**Product Engineering and Design Thinking**
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**Module - 01**
**Introduction and Prelims**
**Lecture - 02**
**Introduction to Product design**

Today we will be discussing about Introduction to Product design.

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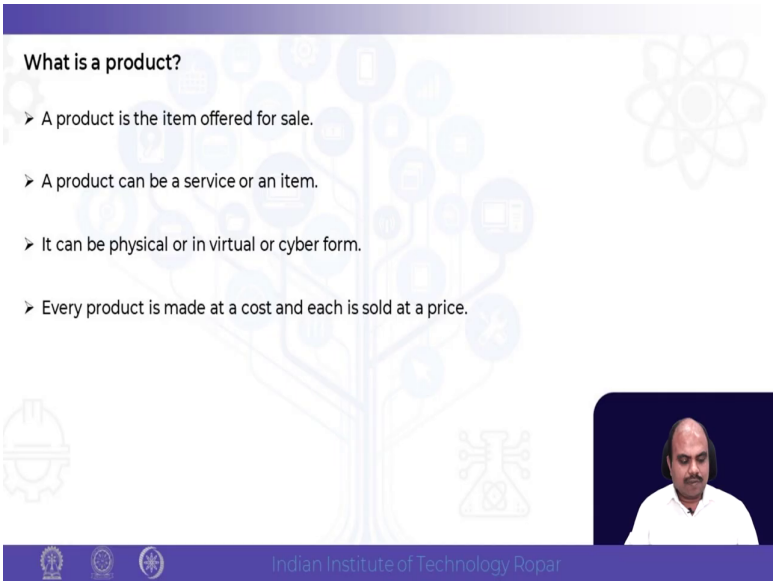


So, first of all we have to know what exactly is product and what are the different kinds of products. So, there are various kinds of products which are available a product is a item that is for sale a product is service also or an item and it could be physical and virtual also. Each

product is having a cost and basically cost is to which is used to manufacture the product and there is a price which is which is basically the price at which the product is being sold.

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What are the different kind of products? There are different kinds of products which are available and products can be tangible products and it can be intangible products also. What are tangible product? Tangible products are those products which you can feel and touch and intangible products which you cannot.

So, some of the examples of tangible products can be laptop, mobile phone, then chargers, computers, then any anything even transformers then bag there are so many products which are there which are in tangible products. The second kind of product are intangible products intangible products which you cannot directly touch and feel, but they are important.

So, some of the examples are services like you know mobile service, internet service. So, these are the service and these are these are basically in intangible products. Software; software is very important and it is used widely. So, these are also the different kinds of software these are all are coming under intangible products and there are the tangible products again can be divided into two types; one is industrial products.

So, industrial products is basically the product which is being sold from one industry to another industry and the consumer products. Consumer products means those who are those consumer products which are purchased by the by the user. So, take it takes for example, this shirt. So, one company would have made taken the cotton and actually made the fibres and that fibre is being sold to another company which is making the shirt or the this cloth.

So, from one company it is being sold to another company. So, that is for industrial product. However, when actually the cloth from the cloth we make the make the shirt the shirt is purchased by the user that is we are purchasing. So, that is consumer products. So, when we are talking about product, we are talking about product processes services. What do you mean by processes?

Processes means take for example, the process which is used to convert one chemical to another chemical that is also processed process of maybe making the this from iron you can we can make the steel. So, that is a process. So, service, process, products all are coming under product, but in general when you are talking about product design, we are talking about a in general we are basically talking about tangible products and mainly for the consumer products, but that does not mean the product design is that only.

There are a numerical numerous products which are available both in terms of products processes and services. So, in chemical industry take for example, a processes are very important. So, there are so many processes which are which are required for in chemical industry. So, all these are coming under the processes. So, products, processes and services are the three important things which are coming when you are talking about products.

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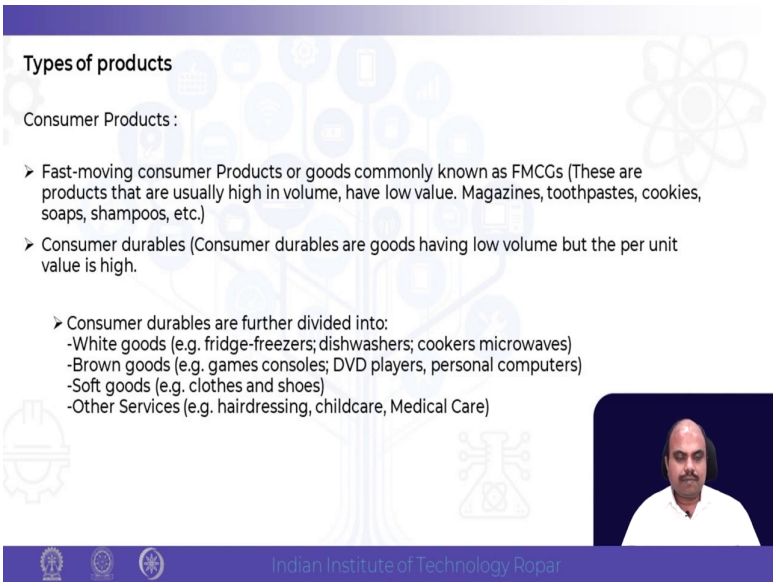


Now again the consumer products. The consumer products can be segregated into multiple ways one is First Moving Consumer Goods that is also called FMCGs. So, they will take for example, and Reliance is making a lot of products.

