are the features characteristics or the policies of any organization which help it to design a successful product. Or in nutshell in summary we can say that the policy that the organization should follow for launching a successful product.

As I told in the previous lecture also, there is no single policy which can ensure the success of the product, but different companies can follow different policies. Like, a company can follow a policy of the cheapest cost for that product or another company may follow a policy of highest quality for that product segment or there can be a compromise between the cost and the quality, there can be a segment in which the safety is the most important product policy.

We have seen; that what are the policies that the organizations usually follow in context of the product design. Thereafter if you remember we have also covered that how to launch a successful product. In that particular segment we have taken only one particular tool that was sort analysis, strength, weakness, opportunity and threat specifically in context of the organizations, that organization should do a check of themselves, self check introspection so that they can come out with the solution or they can come out with the product which can be successful in the market.

If the organizations focus on their strengths definitely they can come up with a successful product in the market. Now today our target is to start thinking about the design of the product or the design thinking that how we can design a product. Suppose I have a idea, how I can culminate that idea into a tangible product, those idea to reality, from idea to a product, that we are going to cover in this particular segment, maybe for another 25 minutes. Let us first go through the basic concept of product design.

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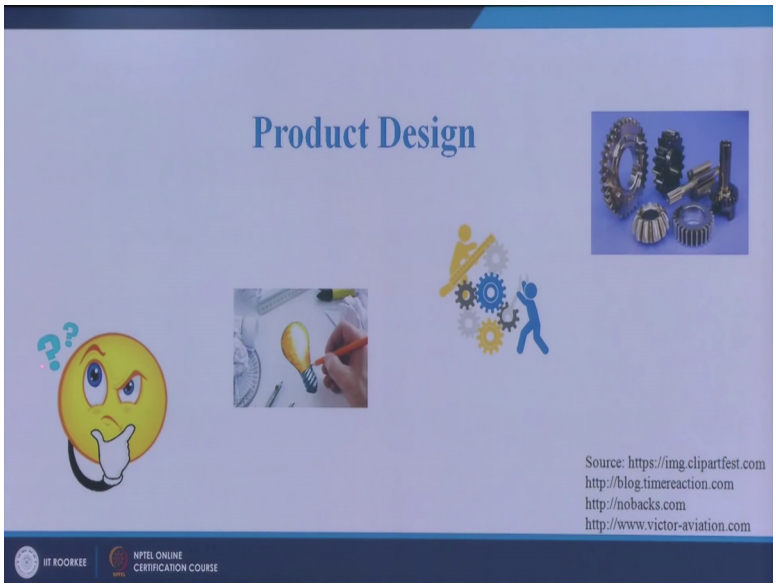

You can seen here initially you have a idea; suppose I am sitting in my room and I am facing some problem I am not finding proper environment or may be the humility levels are too high. I may think of idea that how I can control the humidity in my room during the rainy season, especially during the rainy season or how I can control the moisture. Certain things may come to my mind because of the basic engineering I have studied, because of the concepts of science that I have studied that is basically idea generation.

Maybe you will come up with the idea that how maybe we can do that, may be I will read some literature I may go through certain books that how to maintain the particular humidity or moisture levels in a room. So, that is basically your idea generation. You start thinking about a problem and the tentative or alternative solutions to that problem that is basically first step.

Second is you just find out 3 or 4 alternatives, all right and when you have 3 or 4 alternative you will try starts sketching them and trying to just may be have a over view

concept of a solution, it is not the exact solution at this stage. At the second stage it is not the exact solution it is just sketching or conceptualization of idea based on my literature, review based on my experience, based on my discussion with my peers, with my professors, with my students, I may come up with 3 or 4 broad solutions which can solve my problem.

The third stage is the detailed design. Initially I have only done the sketching at next stage I will do the detailing of the design that I have selected. I will definitely eliminates some ideas here. Suppose I have 4 ideas I will try to eliminate 2 ideas and further I will work on 2 ideas at the detailed design stage and their I will do the detail designing, I will give the tolerances, I will give the dimensions, I will give the material, I will give the manufacturing process, which will be use to make that product all those things will be frizzed here. Frizzed means will be finalized here. And once we finalize all those things, the design will be sent for manufacturing and then it will be manufactured in the form of a tangible product.

