Product Design and Manufacturing

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Lecture - 01
Introduction to Product Design and Manufacturing

Welcome friends. Let us get into this course of introduction to product design and manufacturing. So, this is lecture number one. So, in this lecture, we will try to cover some basics, very basics about the product, product design, and manufacturing. (Refer Slide Time: 00:30)

So, the content of this lecture will be an introduction, then the design is in two ways. One is by evolution the other one is by innovation. Then we will look into production-consumption cycle, and the ideas and methods of product realization process, certain definitions like manufacturing logistics and producibility.

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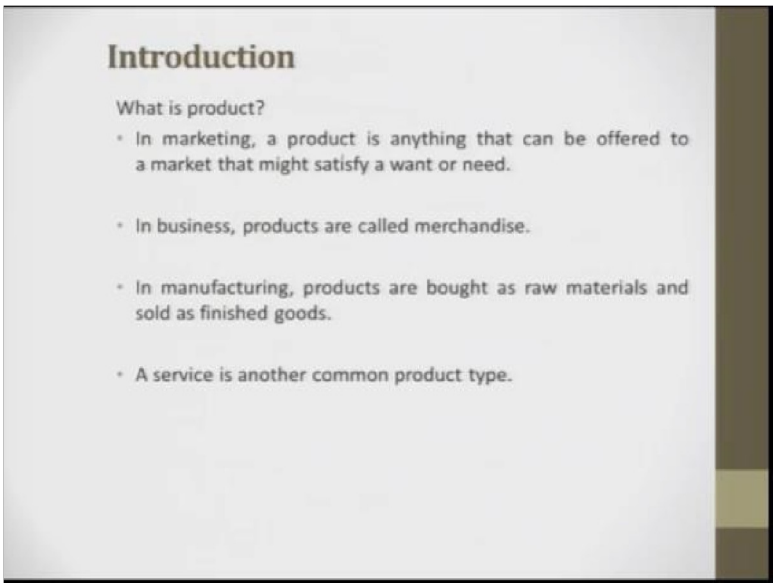

First let us try to understand, what is a product? This is very important. Product in a very crude sense is trying to understand customer needs and developing something, which is useful for the customer. And when you try to do this for the customer you also have to put in some economics into it, that is what is a very crude definition for a product if there is no customer no point in developing a product.

So, it is now very clear anything we claim it to be a product has to have some customer's right. So, in marketing a product is done in several different segments or sectors, the same product can be redefined or can be given different-different views. So, when you talk about in marketing, a product is anything that can be offered to a market that might satisfy a want or a need of a customer. Today, there are so many products which are available, and in spite of it, there are new products also going into the market; why because earlier people were happy if they get something to satisfy their needs.

Today people have started asking or demanding for customization. The key word in today's product is mass customization. When you talk about mass customization, then every individual needs a product to satisfy his or her own needs. For example, let us take the shoe and typical population of India where it is 130 billion people or let us even take 1000 people are there in a college 1000 people are there. And all these 1000 people are segmented put under several sizes like shoe size of 6, 7, 8, 9 and 10.

So, all these 1000 people have to fall in the 5 boxes of sizes 6, 7, 8, 9 and 10. Suppose let us assume a boy has a foot size of 6.5, which falls 6 size is tight to wear 7 size is loose to

wear. Now he has to take a trade-off between to choose 6 or 7. So, here the product is not customized for his requirements. Second thing when we buy shoe we all always look at the foot size, but when you talk about the foot, foot also has a covering on top of it this plays a very important role because many people have broad foot short length. So, here these people also have a problem in identifying the exact shoe for them. Another example let us take a readymade shirt or jeans pant. So, when we try to buy a pant we always get into a small problem as the length is ok, but the waist size may be tight or loose. So, again here there has to be a mass customization has to happen.

So, in marketing term, a product is anything that can offer to a market that might satisfy a want or a need. Another interesting thing let me explain to you, a product which works very good at certain geographical locations might not perform the same percentage or the same efficiency in another place. For example, let us take all European countries or let us take all developed countries the solar panel are put on the rooftop solar panels, they work at efficiency somewhere close to 15 percent. The same panels when they are installed in India or in the in the developing countries, their efficiency falls down by another 5 percent. This is because there is something called as dust factor which is present in the environment which dictates. So, which worked very well in developed countries and when it came down to India or in developing countries, the same efficiency is not reached.

