Functional and Conceptual Design
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Lecture 3
Types of Design

We will start our journey through Product Design today. In the last two classes we discussed Product Design and what are the important challenges and how people start designing new products. From today we will discuss the different ways in which product design is attempted and what are the different kinds of design etc.

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Before going to that, let me ask you a few things. How many of you are Apple fans here? You know, Apple, not the one which you eat, the products, you know Apple? Apple iPhone, iPad? How many of you are fans of Apple Company? Very few. How many are fans of Samsung? Samsung fans, Samsung phones, Samsung TV, Samsung has bought multiple products. Do you know how they fight each other in the market?

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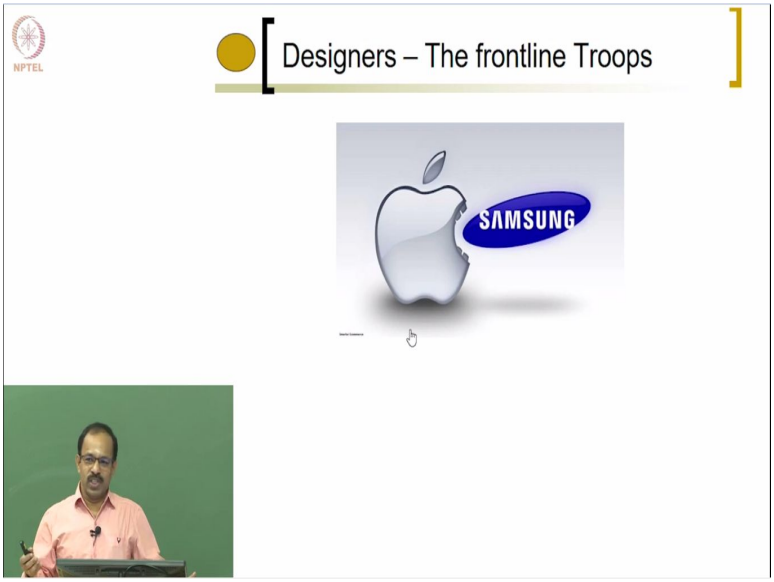

One will try to eat the other one, right. Apple will try to see how the Samsung products can be stopped in the market or how they can capture the market from Samsung or Apple and they have a lot of fights for their patents also. Might you have heard about the patent fights going on between Apple and Samsung? And what do they do to capture the markets?

What are the things these companies do to capture the markets? Pardon, Advertisement Okay, what else? Don't they bring new products to the markets? They always try to bring new products to attract customers; it is not only Advertisement. Advertisements will do to some extent, but they try to bring new products to the market. So, that they can compete with the other products that are available in the market over the competitors for the product. So, in the Product Domain or in the company's domain, the designers play a major role in making the company or breaking the company.

So, they can actually make products which will take the company to new levels or if the products are not good, the designers are not working well. And they actually go down the market; they will not be able to succeed in the market.

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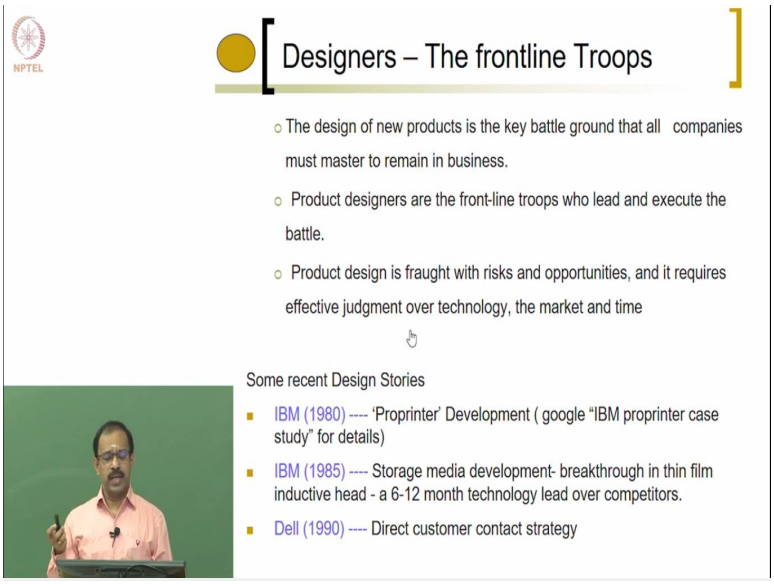

In most of the cases the design of new products is a key battleground for all the companies, especially any consumer company like Apple, Samsung, Nokia etc., you will see that new products are one of the key challenges for all these companies.