In a product design process basically starts with generation of ideas, then conceptualization and alternatives for finding out solutions to the problems that we face, then the detailed designing of our ideas, and then finally the manufacturing of the product. In between somewhere here we will have the prototyping stage also in which we will do a prototype of the idea or we will make a prototype or model of the product that we want to make: it can be a fully functional model or it can be a partially functional model, in which we will just try to have a look that how the product would look like. So, prototyping stage will also be somewhere here.

And finally, we will get our product which as per our last discussion may be successful, may not be successful, that depends on how well prepared we are as response to the needs of the customer or the needs of the society. If we are well prepared we have done our marketing research properly, we have done our analysis correctly, then only this product will finally become successful in the market. These are the broad stages of any product design process.

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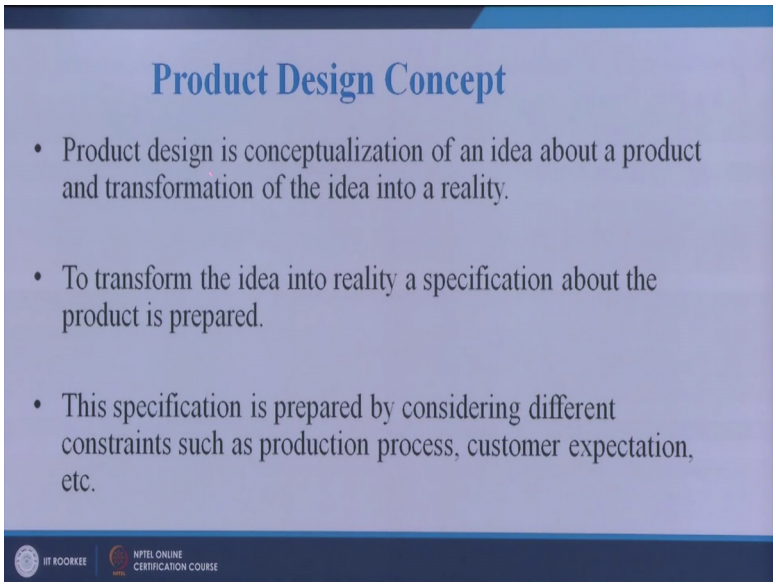

Let us see the concept the Product Design is Conceptualization of an idea about a product and transformation of the idea into a reality, as we have seen in the previous slide this is just to summarize, but I have already discuss the as a result of the previous slide. It is the conceptualization of any idea and then converting that idea into reality initially they that idea will be in our thought process only, but with passage of time we will convert that idea into a tangible product. For example, the LED screens that we see the television sets that we have used. Initially there may be in the ideas of the researchers or the inventors, but then after doing successive research fundamental research and then the applied research and then finally, the engineering research the idea culminated into a product and the product now is being used by all of us.

So, similarly here also any product design basically is culmination of an idea in form of a tangible product, to transform the transform the idea into reality a specification about the product is prepared. I have already told specifications are prepared at 2 stages. Initially, we have a concept design where we finalize may be suppose we want to design a new car what will be the various stage is first thing we will have to see that what is the need of the customer, what are the specific needs of the customer at the conceptual design stage, we may have to take a decision that whether it will be under in a SUV category or it will be in a sedan category or it will be in a normal we can say lower automotive segment may be apart from the sedan and the SUV category.

We have 3 categories of vehicle so, at the concept stage we may just view tinkering around that which one will be more suitable in the market, but at the detailed design stage our target is fixed. Now that the product or the automobile that we are designing we will fall in the SUV category and we are designing SUV all specifications will be design as per our idea which we have already finalized at the concept stage that is that we are going to design a SUV vehicle for the particular segment of society or for a particular specific set of customers.

So, to transform the idea into reality a specification about the product is prepared may be at the detailed design stage the specification is prepared by considering different constraints such as production process, customer expectations. We will see that is SUV has to be prepare what are the various components that will be used to assemble and produce that what to do the specifications of those component. For example, suppose the gear box has to be used for the SUV we will see that what should be the specification of the gear box it should be 5 year, 4 gear, where the reverse gear should be applied it should be in front motion or it should be in the backward motion all those detailed specifications are required during the detailed design stage.