So, these are what are the examples of this examples are which are generally low value and high volume which means the some of the examples are magazines, toothpaste, cookies, soaps, shampoos, etcetera these are all high volume, but price is very very low as compared to other products these are called fast moving consumer goods.

Then there are consumer durables. Consumer durables are consumer durables that are having goods which is having low volume, but per unit value is high and again consumer durables can be divided into white goods, white goods means freezer, refrigerators, dishwashers then

then cookers, microwave these are all white goods this have big bigger products brown goods the game console DVD players, personal computers.

Then soft goods; soft goods are clothes, shoes and there are other services like you know hairdressing, childcare, medical care these are all products which are coming under other services.

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Now, we have learned about products, different kinds of products and now we are going to know about product design. So, in general product design is a it describe a process when we imagine create and iterate a product that solves user problem and at this specific need of the user in the market. So, the key to successful product design is understanding what exactly the customer needs and the person with whom the product is being created for whom the product is being created.

So, who is the user of the product and what exactly they need. So, that is going to help us in creating a better product. So, product design is concerned with the efficient and effective generation and development of ideas, the process of that leads to new products this is the definition given by a Morris in 2009 in the book of Fundamental of Product Design. Product design is also considered a goal directed problem solving activities.

Goal directed means the focus is on a particular problem solving and then the product designers conceptual. Who are the product designers? Basically, the product design is designed by a designers. So, all the product we see somebody designed it. So, these are called they are called product designers.

So, product designers they what they do they conceptualize, evaluate, make them tangible through products in a more systematic approach and their role is to combine art, science technology and science technology and create tangible three-dimensional goods.

So, this is a very difficult job and that is the reason product designers get lot of money also and this is very their need also is there in the society especially lot of companies with bigger companies they have R and D sections where this products have been designed by these product designers.

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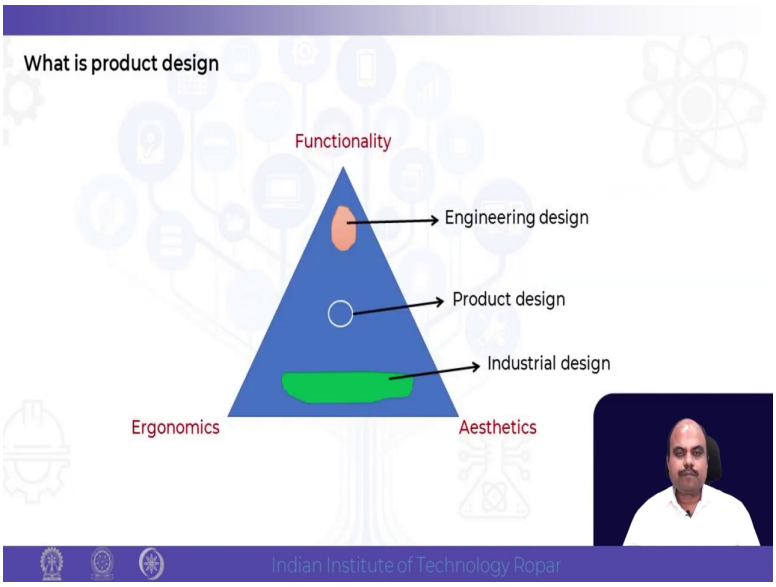


So, when we talk about product design the three things comes in mind ok little difference between industrial design product design industry then engineering design all are very similar that is true and there are also similarity among them, some of them are quite similar to each other.

But when you talk about product design generally for any product we have three important things what is the functionality each and every product which you see in the market it has some particular function or multiple functions together. Like take for example, mobile phone; mobile phone is having function of what?

It is having communication device, it is having recording device, camera device and many things right. So, when we talk about functionality, functionality of product is important

second is ergonomics. Ergonomics is when the product is coming in the contact with the people like somebody is using the using in hand.

So, how is going to be in hold. So, when you are using when you are taking the mobile phone how you are going to hold it, how what is size of the mobile phone, what is the weight of the mobile phone all these are coming under ergonomics. The aesthetics how it looks because if the product is looking good people may not buy it or if the same functionality and same ergonomics is there in multiple products people will prefer only that product which is aesthetically good.

And that is the reason you see the several products are not being sold in the market that easily, but some other products are very very sold very very many many it is sold quite and is becoming quite popular. So, in general engineering design is more concerned with the functionality and industrial design is more concerned with the aesthetics and ergonomics portion of it.

And product design we are talking about it is basically all three functionality is also important ergonomics is also important and aesthetics is also very important. So, we have all three together and that is the reason it is important to have we when you are designing product, we give a importance to all three.