So, that is the battleground for most of these companies. They will be having a big battle to capture the markets. Have you heard of Ambassador? What are Ambassadors? Car. Do you see it in the market now? Why? They could not compete with their competitors. They did not bring new products or new cars, which will actually capture the markets. They had only one product or very few Variants.

And that was not attracting people and the other companies came up with good products, new products to compete the markets. Similarly, Nokia phone, Nokia was one of the leaders in mobile markets a few years ago. Are they in the market nowadays? Very limited presence, because they could not bring a new product. So, bringing new products is one of the key challenges for any product manufacturing company. And who will do this? Designers.

So, the designers are the one who exactly make new products and bring them to new markets. They are the frontline troops for any company or any industry. Product designers are the frontline troops that will actually fight with their competitors, all others are actually supporting

them only such as Advertisement, Pricing and all those things. But the moment you bring new products, which are actually innovative and have got a lot of features and the function which will actually meet the requirements of the customer, it will be the biggest asset for any company.

But there are a lot of risks and opportunities in any product development. Not all products will succeed, a lot of products will fail in the market because of various reasons. So, there is a big challenge or a risk in developing new products also. There are a lot of case studies from the industry, which talks about how new products are being developed or how they can actually change the whole market with bringing new products.

For example, in IBM, have you heard of IBM? What is IBM? IBM is a company which actually manufactures computers. Yeah, so they were actually the world leaders in markets or products for computer products in the 1980s. And there are no competitors for them and they were actually doing very well with the computers. But there were no, there were no printers coming from IBM. Most of the printer market was dominated by Koreans and Japanese companies.

So, they were actually very good at making printers. And all the printers or 90 percent of the printer market was completely dominated by Japanese and Korean companies. And IBM wanted to see whether they can actually start getting to the printer design, or can they bring new printers to the market and compete with the Japanese and Korean companies.

They analyzed the market and they found that they would never be able to compete with the Japanese or Korean companies in printer manufacturing, mainly because printers had hundreds of components and a lot of parts needed manual assembly. And all this was possible only in Korea and Japan because of very low cost of manufacturing or the labor cost was very low. It was possible for them to compete, make the product at a very low cost.

So, IBM decided, oh, no, we cannot do this. So, let us not get into the printer market. But one of their research heads, he thought in a different way, he said, why not? We are so big in computers. We are having so many engineers. Why can’t we make a printer? If Japan and Korea can do this, why can’t we do this?

They formed a team and then tried to understand what actually goes into the printer design and how the printers are designed and manufactured in these companies i.e., in Korea and Japan. And they formed a five-member team with the three designers and 2 persons from the marketing. And they started working on it and then analyzed each printer, each product, each component of the printer, and they realized that these are designed in such a way that only men on a manual assembly is possible.

And with manual assembly, they cannot make the product in the US therefore they decided that will rework the whole design, we will make a new printer design which is completely different from the existing printers where the number of components can be reduced to very minimum and assembly can be automated. You can use robots or automation to do the assembly and as many products as possible can be made of plastic, so that it can be easily assembled.

So, like this they actually came up with a new design where the cost of manufacturing could be brought down drastically, the manpower required can be brought down drastically. And finally, they brought out the design and then showed that they can compete with the Japanese and Korean market Korean products with almost the same cost, but it is very high quality. And so, they brought the printers they called IBM pro printer, and then that actually ruled the printer market for many years.

So, it was only the designer's innovation and the creative design of IBM designers that would actually bring the product to the market otherwise they would have never entered into the printer markets. But with the designer's creativity, they could actually enter the markets and even became the leaders. And if you take another IBM's success story about the storage media developments. That is the thin film inductive heads. So, in the 80's and 85's that period there was a big recession in the markets.

All of you know, what is recession? Economic slowdown. And IBM decided to close their research in the R and D division in the US most of the time when there is a money problem. They immediately said okay, cut down R and D. We will focus only on manufacturing and they decided to close R and D Division of IBM. But the IBM R and D Division head, he said, give me

time, I will come up with a product which will change the whole market or IBM will be world leader in that particular product, give me one-year time to develop a new product.