And we will also outline that what are the specific manufacturing process is that are going to be used for manufacturing the individual parts of that product. Specifications are prepared by considering the constraints such as production process and customer expectations. The word constraints is used your constraints be is used because they limit our choice constraints is basically limitation.

So, our choice of selection is limited by the constraints by the customers, as well as sometimes by the process is also many a time we may like to produce or particular shape or give a particular profile to our vehicle. But, many times it may be limited by the choice of the manufacturing process, that particular design may not be possible by the process that is being used by a particular company for manufacturing that particular part or that particular segment or that particular component in that product.

There are lots of limitations and within those limitations we have to design our product. In product design stage all aspects of the product are analyzed. In our next lecture our title would be product analysis.

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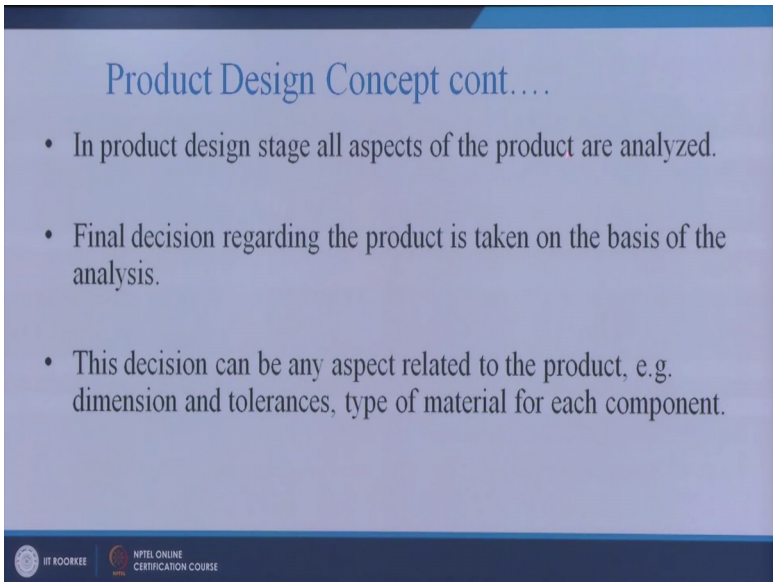

And there will see that what are the various factors or what are the various parameters that need to be considered during the detailed analysis of a product. So, a product design stage all aspects are products are analyzed. Final decision regarding the product is taken on the basis of the analysis, that analysis product analysis we will see in our last lecture on product design.

This decision can be in any aspect related to the product, for example, dimension and tolerances, type of material for each component. So, may be all these things we will get finalized that dimension, tolerances, type of material etcetera. This decision can be in a can be any aspect related to the product, our decisions can be any aspect, whatever analysis we are doing can focus on any aspect related to the product design. Now here you can see dimension and tolerances, type of material. Let me tell you that a design is itself a very very wide field, in design we can do the aesthetic design of a product, we can do the mechanical engineering design of a product or we can do the industrial engineering design of a product.

A design can be done by different approaches, if we are suppose designing a particular chair, from the industrial engineering point of view our focus would be the customer needs, the market survey. Then the functions that the chair should process then we will see that the comfort or the ergonomics aspect of the chair that the person whose going to sit on the chair should feel comfortable if he has to sit for a long duration of time.

For a mechanical engineering design point of view we will see that how much load the chair can take, how many number of cycles the chair can take before failure, how much load there armrest can take, how many cycles of loading the armrest can take before failure, what should be the angle, that is common area may be mechanical engineer or a mechanical engineering design student will definitely focus on this aspect also. And then we will design how much should be the cluster, how many number of wheel should be there, what should be the base, how whether it should be 3 legged based or a 4 legged based all those will come under the mechanical engineering design point of view for the chair

Whereas from industrial engineering point of view I have already highlighted that what are the factors that we are going to consider, what type of analysis we are going to do. So, that is from managers point of view when you see a product you will do different type of product analysis, from an engineers point of view when you see a product you will to take different type of products. Here our target may be maximum discussion we will have from a managers or from a industrial engineer engineering point of view or from a industrial engineer prospective.