So, here if you want that same efficiency, we have to do customization ok. Next in business; that means, to say in retail business, the product is always called as merchandise. In manufacturing, a product is bought as the raw material you add value to the raw material and convert it into finished goods. When you talk about service sector the product has a different definition, for example, Ola, Uber they are all also products wherein which it is more focused towards service segment and they also try to make a customer satisfaction.

Today Ola and Uber they started with a car and now they have gone to auto rickshaw and today they have come down to bicycles. So, look at it. So, there is a possibility of evolution and when this evolution happens, they always try to make the customer happy plus they also try to put an economics. So, now, I think I have made it very clear a product is something you make to for a customer, and make him happy and where

economics also plays a role, if economics and customer satisfaction is not there we do not develop products.

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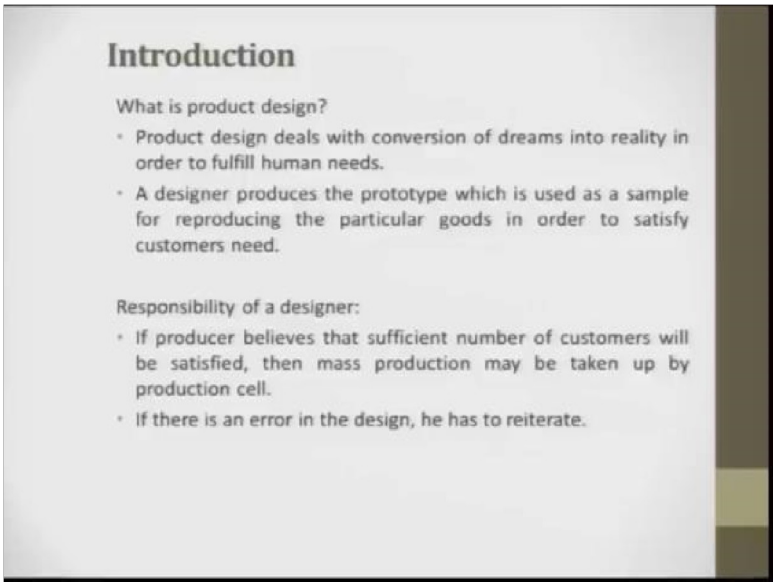

Next, I will add one term to it, which is product design. What is a product design? Product design deals with the conversion of a dream into reality in order to fulfill human needs. See why am I putting this? Because you can think of a product and you can virtually draw the product, but virtual drawing does not give a satisfaction to the customer. When you talk about video games yes of course. So, video games are more towards virtual, but when you want to have a feel for a product and when this product has to be touched and used. So, then it is like a product designer deals with the conversion of a dream into reality in order to fulfill human needs. A designer produces first a prototype and this prototype is studied several times and got customer feedback, and then what he does is he tries to freeze the design for mass production.

So, a designer's responsibility is to produce a prototype and then try to freeze the prototype such that, he can make goods for customer needs. So, what is the responsibility of a designer? The responsibility of the designer is to make sure that mass customization happens in the product. So, he produces a sufficient number of prototypes, gets customer satisfaction and then he freezes the production drawings or manufacturing process such that this process of producing can be repeatable. If there is an error he has to go back reiterate and then come back and start doing it.

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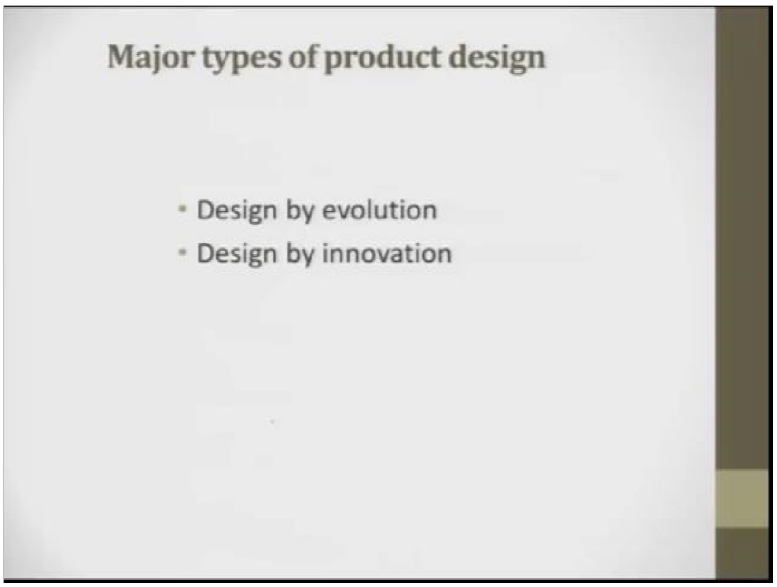

Products are of two categories or the product design is of two categories, one is designed by evolution and design by innovation.