And IBM with reluctance there is a lot of reluctance. They agreed that okay, will give you one year's time, if you cannot bring out a new product in the market, which will actually change the whole way that people use storage media will close your division. So, the R and D head along with the product designers, they worked for one year and they came up with this product of the Thin Film Inductive Head and that actually gave them 12 months technology lead over all other companies.

So, they became the leader in that particular product. And nobody could actually come up with IBM's level of product development. Again, product designers kept the company to capture the market and then continued to be the world leader in product development. So, like this, if you look at the history, you will see a lot of Product Development and the associated lead over other companies because of only Creative Designers.

And Google, Apple and they all are examples. A lot of examples you can see that things were actually the designers could change the way products are being designed and developed by the industry and which actually gave them a lot of lead over the competitors. So, this is what we need to learn that the designers are the one which actually fight with the competitors in the market though they will not be the front line you will not be able to see them, but they are the one which actually create a lot of changes in the markets.

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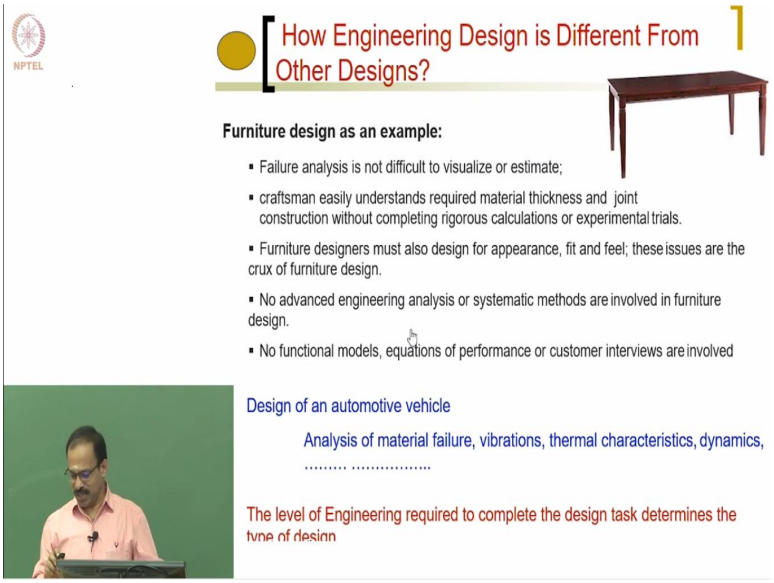

So, what these people do, the Creative Designers, what actually they do. Are they doing the same thing that we are doing? You do a lot of design. And without knowing that we are designing, something will be doing this. For example, if you go to a carpenter, you go to a carpenter and tell him I want a table. I want a study table.

What he will do, if you go and ask for a carpenter to make a study table, what he will do? He will ask the size what is the size you require or one person or two people he will ask you a few questions. And then he will say okay, oh it is a study table you want this to be used for general studies notebook writing and all those things. He will not ask you further questions right?

He will not ask you again, what should be the thickness of the leg? What should be the thickness of the plate? What should be the surface finish you need, you won't ask all these questions, he will actually make a product and then give it to you. And you do not really test whether you can actually weigh, can take the 20 kilogram or 35 kilogram and you do not really bother, because that is all routine things.

But a Creative Designer or Engineering Designer, he will go into the details and do a detailed analysis and then create the product. So, the main difference is that between a general design and a Creative or Engineering design is that the level of detail, the level of analysis you need to make is completely different from the conventional design.

Because in conventional design failure analysis,it is not difficult that Carpenter knows what should be the thickness of the leg to withstand the load, you would not do a failure analysis, you would not do a PA or a finite element analysis to find out the stress and strain and then see how much deflection it will be having when loaded. So, all those things will not be there, he will be trying to use his general knowledge and understanding to create a design that is not an Engineering design.

Engineering Design is looking into the details, making an analysis complete and coming with a new product which can actually meet the requirements of the product, the functional requirement, as well as the, the requirements of safety and all other things are considered and that is for the Creative Design or Creative Engineering design is coming. So, an analysis the, the level of analysis is what actually makes a difference in Creative Engineering design and the conventional design process. The last one is important, note the level of engineering required to complete the design task; this determines the type of design of the design.