We may not do all the design calculations and stress calculations and stress strain behavior and all those things and failure criteria things related to the product design. We are going to discuss the industrial engineering aspects that if a company wants to launch a new product, what are the factors or what are the tools the designer should have in order to come up with a good product.

Design team as I have told in the last lecture if you remember product design is a team effort. There will be people with different specializations who will sit together and designing the product. So, definitely there will be people from mechanical engineering background also, there will be people from industrial engineering background also, there will people from management background, there will be people from legal background, there will be people from you can say the marketing background, there will be a complete team of people who will lead to the design of the product.

But, the title that we have product design and development is relevant in general sense for all different disciplines of people may be their managers, may be their marketing professionals, may be their industrial engineering background, students, may be there

from mechanical engineering background, the tools and techniques that we are discussing here are relevant to all particular disciplines who want to focus their energy, where who want to focus their interest specially in coming a with new and new product.

This 10 hour of discussion will you can say form a strong foundation for all aspects of design related to the design of products. So, therefore, not therefore, I should say I have focus this, because we are not going to design a product keeping into mind the dimensions and tolerances. This will also be done by another engineer whose part of the team, but our job is to simplify the overall design process and use the systematic tools or product design that the product design becomes the successful design in the market.

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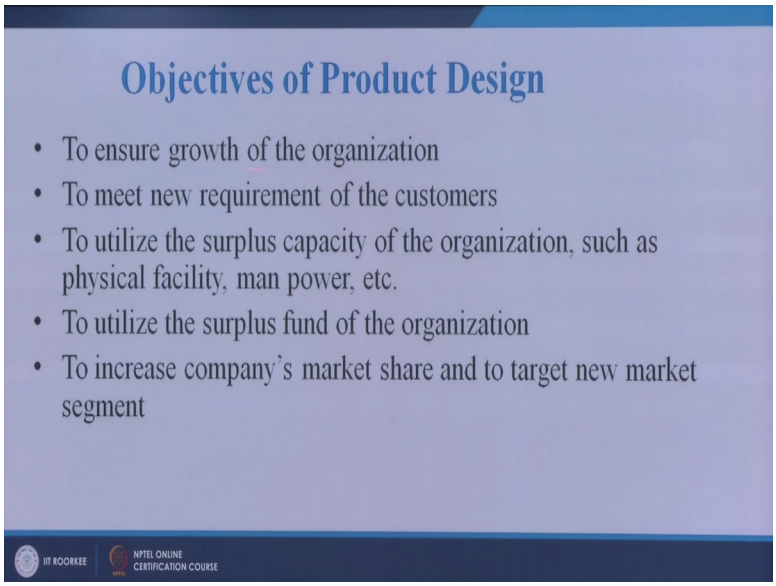

This is all related to I have I think summarized the product design concept to all of you, let us see the objectives of product design, that why a new product design should be done or what with what objectives we should go for a new product design. First you can see to ensure growth of the organization I have told in the very first lecture that product design is done for if you remember just have a thought over it as a survival strategy or as a growth strategy.

So, here you first thing is to ensure the growth of the organization, second is to meet new requirements of the customers, suppose we have a product and the customer gives additional suggestions or additional feedback that if this feature is also incorporated the product life would increase or the product acceptability in the market will increase, there

will be a increase in the market share, definitely a company will go for a additional feature in the product and that can be incorporated with the help of a product design process.

First is to ensure growth of the organization second is to meet the new requirement of the customers, third is to utilize the surplus capacity of the organization such as physical facility and man power. So, many a times it may so happen that company has a capacity usually we call it a capacity constraint number of companies have a defined capacity to produce or to design a particular product and then manufacture it into a commodity or a product which is required in the society.

Now, many times there is surplus capacity, suppose there are 3 different big shops in a particular organization, only 2 are working one is not working or there is a capacity you can say available which can be tapped or utilized. Company may think of coming up with the new product so, that surplus capacity can also be utilized, many times surplus funds are available and sometimes the companies do product design to increase the companies market share and to target the new market segment.