Design by evolution means the products gets evolved over a period of time and it always has a delta x improvement, and there is not much of change in a basic structure of the product ok. This is been there for a long time, my grandfather developed a product my father improvised the product I further improvised the product, but still, the product is the same. For example, you can take a house my grandfather constructed the house my father added some energy efficiency models into the house, then I further tried to improve some other technological developments which have happened I have added to the house, but still, that house is a house which has the basic structure. The other example for design for evolution can be this bicycle.

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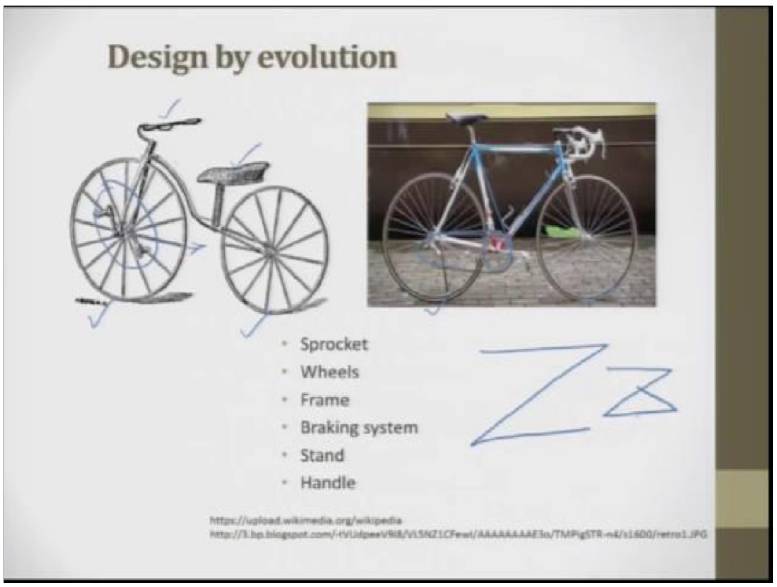

Bicycle which was maybe this bicycle came in 18 century and the full 19 century the bicycles still maintained the same design, for example, it had two wheels right it had two wheels and a place to sit and handlebar to do. The only change which happened was it had a crank at the front wheel; this was shifted to this place. So, that crank whatever was there got shifted to this portion why? Because people had difficulty in first pedaling it that is economically not a friendly and second thing is they had to apply a lot of loads.

So, this got over a period of time, this got changed and the crank got shifted here and then we had a chain and sprocket mechanism, which improved the efficiency of the bicycle. But interestingly till the late 19 century or in the early 20th century, this triangle part which was there was common in all the bicycle. If anybody you ask in sleep please draw a bicycle he quickly puts a triangle and two wheels and a seat to sit.

So, this triangle structure has now changed, today you have structures like Z, today you have structures like this; so, wherein which it is taking more strength component into the design. So, these are all recent evolutions, but this is designed for by evolution there is a delta x improvement, but there is not much of new things have got attached to it over a period of time.

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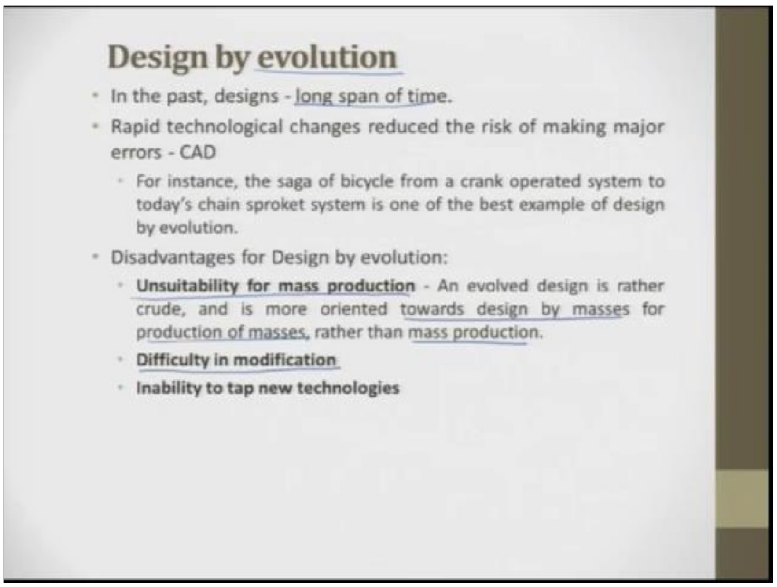