Alright, so that was just to bring you back to the product design about what we discussed in the last few classes. So, let us just look at the way people approach that Design role. How do we classify the Design into different classes? Okay, let me skip this. Let us see this picture.

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So, you can see this set of products over here. Can you identify what this is? Pardon, Processor Yeah, this is a Microprocessor and this is an Intel Chip. This is the basic microprocessor. This is a chip which actually goes into your computers and all, and of course, this is the desktop and this is the laptop okay. And look at the next one this is the CD and this is the DVD and this is your storage media, Flash Drive and what is this one? Pardon that is the transistor. Do you know what the earlier version of the transistor was?

Yeah, they call it vacuum tubes. Now, if you look at this thing, from vacuum tube to transistor, microprocessor to laptop. Can you tell me which one was the, which one is the original design in this one? The design which actually changed the way people started using products, Pardon cassette transistor okay yeah, well. Transistors actually changed the way people use them. People use electronic devices, I am not sure how many of you have seen the old radios, vacuum tube radios, very big one. Okay. Probably in old Hindi movies you will see the hero listening to music and all.

They were actually using this kind of vacuum tube so it is a big size. And if we get a lot of space and a lot of a lot of issues with that one and that actually changed with the introduction of transistors. So, transistors can be considered as an original design, which actually changed the way people started using products. So, such broad designs which actually start or which actually change the way the market your product or make a complete change in the way people use products, such products are normally known as original designs.

Okay, similarly a microprocessor was an original design, very innovative and Creative design, which actually changed the way we started getting computers. Earlier, Microprocessor was not there, so computers were using the transistor, I mean, vacuum tubes and things like that. But with the introduction of microprocessors, you got a lot of change in the markets, and that actually created a lot of variation, a lot of New Product leading to New Products, which changed the whole market.

So, whenever we get such designs which actually change the whole market or whole product categories and wipe out many things from the market, so such designs are normally known as original designs. So, this is an original design and this was an original design. Do you

remember? Do you know what the previous way of storing, storing data was? Pardon Floppy Okay. What was there in the Floppy inside? Magnetic tapes kind of thing.

So, we are actually writing it on magnetic tapes. So, that was the way and again you might have seen the old cassettes basic cassettes. Yeah, that a tape one. So, you have two holds and then we put it in the cassette reader. The tape will be having all the magnetic reads in the data and it will be read. And that was the way how data was being recorded in the olden times. And with the introduction of CD media, everything changed completely the whole magnetic tape business was completely closed.

And then we started a new product segment, which is actually data recording digital data recording. So, CD media was one of the original designs which actually changed the way products are being designed and used for a particular application. Similar is the case with the transistor. Now looking at this kind of development, the product design can be classified into three categories. The first one is the original design.

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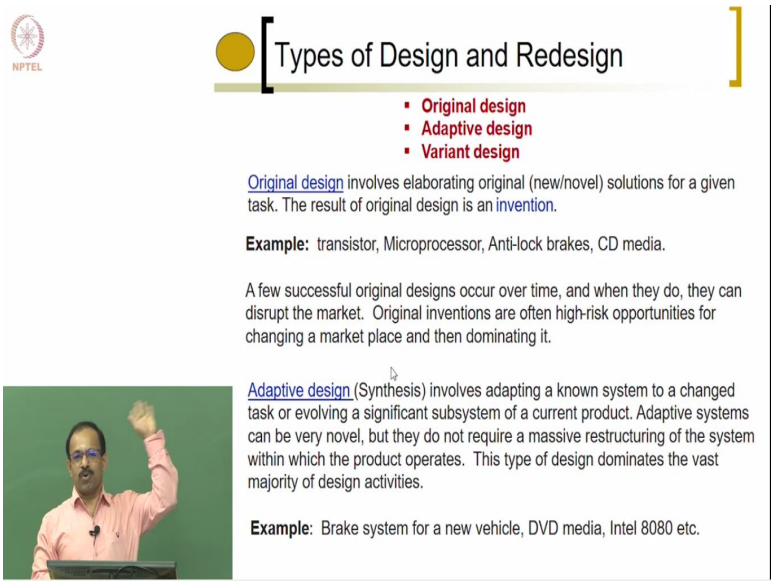

You can have an Original Design of products and the second category is known as Adaptive Design and the third category is known as Variant Design. Any product in the market can be classified into these three categories, you have an original design, which actually changes the

whole market concepts. It is a highly innovative inventive product, which actually leads to invention or may lead to a novel, novel prices also because of that, the importance of that particular technology or the products.