There can be target overall target is same to improve or to increase the financial wellbeing of the organization or the economic wellbeing of the organization or to ensure the growth of the organization. Companies usually go for new product design and new and new as we have seen in the previous slide also many examples we are also given in the not the previous slide sorry previous lecture, many examples we are also given in which we have seen the companies come up with new and new products with different policies.

So, that they are able to maintain their market share number 1 and to improve their market share as a number 2 approach, for example, sustainability or the other word that we have used is survival. Survival and sustainability is one thing and then the second thing is the growth, every individual seeks growth in his life. So, companies also seek growth in their financial wellbeing. This is a summary of why the companies should go for product design.

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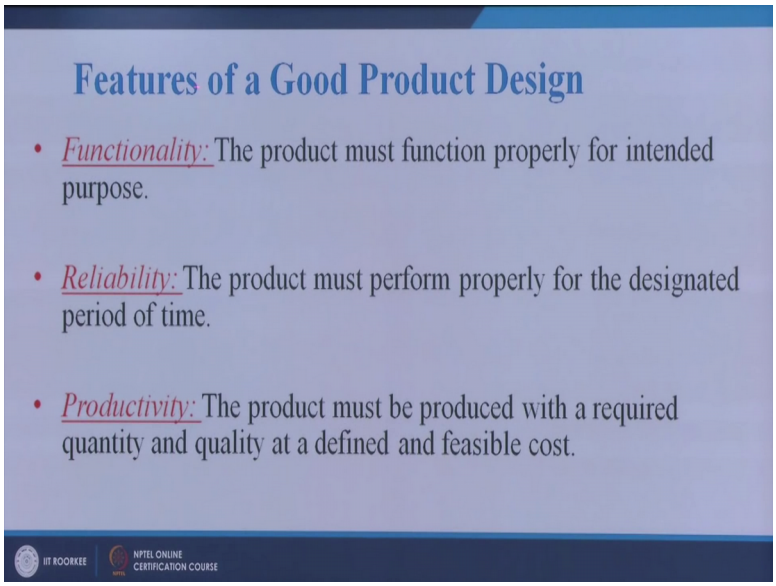

Let us come to features of a good product design, I think in the last 2, 3 lectures I have been able to emphasize on the importance of product design, it is kind of you perform or you come up with the product or you parish. If you are not able to innovate create new and new products I think the company is not going to maintain it is a balance or maintain it is position in the business environment.

So, if we by to by now if you have understood the importance of product design, you will be able to appreciate the features of the good product design and now you would be more eager as well as more interested to know that; yes the product design is important and how we can equip our self with the knowledge that is related to product design and successful product design, most of the time what people do there is a famous saying I will try to just get it right

That people do not plan to fail people do not plan to fail, but they fail to plan. So, nobody ever plans to fail, but usually the failure is in terms of planning, no company would launch a product to be failure product. They will definitely like to come up with products which are successful products and in order to launch a successful product the preparation also should be very very robust so, that you take all factors into account before launching a particular product.

We are in this short duration course 10 hour course trying to learn the tricks of the trade, trying to learn the different technique, tools that will help us in this process of product

design, mind you must I tell you that even if we have done this 10 hour course does not guarantee that whatever product we will aim at will be a successful product in the market, but the chances of success will certainly improve if you will take the informed decisions based on the discussion that we are going to have may be in this 10 hours of time that has been allotted to us for executing this course.

Let us see get into slightly technical concept of product design and see what are the various features a good product design, should have features of a good product design first of all the functionality part. I would like to define the function when we will go into the next week and we will start our discussion related to value engineer as applied to product design. There we will see what is a function, what are the various types of function or different types of functions, then we will also see the anatomy of the function, we will see the functional analysis, we will see how function behaves in respect of cost, we will see how function and cost behaves in respect of value of a product.

So, all those things we will discuss here, but in today's class let us just see the word functionality the product must function properly for the intended purpose. Now I am using this pointer it has a intended function, it has been handed over to me to flip the slides as well as to point on a particular portion of this screen. So, I am seeing a red dot here and it is written in red only functionality, if you can see the red dot here it is performing it is intended function satisfactorily. I will say it is one feature of a good product design that any product that we are using should satisfy it is function for which it has been design that is the functionality part of any product design.