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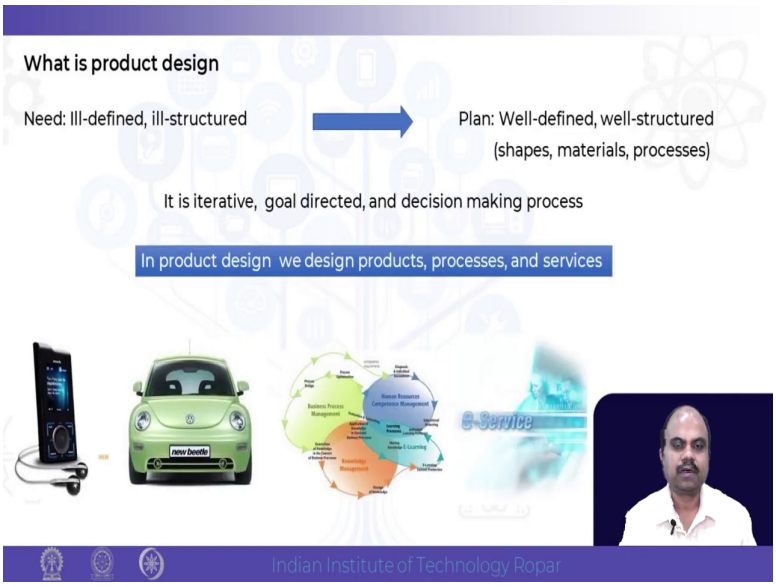


So, in the next slide that is on what is product design. We are seeing that we can express product design as a process of you know changing the need is to from III defined an ill structured activity to planned and well defined and well structured activity.

So, what it mean by that is that in ill defined. So, any product is you know in especially new product development in PD the issue is that often the customers will know what they want, but they will not exactly know what exactly they need. So, is often the requirements are III defined. And when we have a well defined thing we have well defined means it is shape, it is a material and processes.

So, let us go with some examples also, but apart from that in a small small example could be that take for example, that somebody is interested in purchasing it this maybe laptop external speakers. So, if you ask any customer why you need a speaker. So, he may say ok the my

laptop speaker is my laptop in build speaker is not that not that powerful it means that it does not make that much clear sound and it is not that loud also.

So, I need a; I need a speaker. So, they will not be able to say that what will be the size of a speaker how much intensity is like it is basically is a feeling. So, ok it is more than that what I need; however, with these we cannot do designing our product. So, we have to actually go to the customer and ask them what exactly they need and how much intensity is required.

So, this intensity is we need to have some have some measurement of it also and they should be what kind of control they need do they need only volume control or do they need bass and treble control also. So, somebody will tell yes, I need bass and treble control because more fascinating with people if you need. However, if I wanted to design a product of the same kind, we actually need to see that if you use volume control yes that is required.

But if you use bass and treble control it is maybe good to add, but then the price of this will be more because we need to add some more features some more electronics in it size, weight all these things has to be also determined. How much power is required is if we either if we the speaker require lot of power more than what an USB can supply then we need a external power which is need to be connected with the main power.

However, if you do not need that we can actually use the USB drive USB port which is there in the laptop. Size also you have to see weight also you have to see. So, in the design specification that we will learn later that product design specification we are going to understand from the vague understanding of the user we will make some complete understanding of the requirements and make some specific engineering or technical a specification.

And then the thing then the process is going to go on that we are going to design product based on this requirement and try to satisfy the user. And of course, the evaluation part is important whether d d d di satisfy the user norm. All set users are not same there are users who need who need more loud sound they may be user who need very crisp and sound they

need more control about the bass and treble then may be user who does not want expensive speaker.

So, there may be speaker there may be user who have a lot of money. So, they do not mind, but they want something which is very good in terms of quality long lasting. So, there are various things we need to understand next thing is about product design is a iterative goal directed and decision making process.

Iterative means any product design any design which you make it cannot be done the best design does not come in the one shot, it has to be done multiple times. The more times which you do the quality is going to go better and better and that is the reason many many times you will see in a various versions are coming.

However, we should understand that the there is a limit in which you how many times we can do it is also resource intensive designers need to do the same design again. So, it is very resource intensive we cannot go on many doing many times and there is a and kind of designers we need. So, there is professional designers, experienced designers and the novice is also.

So, we there is a balanced required between the designers who will be there in the group will be designing doing the design. Goal directed goal directed as I already told the goal is to take for example, in the speaker case the goal is to make a very good speaker for a laptop, for a particular set of user.

And decision making process. So, there are so many decisions size ok, shape, then the quality, price, then manufacturing process the so many decision need to be done and all the things are done during the design itself. So, in design in product design we generate design product, processes and services that has already been discussed in design in product when you are talking about product in general, we mean physical tangible product but there is not the case.

If product design is also encompassing it is both processes; processes means take for example, the process of converting sugarcane into this crystal sugar that is the process chemical process. There are also services; services means the mobile service which we are using nowadays many software services also there which we can use and the electricity.

So, there are so many so many things are there which are coming under services. So, we are talking about product design, we are talking about products processes and services. So, let us go to the next slide.