And that is basically known as the Original Design. When you have an Original Design, then there will be a sudden growth of products related to that particular original design, you modify that. So, when you have a microprocessor, you develop microprocessor based computing devices or whatever the device that is possible, so you develop a lot of products based on the original design, and most of these products will be highly innovative, highly creative, but we do not call this original since they actually use the product which was developed as part of original design and they use it for making new products. So, thus such designs are known as Adaptive Design.

That is, you adapt an original design you modify or adapt an original design to make many more new products, which are highly innovative highly Creative, because you are microprocessor to microchips to desktops to laptop, everything was an innovation lot of creativity was there in developing laptops and all. But all these products are known as Adaptive Designs. You are adapting a technology or a product or a new product or an original design to get a variety of products, we call it this Adaptive Design.

And the third category is known as Variant Design. Variant Design is neither original, nor Adaptive. What they do is they just change the size of the product or make small changes in the dimensions and make a smaller one to a bigger one or a bigger one to a smaller one. It is kind of like you vary the dimensions or some features to get a new product.

For example, you have a washing machine for domestic purpose you make it for an industrial purpose by increasing its capacity, increasing its torque rating, increasing its strength and things like that, all the technologies products almost remains the same not much of changes, but then you get a new products by varying the parameters of the product and such products are known as such designs are known as Variant Design. So, you have Original Design, Adaptive Design and Variant Design.

Okay, so an Original Design involves elaborating original solutions for a given task. The result of Original design is an invention. That is, it happens very rarely not every day you get an original design, because microprocessors, transistors do not happen every day. Okay, Internet, Internet was probably an original invention. And now with based on Original, which you can get hundreds of products based on the internet.

So, this way these things happen very rarely, original designs happen very rarely in the market. But when it happens, it disrupts the whole market, it actually changes the way people start using products. It changes the way people see products and probably changes the lifestyle of products, people also. So that kind of disruption in the market, if something can bring that kind of disruption in the market, then we call it an Original Design.

But then can you give some examples for original designs. I have given you a few. Can you think of? Pardon, Light bulb. Yes, Light bulb was an Original invention. But based on Light Bulb when you started doing your same principle you use it for many other things that became the Adaptive Design. Any other products can you think of Original Design? Wheel, okay yeah, Yes, Original Designs and the Lock Braking System as an Original Design.

It was nothing like that. They brought the Anti Lock Braking system into the market. And then almost all the cars started having it for cars, auto, I mean, all kinds of automobiles started using this kind of thing. So, that kind of product is very innovative, very creative and actually changes the way people start using products. IC engine was an innovative Design, IC Engine changed the way people used Vehicles.

There was, I mean, not only vehicles so many other things changed. Electricity was again Innovative but it is more of a technology but IC engine was as a product it was a Original Design. So, Transistor, Microprocessor, Anti Lock Brake, CD media, these are all examples for Original Designs. So, these actually occur only very few in, in, in a decade or so, maybe few in numbers happens, but when it happens, it changes the way people see the market or Original inventions are often high-risk opportunities for changing a marketplace and then dominating it.

So, these things can actually dominate the market once you have the products. Okay, so let us look at what is Adaptive Design. So, Adaptive Design as I mentioned it involves adapting a known system to a new application. So, now you know what a microprocessor or a CD media. Now, I adapt it to different applications or I change things, or I may completely rework on it. But my basic principle is based on the original design. And it might be very Creative, very Innovative, so nothing, nothing to say that, okay, it is not too Creative you already had it.

But it may be very Creative Design. It is not an Original Design, you make a new product by adapting the existing knowledge. And that type of design dominates the vast majority of design activities. If you look at the products coming in the market nowadays, a vast majority of the products belong to the category of Adaptive Design, because most of the things are adapted for something else.