So, in the past designed by evolution was the standard thing thumb rule, which was followed here that design took a long time for stabilizing and changing. So, along spend time design was followed the same. Rapid technologies were never thought of getting added, for example, the cad which was software's were never used, cad software's with no time can give new models new designs can give you new visualization for the same, which was not thought of him designed by evolution ok.

So, then the major disadvantage because of this evolution is, unsuitability for mass production. So, look at it here, an evolved design is rather crude and is more oriented towards design by masses. So, people tried to design their own solution for production of masses, rather than mass production. Please underline this and it is very interesting towards designed by mass. So, all of them contributed to evolving the design ok, but and it was very heavy production for of masses. So, it was very heavy, but it was never for good for mass production.

Any difficult; the disadvantage of the following design for evolution difficulty in modification people were not ready to accept or companies were not ready to take because they felt that existing design is well proven why should we change the design, which is going to be more costlier for them and it did not look at new technological evolutions.

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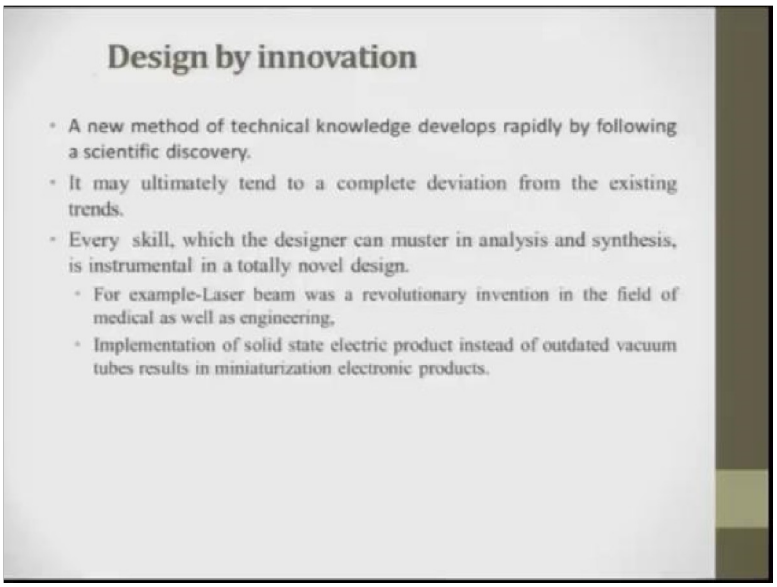

So, design for evolutions never gave a scope for adopting new technologies which were concurrently happening.

During that time of the design of a particular product design by innovation design by innovation is here people started taking a product and people started adding a lot of scientific, this new scientific discovery into it new technologies into it and they were allowing the product to evolve to develop rather than evolution. So, here there was a drastic change for example if you take a camera which was earlier a roll based camera.

So, you used to take a picture and then you the develop the film, then you make the photograph it used to have a long cycle time. Today the entire concept of photography is changed because of digitization. The computer memories space has gone smaller and smaller and smaller, the performance of the computer has gone efficiently more and more and more why because they the design which happened was by innovation, they started adding new technologies to their products, such that the product can become smaller efficient and better ok.

So, a new method of technical knowledge developed rapidly by a scientific discovery. So, this was integrated into the product. It may ultimately tend to be a complete deviation from the existing trend. So, that deviation of the photograph is earlier we had a roll based we used to have a cleaning a washing room, then we used to have a developing room, there was a developing liquid which was used all these things have changed today.

So, every skill which the designer must muster in the analysis, it is muster is a is a right word in analyzing and synthesizing instrumental in a totally novel design. So, basically what a designer has to do is, he has to go search for literature he has to go search in Google, he has to go search in for new books, handbooks and develop the technology. Do a lot of cut and paste between two technologies, try to customize it his product and develop a new product.