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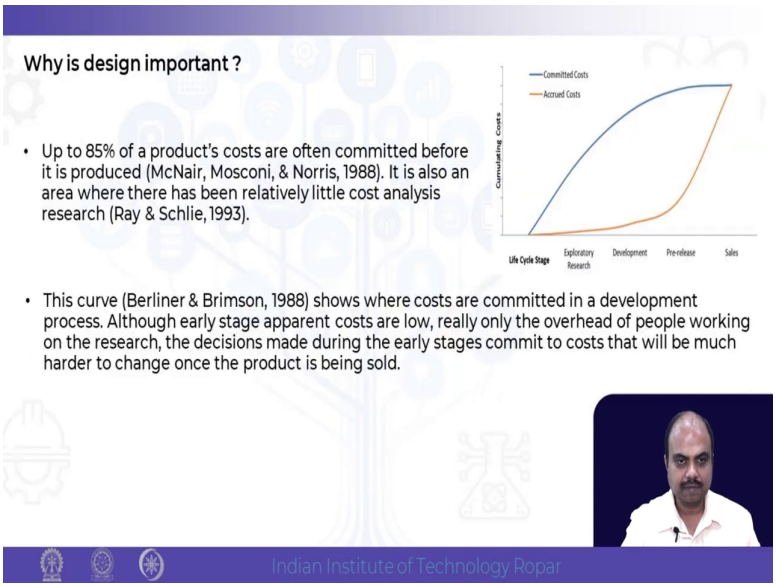


So, now, question is we are talking about product design and why product design is so important. Product design is important because that is 85 percent of the product cost are often committed during the during before it is produced this lot of researchers has been has done

this research and therefore, found out that it is also an area where it has been little low cost analysis research which means that any this design when you have.

So, if you see in the in this chart that during the initial stage of the product the actual cost which is committed is very less, but we are planning for what? We are planning for not only designing, but manufacturing of the product packaging product, of the packaging of the product, supply chain of the product, materials we are in deciding we are also deciding packaging and transportation so many things we are designing even supply chain and even other things which are related to the manufacturing everything.

We are deciding in the product design this conceptual stage only. So, each of these decision is going to have an impact direct impact on the cost of the product and that is going to be after the product design. So, we are committing a lot of cost. So, during the product design I am getting very careful that not only the cost, but the manufacturing process has to be appropriate the usage how the product usage will be there that also need to be decided power requirements there are so many things.

So, we are committing lot of cost during the product design stage itself. However, the actual cost that is the actual cost which is much less. So, if you want to change anything take for example, we are not happy with the shape of it shape the shape of the product during manufacturing we cannot do it is very difficult and expensive. So, during the product design, product if design itself we are changing the product design of it.

So, that during manufacturing whatever change is there that can be done, but the amount of change extra cost is committed is very little less. So, whatever you see that whatever change is required in the product is better to do it at the early stage and so, that the overall goal is to reduce the overhead cost and there are lot of cost which are related.

So, here whatever we see that researchers Berliner and Brimson in 1998 shows that the cost stage product cost are relatively low really only the overhead of the people working on the

research. The decision make during the early stage committed to the cost that will be much higher harder to change one of the product is being sold.

So, you will see that sometime the solar lot of issues are there in the product. So, that is the difficult to take it back and modify it. So, we should give more importance to the product design itself.

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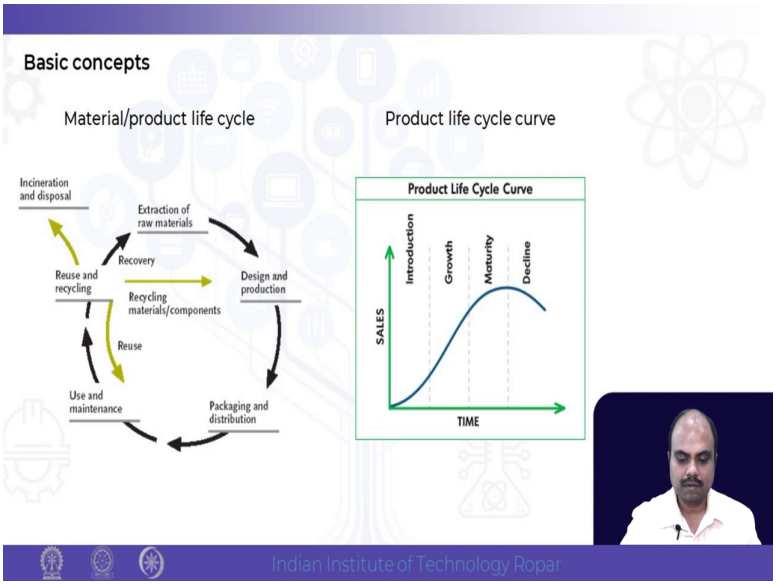


So, in the next slide what we see the basic concept basic concept is any product designer should know that a material put on life cycle that is product life cycle. When we make a product, we are basically taking the material from the ore then we are making the material after some processes, extraction of raw materials, then we are taking we are putting it to the company give it into the company the they are designing and processing, the packaging then usage, then after usage then recovery recycling reuse and disposal.

So, one of the important thing is sustainability that we will learn in this course later and sustainability is extremely important because whatever you do today it is going to affect not only was. But our next generation also the materials which we are using we will learn again after some sometime that these are recyclable, but cannot be generated energy can be there are two kinds of energy renewable and non renewable.