For example, you take this camera, take your mobile phone camera, there are different products per se, but they are all adapted from a Original Design of a Camera. And from there, you adapt it to various applications. They are very Innovative, they are very Creative, nothing to say that, okay, these are all not original or they are not Creative or anything. But we do not call it as a Original Design.

We call it an Adaptive Design, which actually came out of an original idea proposed by someone else as an original product already exists in the market. Those kinds of products are basically the Adaptive Designs. Okay, any questions? So, give me some examples for Adaptive Design, any product you take and tell me what is an Adaptive Design and what product, because as I told you, the majority 90 percent of the products available in the market can be classified into Adaptive Design.

Any examples, yeah Headphones, yes headphones, yes, we had speakers and then it actually went close to your ear. Basically, adapting the same technology of a speaker is adapted to personal use or whatever. Then Pardon, Tablet PC Yes, Tablet PC, Laptop PC. These are all adaptive designs. Okay, we had a Desktop PC. And Desktop PC was actually brought down to your personal, your laptop computer and then to tablets. Yeah. Any other products?

I mean, you can see hundreds of products like that. Okay. What about your watch? Is it an Adaptive product? Yes or No? Yes. Okay. Digital watch? Okay. Then what about your Flash drive? Pen drive, is it an Adaptive Product? It was actually adapted from your CD to DVD because the same principle is being used in all but of course, in thought of Innovation Creativity coming from DVD to flash drive.

This way you can see that lots of products can be manufactured or designed and brought to the market by adapting an existing technology. Looking at a lot of Creativity, looking at a lot of design thinking and design analysis to come up with that product, but still we call it an Adaptive Design.

What is the third category? Variant Design. Okay, so this Brake system for a new Vehicle, DVD media intellectual. These are all, so Intel you can see Intel has got a lot of processors. It started from 8080 then it started a lot of other products, Pentium, Pentium 6 lot of product gathering, but these are all adapting the existing microprocessor principle, they are actually adapting that microprocessors to get new products. So, they are all coming under the Adaptive Design.

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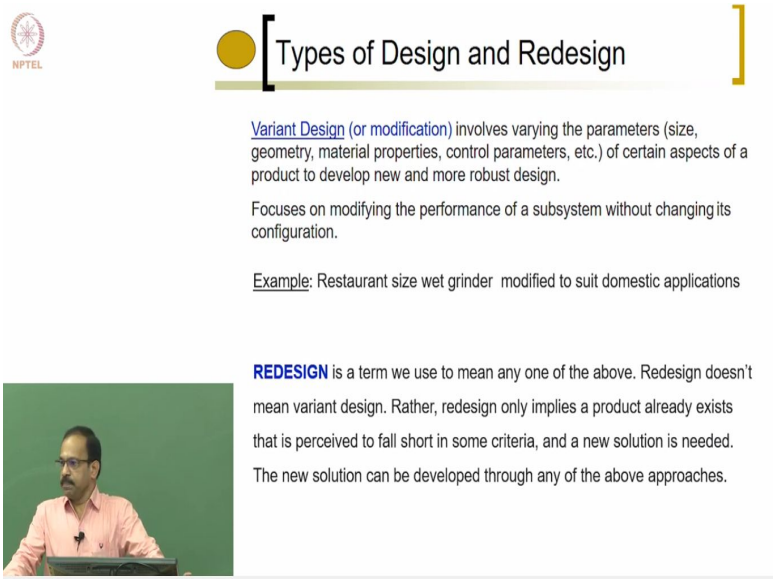

The last one is the Variant Design. Variant Design is a modification of a product to suit a particular recap. There are no technological changes in the products. It is more of a dimensional

change or parameter changes. So, certain aspects yeah. Yeah, so here actually there are no changes in the technology or the process by which the product is being used or developed. Only if they change the dimensions to meet some parameters of the product will they be changed.

For example, you are using a 100-watt motor for a particular thing. You change it to make a 300-watt motor and the size of the thing changes that kind of designs are known as a Variant Design. So, for example, you have a grinder, a domestic grinder, which I use for making your Dosa, Idli and all those things downsides. Now, you want to use it for an industry for a big restaurant. So, we will make the whole thing bigger by changing the dimension.