For example here I have given laser; a laser which was there for a long time it became more and more efficient and it became smarter over a period of time, which started initially from distance measuring cutting today it has gone to into every mall, wherein which the product numbering product counting is done by your laser scanning.

So, the laser beam was a revolutionary invention in the field of medicine as well as engineering. Initially it was used only by physicist, but today it has found a lot of application in medicine, today lot of optical surgeries are done very fast very quick and the customer is very happy the turn over time of hospitals is very is very low; that means, you say a person patience enters in the morning by noon he is done with his operation and he goes off. So, the great revolution happened because of laser bringing it into medical and engineering field.

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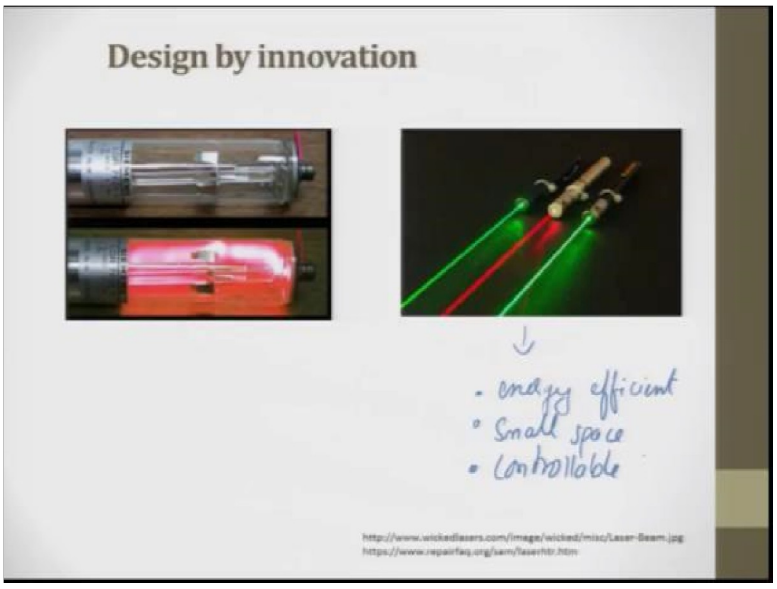
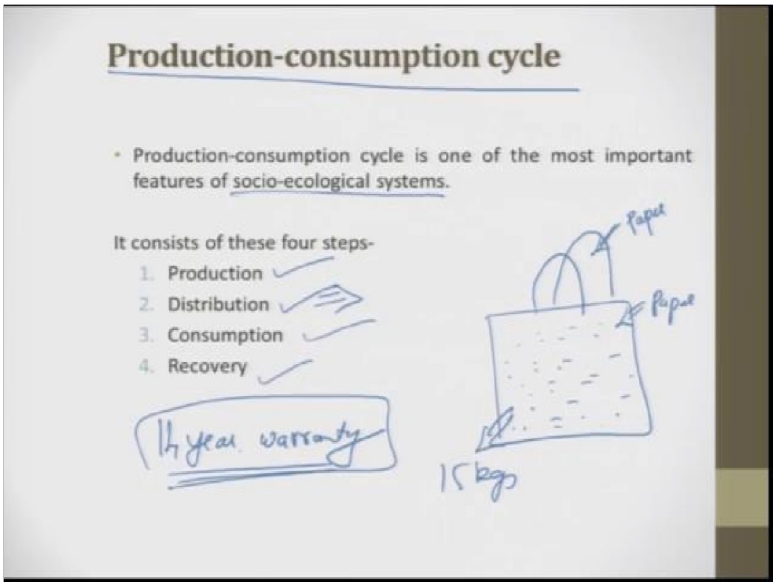


So, this is what the earlier laser design, we used to have a valve based system, today they have completely changed into the diode based system this is more energy efficient energy efficient and it occupies small space and it is controllable; that means, to say selectively tunable.

Today all the hardware with hardware drive which is there is a blue laser which quickly jumps from one segment to another segment one sector to the other sector and quickly reads the data it is all because of this laser becoming more and more efficient. (Refer Slide Time: 17:44)



So, let us get into it into another topic which is nothing, but production-consumption cycle. It is one of the most important things which features of socio-ecological systems. So, when we try to develop products we should try to have this social touch also to the product. For example, I develop a product introduced into the market what social impact that is going to happen on to the product on to the customer or to the society what social and it is also what is the change or what is the stable needs which is going to do in the socio-ecological system.