However, the material which are there with us that should not go to the land field. So, if you try hard to either recover recycle and reuse. The another concept which is there in the product life cycle curve product life cycle curve is the curve which you see for any product generally the introduction in terms of times the sales will be very less. So, only the growth will be there and then the maturity and then decline. So, it is there for almost all the most of the product which we see.

So, take for example, you many of you would have seen the cassette player. So, once upon a time cassette player when it started by as a workman by Sony long back the workman came the cassette player was much much before that the workman is a where you can use the cassette player and move along with you. So, this cassette player and workman that is initially it was in a growth stage maturity stage then lot of people used to buy it lot of people used to use it was very famous.

So, Sony has made lot of money by selling it. But slowly now you see that it is not there at all in the market what we have here later on it has been replaced with a small device which is which is made by Apple which is having hard drive and that is have a memory of hard drive memory and that is going to have a provision to save the music files.

But later on again it has been it has that also has declined right we have we do not carry again a movable hard drive in a in our pocket. So, then it has come with electronics a circuit is there and that is having a transistor and also some kind of you know electronic data saving system chip and that is having 256 memory and 512 memory and slowly it become 1 GB, 5 GB and that can save the memory of the music and that is provision to plate with you.

And now that is also having slowly declined now, we do not use that much we have a our mobile phone, in the mobile phone we are using the memory itself the memory chip or the inbuilt memory to save the music. So, if you see that from user perspective what they want they want that whenever I want whenever as a user whenever I want to play particular music it should be available to me, but the mode of the way in which we give to the user that has changed over time right.

So, this is important to understand that any product is going to go when the mobile which we are using that also we are going to one day it will going to have some other some decline something else is going to come now foldable mobile has come who knows after some time some other things will going to come. So, we are going to have some innovation continuously and that is a product lifecycle curve ok. So, now, we will go to the next slide.

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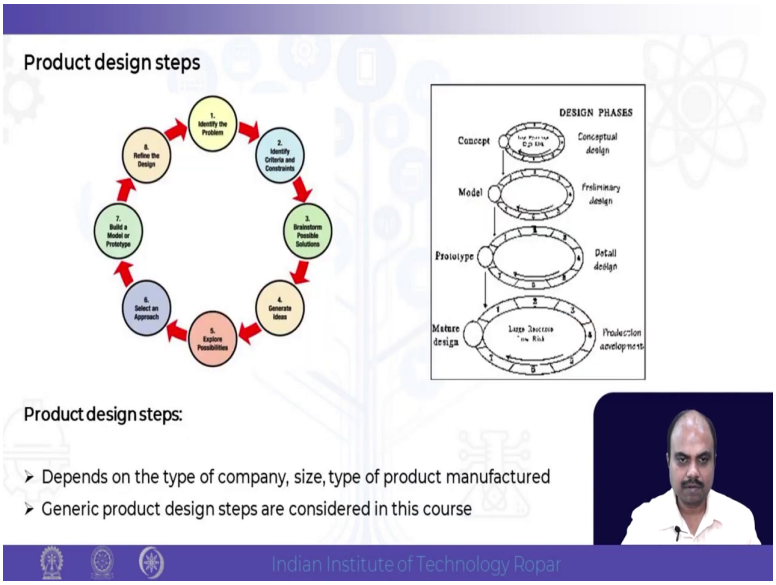

Now, we are talking about product design steps. Product design steps is depending upon the kind of company which they are designing product they are so many design when we are talking of product design in company there are various companies which are making which are designing products right starting from camera to shape. So, and then its very even very small electronic components to pen and there are so many different kinds of companies.

So, we cannot expect that all the companies which have will have the same steps in product design. So, there are various different steps are there and different companies follow a different kinds of product design steps; however, there are a lot of commonality among them. So, in general you have conceptual design, detailed design, ok.

So, now, we will let us go to the little bit of some examples if you see that in one of the steps is I can identify the problem, identify and criteria, the brainstorming possible solution, regenerate ideas, explore possibilities, select the approach, select the an approach build a model and refine the design this is one cycle.

In another cycle we have conceptual design make the model the preliminary design the detailed design prototyping and then mature design is the production development cycle.

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So, another thing we should understand in the in this that design everything about a product means sometime back I was talking I was telling that when you talking about product life cycle which we are designing in the product itself. Designing one part apart from the manufacturing, distribution, customer and end of life.

If you see that even the in the design phase itself, we are discussing that the decision has the lot of decision need to be taken in the especially for bigger products where number more number of component, more number of complexities are involved. That is business process collaboration manufacturing process collaboration, supply chain we have to decide, quality testing how the quality of the product will be tested each and every component need to be tested,

Then whether can you use statistical approach for this one where I was in where you are going to keep the product delivered to the customer how you are going to deliver to the customer, service how you are going to do service especially for cars and automobiles service is very important then customer comments how you are going to take the comments and take it back to the design phase.

So, that improvement can be made from the comment of the customers. Then product improvement, when we have the improvement, it is going to come to the next phase. So, how much time it will require for it then product concept engineering then product design engineering that this is what one of the focus of this course also.

So, in the product design we are talking about all the things together and collaboration is important. So, we are deciding not only the shape and size of the product, but also the supply chain business service all the things is going to come in the product design itself.