For example another example we take suppose we use a nail cutter, to cut nails and if it is able to cut the nails properly we will say it has performed it is desired function satisfactorily, it is a good product design, but suppose it is not able to cut the nails properly we will say it has not performed it is desired function it is not a good product design. First part and foremost part is the functionality, second is reliability, the product must perform properly for the designated period of time. As we have seen that if we are buying a pair of shoes, in pair of shoes I may expect that they should perform reliably for 2 years and if they perform reliably for 2 years, I will say it was a good product design and they have performed reliably for the designed life.

Next is productivity, the product must be produced with a required quantity and quality at a defined and feasible cost. The design should be such that we should be able to produce it effectively and efficiently, many a time it may so happen that the product that we have designed may take a too long time for manufacturing or production. Those things are not required or may lead to failure of during the manufacturing process the defective items produced are much more that will certainly influence or effect the productivity of the organization. These are 3 important points let us quickly go through the other point.

The Quality is a relative term we will discuss this quality when we will discuss design for quality, design for manufacturing, design for assembling, in that particular topic.

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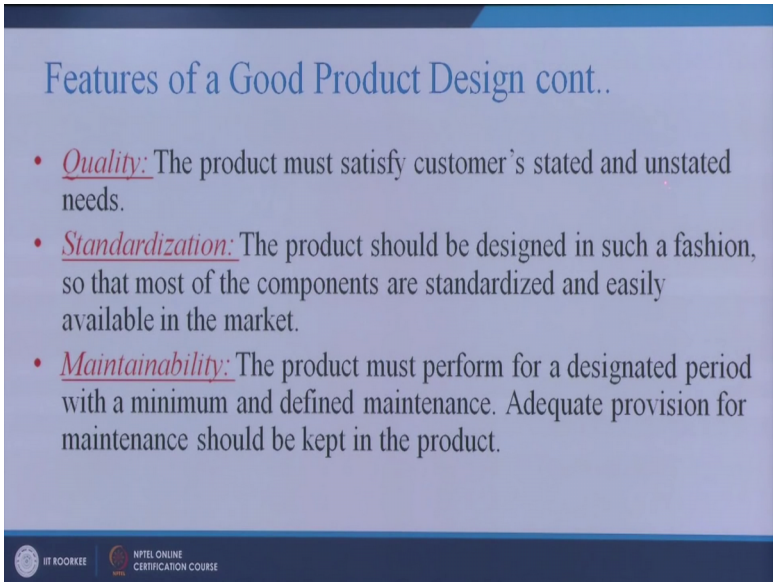

We will cover Quality, design for quality the product must satisfy customers stated and unstated needs so that is another important point we are designing the product for satisfying the customers need, it should be able to satisfy those needs otherwise the product may be of poor quality.

Then Standardization, the product should be made up of standardized part then only you it will undergo, it will be able to justify the cost if each and every component that goes into the final assembly of the product is non-standardized, than the cost of the product would certainly increase. So, it is always advisable that we should use as many standard parts in the product as possible.

Next is the Maintainability, we have to be we have to ensure, we have to be double ensure that if there is any problem in the performance of the product. It needs maintenance there are different types of maintenance strategies, that we are not going to discuss, but if we have to maintain a product there should be adequate provision in the product that it is easy to maintain, that is it is easy to disassemble it and easy to carry out the maintenance process, that also has to be ensure, ensure during the product design process only and it is a feature of a good product design.

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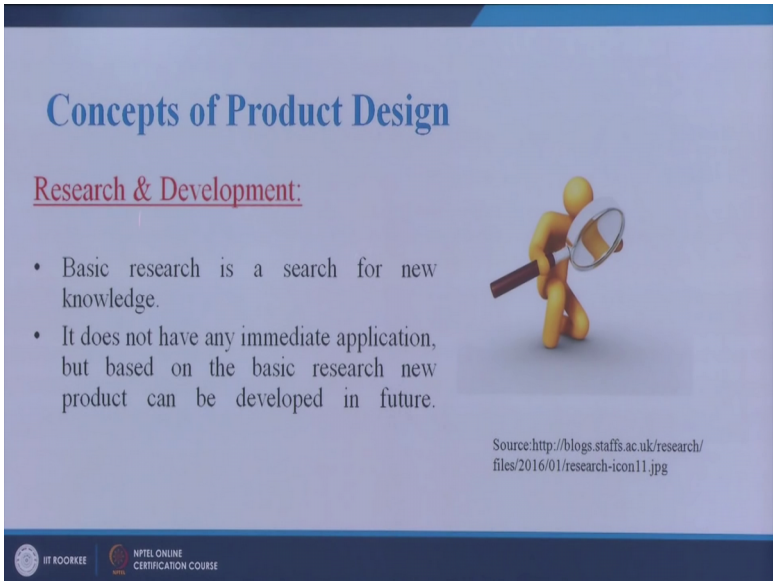