When you develop any product, today you should also make sure that what amount of social changes it is going to bring in. So, developing a product which can kill 20,000 peoples job is no way acceptable, because a developing country needs to have products wherein which they still have to involve the people around in the society. If you try to

develop all intelligent based products and if it is going to not consider the semi scaled or unscaled labor present in the society, then the product over a period of time is going to create a huge damage. So, there has to be a scope for involving everybody in the society to use that product or by giving service by you using the product to the customer is the best product which we can develop. In this production and consumption cycle, you have four steps one is a production step, distribution, consumption, and recovery.

So, production is producing, distribution how good or how efficiently you are going to distribute the produced product from one place to rest of the places. So, that is distribution and as for as when the customer is consuming the product. So, when he tries to consume what is the residue left, for example, today we use a lot of plastic bags. So, these plastic bags are going to bring a lot of damage to the mother earth. So, people recently Ii have been reviewing several projects. So, there was a product which was developed by one of our friends. So, what he did has he developed a bag which is biodegradable a bag, which is biodegradable and in this bag what he did is he has dispersed seeds of Tulsi (Basil plant).

So, when you throw this bag into the into mother nature or when you throw out, this bag is biodegradable it is made out of paper and this paper has been worked on it he has put used enough he has proved that it has enough stiffness to hold at least 15 kilos of material, and then he has made to two handles and everything which is all made out of paper itself.

And then in the base, he has dispersed a lot of seeds of Tulsi (Basil plant). So, his claim is when he tries to disperse this bag, and these Tulsi (Basil plant) are dispersed in the soil, there is a possibility a new seed can germ out. So, this is something which is very interesting. So, here he has started about the socio-ecological system, and when I tried to distribute now people are trying to talk about why see you try to distribute in the larger packet where plastics can be reduced and distribution I recently found out a very efficient way, which students are doing it.

See when this big basket company, which says that if you try to place an order of up to 1000 rupees, we do free home delivery. So, you can replace this big basket with x company, y company, z company whatever is your choice. So, x company comes in says that if you buy if you place an order of more than 2000 rupees we do a free delivery.

So, here what students have started doing the company did because they have worked out on a transportation. Students what they have come out with the beautiful module is they started having a WhatsApp and then they circulate that am going to order from this x company for whatever it is. So, you do anybody wants to be ordered in the same x company. So, then there were 6 or 7 more students added their own items to it. So, the total cost came to 2000 and then they got it delivered. So, all the students could get their products delivered to them in their room with zero transportation cost. So, a company works out with the distribution module the customer works out with the distribution module. So, these are all these are all keeping socio-ecological systems into their mind and another thing is recovery today.

So, what is happening when we look at heavy heavy products, for example, a refrigerator? So, in refrigerator what happens is, the compressor many companies give a certificate saying that I give you warranty that 14 years my compressor works, but hardly today people keep a refrigerator for more than 5 years for two reasons; one design is becoming more and more efficient two the requirement of people are also changing for example, when I am a family we are 4 members, today my I have two sons one is the age of 10 and other is of the age of 5.

So, today the requirements are I have to buy and keep a lot of fresh foods this and that, but 10 years from now or 5 years from now I become old my wife becomes old our food habits style changes, my 2 sons have now become adolescent their food habits have changed. So, I need a refrigerator which can now accommodate to the new requirement.

So, earlier the freezer was thought of to be kept on the top compartment of the refrigerator, today it has got moved now it has moved to the bottom. Earlier they used to say fridge has a standard size, today we talk about fridge with expandable size both in terms of length and breadth. We say ear earlier the refrigerator was completely controlled under one temperature, now they say every compartment can be customized and controlled depending upon your item which you place inside. So, these things are now forcing me to change to a new product. So, going back to that refrigerator example, in refrigerators they say a compressor of 14 years they give guaranty or warranty, but I change my refrigerator in once in f5 years or 7 years.

So, what happens to my compressor where a company gave 14 years of warranty? Now companies have come out with two modules the first module, they say please come back to us and you buy a new product from us wherein which we reduce the cost of the compressor. The second thing is that the company says that I will try to remove only the compressor and I will try to take that compressor by back, reset all dispose it to anybody I do not bother.

So, this is nothing but using parts which are already there in a product, which is recoverable and which can be placed in another product. I stop here and let us continue further in lecture 2.

Thank you very much.