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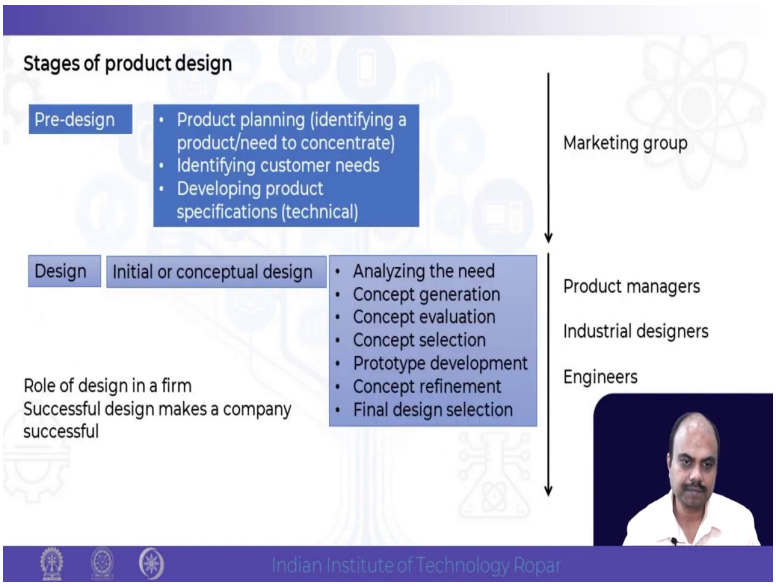


So, even though many companies follow different stage steps in the product design; however, the genetic steps which are being followed is this pre design pre designing first of all if you take from the smaller company, they are talking about product planning they are identification of the product need concentration. The especially what is the; what is the need of a product which what is the need of a customer.

So, based on that we will make a product then identifying the customer means we are going to identify what is the need of the customer in very detailed way what exactly their issues are how exactly we can help them to solve it. And then here then product design specification technical requirement specification product design specification that is going to be developed also once we have this. So, then we are going to go for conceptual design.

Conceptual design basically the initial design in conceptual design we are going to analyze the need what is the need of the product concept generation what is the mean generate the solutions which is basically lot of solution we are going to generate. And find out the best possible solution concept regulation evaluate it or the solution that find out one of the one or two of them which are best among them.

Then product development we will make the prototypes especially in labs or in computer simulation or in virtual reality or we can make it in scale version also in the lab or in the workshop or sometime we can give it to the other companies also to make some prototypes.

Then concept refinement we will once we have the prototype, we will see we will do some analysis also and find out refine it possibly and improve the design and then final design the selection this is among all this few of the designs which we have selected among there we are going to take one analyze it and take it to the next step.

So, in general the pre design is being done by marketing group, but we should understand the marketing group they have a very different way of seeing the customers their way is different from what is done by the designers.

So, there are nothing wrong they are they are doing their job they have done and understood the customer in depth as, but their way is different they are understanding what is the customer need, what kind of things are required; however, specific need of the customer need to be understand being understood.

It should be understood again and that has to be done by the designers. The designer should go to the customer ask them and here design thinking is important emphasize in the customer time to understand their pain points time to understand what exactly they need ok. So, many concepts are them may not be able to understand.

So, as a we have to use some kind of techniques to use it and find out what is the customer need. Then the industrial designer generally does the especially the looks of it aesthetics,

ergonomics and make it much much more attracted to the customers and then slowly the engineers job is going to come they are going to take the functionality of it and manufacturing of it.

So, what we see here itself there are. So, many groups of peoples are involved. So, as a design manager it is important that we make a way that data and the decisions are synchronized with respect to different groups each people understand their own requirements what exactly they need and synchronize their work with respect to one group with the another group.

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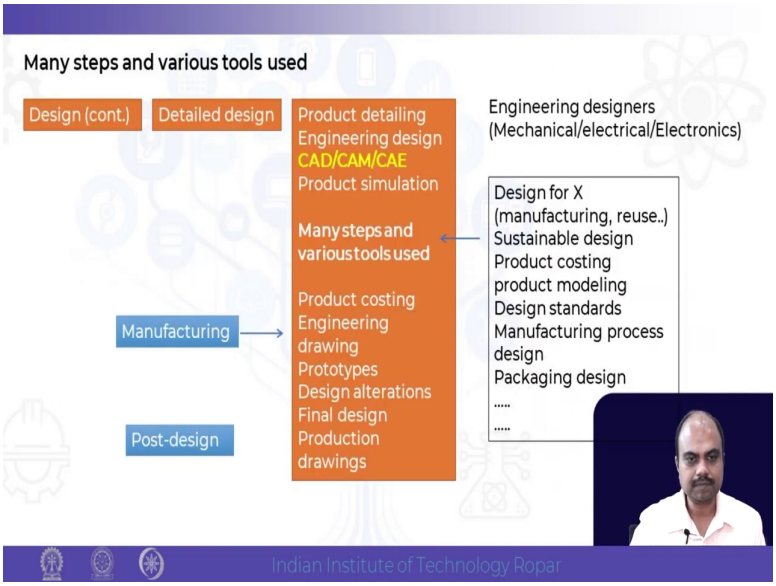


When we finish the conceptual design then we have the detailed design in detailed design we do product detailing engineering design so, from CAD, CAM, CAE. So, competitive design we do we do model, making and CAD, solid works and say solid works then we can use in X

also then in various other software. And then we do CAM competitive manufacturing, competitive engineering analysis the so many software packages their for analysis.