Then the concepts of product design very quickly may be in 6 to 7 minutes we will try to finalize these things, first is Research and Development for any product design lot of research and development is required you need to understand the various features, that are already existing in the existing product and what is your you see USB in your product design what is the best thing that you are going to incorporate in your product. So, that it becomes successful. The research and development is an important ingredient of a successful recipe of a product, successful recipe of a product has a important ingredient that is the research and development.

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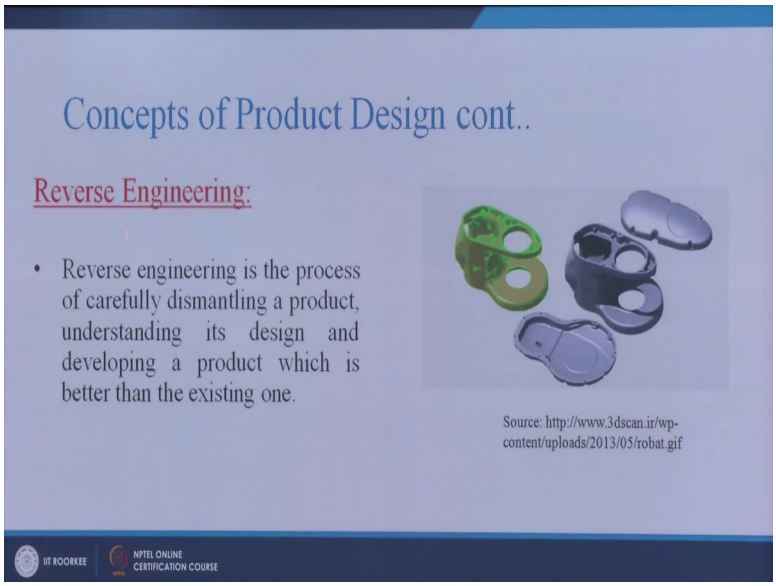

Then one another important topic that is Reverse Engineering, Reverse Engineering is the process of carefully dismantling a product understanding it is design and developing a product which is better than the existing one. We can use the basic concepts of reverse engineering also during the product design process where we can dismantle a product try to understand the design complexity of the product and come up with the mature design a more robust design or a design which is better than the existing design, that is basic concept of reverse engineering.

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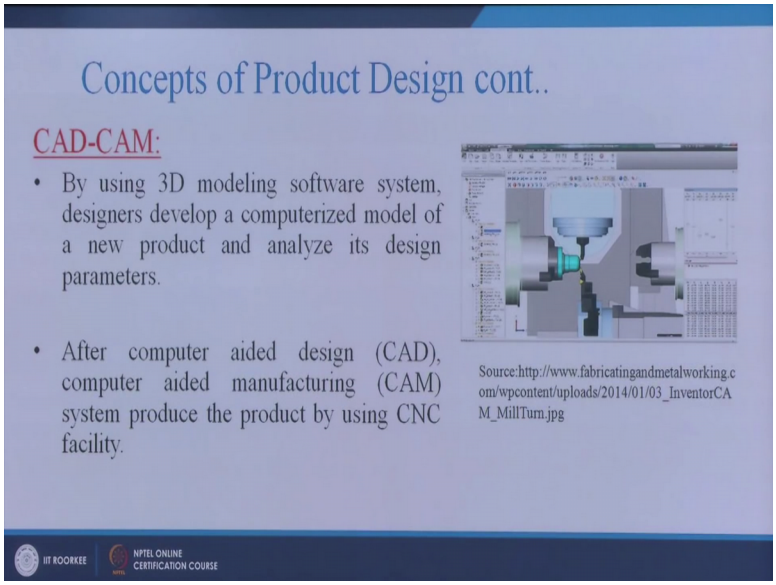