You have to do some design analysis to do that. But it is not that directly simply changing the dimensions and doing it, you design the new product, but you are not bringing much of Creativity into that design, you are just changing that dimension for some parameters to get a new product. So, such products are known as Variant Design. You are just varying some parameters to get the design.

It need not to be very Creative, there is not much of Creativity and Innovation needed in that but still it is a new product. It is a new product, compared to Adaptive Design, Adaptive Design because a lot of Creativity and Innovation to get new products. Variant Design, you do not need to understand why a lot of people in India are able to do this if you go to Coimbatore, you will see a lot of industries making Mixies, Grinders and all. Because there is nothing much they do as in terms of new design, they adapt the various parameters and make new products to get it because the Mixie principle is already there. They modify the dimensions or the size and then and make new products and bring it to the market.

That kind of designs are known as Variant Design. Okay, they focus on modifying the performance of the subsystem without changing its configuration. So, basically not much of a change in the configuration. Some parameters are changed to get a better performance that kind of products are designed and known as Variant design. So, Restaurants size they began to modify to suit a domestic application or the other way around.

Air conditioners for room, Air conditioner to an industry air conditioner, the principle remains the same and the most of the parameters will be changed and configuration little bit of changes in the configuration, but otherwise, there is not much of changes in the whole product. So, that kind of design are known as Variant design. Got it. So, what are the three types of designs?

Original Design, Adaptive design and Variant design, these are the three kinds of design that exist. But many times, people say Redesign Have you heard of Redesign, yeah, so, what is Redesign? So, it implies that a product already exists that is pursued to fall short of something or it is not meeting our requirement. So, you want to Redesign the product to meet our requirements. So, that is basically a Redesign. And this Redesign can be done through any of the three methods that we discussed.

You can have a completely new design, you can come up with a completely new idea to meet that requirement or to overcome the deficiency in the products. Or you can have an Adaptive design or you can have a Variant design. So, redesign simply means that you want to develop a new product. But you do not know which method you are going to develop that product. For Example, as I told you, I am not happy with this project.

Because every time I have to come connect, and then check whether it is working well, I am so not happy with this product. It is not really giving me that required Pen or the Screen. So, I am not happy with this product, I want to redesign the products. Basically, I want to modify this product to meet my requirements. How do I do that?

I can actually say that okay, this is not the method to do this. Let me start working on a completely new idea which nobody has thought of, and nobody has tried. I will come up with a completely new idea where you do not need to do any of this. My technology is going to be the most novel thing. And then I will say I will redesign the products by an Original Design.

Which will be an original design, which has nothing to do with any of the existing technology or the products. If I can do that, then I am coming with an Original Design to replace these products. And that is a very risky thing because I may fail. If I had to do this, I have to try

thousands of methods and then I may fail. If I succeed, I will be the Millionaire next day, because I can have this product for my own development.

Or I can look at the existing technologies or there is a Wi-Fi technology. There is a Bluetooth technology, technology there are so many other technologies. Can I use any of these products or Wi-Fi products? Can I use any of those things to modify these? Can I adapt that to modify these products? Then I will do an Adaptive Design and get new products that are the Adaptive way of redesigning these products. Or I can look at Okay, this is big or probably if I make it smaller, change the dimension I might maybe be happy with that, then I will do a Variant design and get a new product. So, basically, redesign is a term we use to mean any one of the above that is that Adaptive Original design, Adaptive Design or Variant design.

Generally, you are not happy with the product, you want to make a new product and how do I make the new product? Should I go for Original Design, Adaptive Design or Variant Design is my choice. If I decide to go for Original Design, I will be developing a technology or a new product which is completely different from the existing one. And I will be making an invention which may lead you to complete change in the way products are being used in the Market. Okay so these are the three design methods by which you Redesign a product. Okay, any questions?