Then we do product simulation, virtual product simulation or physical product simulation. Then we make models again. Then here many other things are also done especially on the product is design for X design for X is where design for manufacturability design for reuse and design for remanufacturing all these are coming sustainable design, how to make products more sustainable product costing.

What is the cost of the product how we can reduce the cost and because the cost and quality is something which is both are reduction of the cost and improving the quality required. But then there is some understanding is required how we can balance among them product modeling then design standard what are the design standards which are required then product design packaging then product costing engineering drawing.

So, we have to generate the engineering drawing give it to the manufacturing giving to the manufacturing section making the prototypes design alteration then final design we are doing and then production drawing we are doing production drawing is the final production drawing which is going to for production. So, there then continuous production or in batch production whatever it is depending upon that it is taking place.

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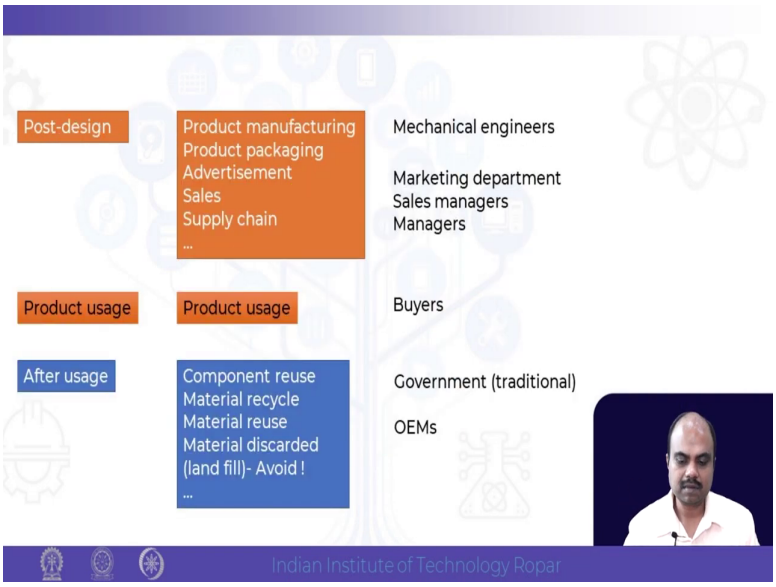


Then post design is after that post design; post design is where product manufacturing product packaging advertisement sales supply chain these are coming. So, this is done predominantly by mechanical designers and marketing department they are doing they are going to help.

Sales managers manager they all these people are going to help once it is done, we are going to save it we are going to give it to the customer transportation and customers is going to go buy it and then they are going to use it for a certain period of time after their usage is going to they are going to either repair it or. So, then again, the main concern is that all these material should not be waste.

So, we should design a product which can be reused or recycled; however, some companies are not able to do or they are not interested. So, there are some rules are there in in

government also these government rules are some recycling is be done being done by the government ok government organization.

However, there are some rules and there are some standards are there which need to be followed. So, material recycling material usage material discarding a land field that need to be reused and there is a another thing which is which is also important.

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So, now, why design is important design is important because of many as various reasons one is that great design sells great design sells more which means that if you see Apple ok Apple come through this Apple mobile phones people are really crazy and they are really interested to buy Apple.

Why? Because it is a great design it is having it is satisfying that people in various ways the brand is good people are going to buy Apple because they wanted to show that ok the Apple product, they are using some people are like that and then nothing wrong in that there are some people are were brand conscious.

The Apple product itself is good it long lasting it is really good in terms of the quality of the quality of the service which they gave it is having the own software which is very robust also. And people has used the Apple they are telling us that once you get used Apple they are they are really interested to continue using.

The great design is innovative that is what I am talking about any product which you see in the market the new product if you see a Tata Nexon or any car which is there, they are great design they are very innovative ok. If you see Mercedes Benz if you see. So, these are the cars which are which you like to buy, they are very innovative in that sense when a when a product is there and if you are feeling something innovative people are going to buy it automatically great design is honest.

So, if something is there a product is there is no cheating there is no defect then which means that when you are buying a good product from a good company well known company, we are sure that this product is going to perform and is going to perform exactly the way it is supposed to perform.

So, that is a one of the designer's responsibility and the company is responsible that quality conscious that design is important. So, great design is honest also great design is emotional. So, there are some product which you see that people like their car so much right they like there some other people like the people used to previously I have made some people who like their personal pen so much that they always try to use the same pen always.

Nowadays often I change my pen this is my pen and if this is a pen like you know pilot high tech 0.05. So, in case this is lost I have a similar pen another pen I have similar company is

having, but there are some people who like their own pen. So, they take it emotionally attached to the products which they have and this Apples for many of us.