CAD-CAM also we will cover, when we will cover the design tools we will have a lecture on CAD. So, by using 3D modeling softwares, the designers can develop a computerized model of the new product and analyze it is design parameters. This is another aspect that we can cover that is CAD and CAM, after the design has been made using CAD software, we can use the Computer Aided Manufacturing technique for doing the manufacturing of that product. So, after the CAD after the CAD Computer Aided Manufacturing system produce the product by using CNC that is computer numerical control facility.

CAD and CAM are other techniques which can be helpful to us for the wellbeing of new product. So, we can see that there are standard techniques which have been invented designed used by the engineers and scientist for launching the successful product

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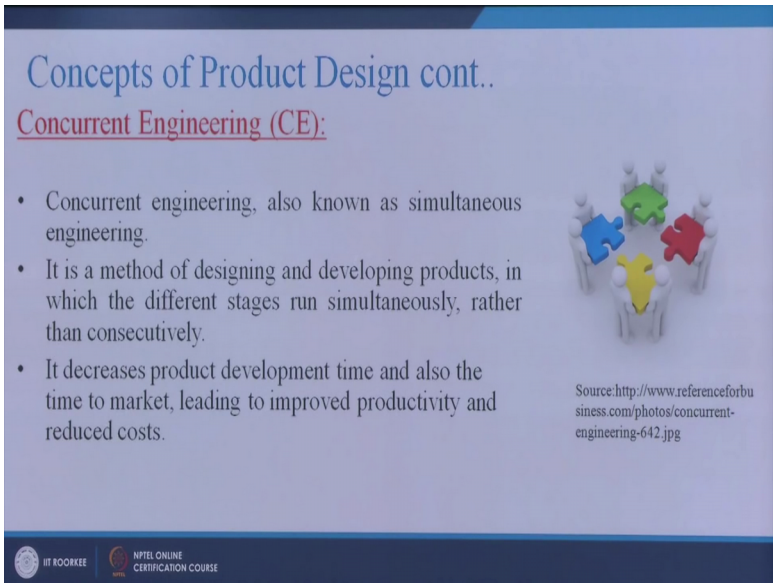

And we are just outlining some of them which are used by the present day designers. Then there is a concept called Concurrent Engineering which saves lot of time in concurrent engineering it is also known as simultaneous engineering it is a method of designing and developing products in which the different stage is run simultaneously rather than consecutively.

We will see in our subsequent lectures what are the various stage is of product design and in concurrent engineering all stages do not occur one after the other, some of the stage is which can overlap can start at a same time, it is saves time. Concurrent engineering is a

technique which is used to save time and to make our product more competitive by reducing the time to market. It decreases the product development time and also the time to market leading to improved productivity and reduced costs. So, concurrent engineering is another technique which is useful for a successful product design as it reduces the time to market as well as the costs.

We have seen that there are different tools which can be use CAD is one such tool cam concurrent engineering reverse engineering all these tools we need to learn in much more detail with specific case studies. So, that we use this tools to our advantage and we can come up with the successful product design in next lecture we will see what are the stages or what are the various steps which are which need to be taken in order to launch a successful product as well as we will see that what are the various evaluation criteria or what are the various you can say characteristic where that we need to look at when we are designing a particular product.

We will see the steps of product design as well as the characteristics of a good you have seen the features of a good product design, then we will see what are the characteristic a industrial engineering aspects for example, the functional aspects very briefly we will see functional aspects in detail we will see in the value engineering week. Initially tomorrow we will have just a brief discussion on functional aspects, we will see the durability and dependability aspect, we will see the aesthetic aspects which we have not covered till date then, we will see the economic aspects of product design and then we will see the manufacturing aspects of product good product design.

So, with this we come to the end of today's lecture, we will meet again for lecture number 5 of this week. And we will cover the different aspects related to the various stages of product design process.

Thank you.