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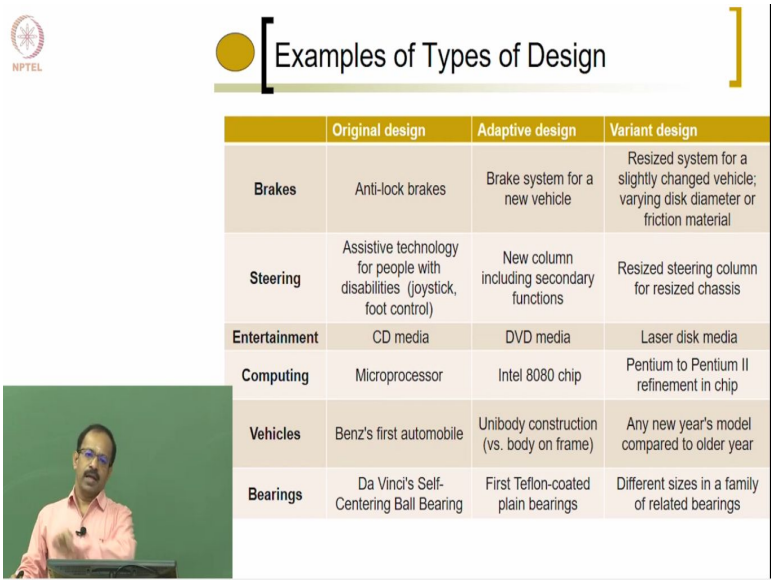

These are some of the examples for the types of design. So, you can see the Original Design, Adaptive Design and Variant Design and you can have any number of products you can take any product you will be able to see right down this. So, Brakes, Steering, Entertainment, Computing, Vehicles, Bearings, you can see a lot of things in this direction. So, when the first automobile was an invention, and then after that hundreds of automobiles came to the market through Adaptive Design or Variant Design.

Similarly, Braking system, Anti Lock brakes and the Variants of that one Bearings, Computing, Steering, you can take anything like this and then you will be able to see an Original Design and then Adaptive Design. Adaptive and Variant Design.

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Okay, so now we will stop here and to see what is the, what are the products that are happening in the markets. So, now if you search the market in the search the internet and see look at the products which are the best technology of any year 2017, 18, 19 and probably you will be able to see how these technologies actually changed the way products are developed in the market and how these products change the way people use the product for an application.

Okay. Is WhatsApp an Original Design? Yes or No? No. What was the original design in WhatsApp? Pardon, Text message okay? Is text message Original Design? Pardon, Pager Yeah. So, if you go back, what was the Original Design which actually led to all these things?

Student: Pager.

Professor: Pager, Wireless Technology, Wireless Communication, Communication Equipment, what actually led to all these things?

Okay, so now whenever you see a product, think about these things okay as Designer now you need to reset your or you need to have a mindset, which actually helps you to think Creatively. And to do that you need to look at Okay, when you see a product you look at Okay, oh, What was this, the original thing which actually led to this product and use a pen, you should think okay, what actually led to the design of this pen?

Do you know the story of American and Russian Astronauts Okay, do you know who actually invented the Dot Pen? I mean, your pen depends on you using Dot Pen. NASA? Yeah. Why did they develop this product? Okay, so NASA developed the dot pen. For what purpose? Do you know? Yeah, the Ball Point Pen or the Dot Pen what you called, Yeah, because when you are in space, you cannot use this Ink Pen, because of the Gravity, Ink would not flow, so they wanted to use a Pen in the space.

So, they did a lot of research to develop the Ball Point Pen. You know what did the Russians do? How did they solve the Problem? Yeah then they said they will write with the Pencil, why we should spend all the money for a Pen. So, write with the Pencil, Problem Solved. Yes, so we can solve the problem in different ways.

So, NASA decided to go through an Innovative and Creative or probably a Original Design and Russians decide to solve the Problem with a simple solution. They did not go for an Original Design or they solved the problem. So, every time you have a problem, so how you solve the problem depends on what way you want to approach the problem. You can have a Original Design, Adaptive Design, Variant Design. Okay so please search for the best technology of 2018

and see which was then and what are the Original Designs or Adaptive Designs or Variant Designs.

So, you can see these are the products which I have shown, that is basically from 2017. Somebody selects it. I am not saying that this is the best technology. But you can see that every year there will be a lot of things coming up as products. Okay we will stop here we will continue the discussion in the next class. So, next class we will look at what are the different processes by which products can be developed, whether it is Original Design or Adaptive Designs or Variant Designs.

Okay so before closing let me summarize what are the, what is most important you learn today? Three types of Design, that is all what you have learned. So, you should not forget, three types of Design. What are their Original Design, Adaptive Designs, Variant Designs. Okay Done, so we will meet in the next class, thank you.