So, great designs as a little design a possible which means that if you see some of the product which is there which is their market it is very simple looking. So, if you see this mouse any product which you see that same simple products are always very good they have a little design very simple, but they are doing the job very nicely. It communicates the cost and target audience is willing to spend the money.

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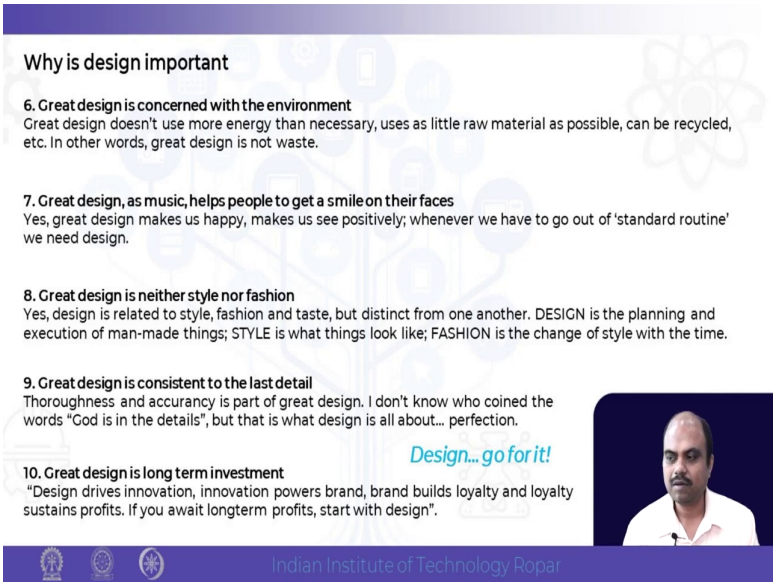


Great design is also concerned with the environment. So, as we are telling the sustainability is important eco friendly design is important and they use as little raw materials as possible. So, this is one of the one of the requirement. Now, previously it was previously it was like good to have, but now not like that all designers should have a it is required by the government by

most of the government that all over the various governments that designs has to be eco friendly ok.

So, we will learn more on this in separate separately. So, it is important that we make products which are sustainable great design as a music helps people to get a smile on their faces. So, if you see that whenever you buy a new product right, we buy a new day we feel happy right. So, if you when you feel happy this is not just about spending money and buying a product right.

So, if you buy a product and then you use it you feel happy that is makes our makes ourselves like you know these products are made to make us not only just satisfy our need, but us to make our self happy that is important as the designers. And great design is neither style nor a fashion when we have a good product in our hand it is not just about fashion ok.

So, take for example, when we use our mobile phone or especially when we use our bag. So, we just not just our fashion it is solving our problem and it is distinct from one another and design is planning and executing the manmade style and this looks like fashion it is changing of the style with respect to the time also.

Great design is consistent to the last detail throughout the accuracy of the part of the great design and. So, that they are saying. So, this the detailing is important in the product. So, when the product design is another important part of it and there is a product engineering we see a product that quality is important and to get the quality the detailing is also important.

It is a long time investment made many times we buy expensive product ok from buildings or something. And it is an investment which people doing it and it is a; it is important that we satisfy the need of the people and that is the reason design has to be innovative and it has to be sustainable. And not only the profit is being company is going to make, but is also going to help people to meet the need by making the investment for long time and it need the need for the long time.

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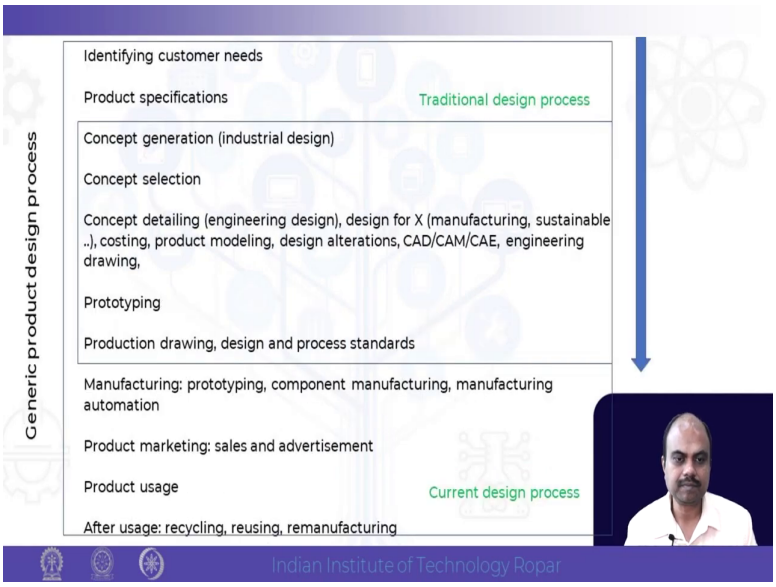


So, traditionally if you see the product design was traditionally conceptual design, concept selection, concept detailing prototyping, production drawings and manufacturing this was basically the traditional design process for many many years; however, right now it is not there. A product design right now it is much it is become a bigger activity.

So, it is starting with the customer need product specification and then the traditional like concept detailing concept selection then marketing product usage and after usage all these things are coming under the purview of product design.

Thank you.