Product Engineering and Design Thinking
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Module - 07
Product Complexity, Affordability, and Design Thinking
Lecture - 35
Frugal Engineering: A Disruptive Innovation Paradigm in Product Design and Development

Welcome back to this course on Product Engineering and Design Thinking It is today lecture number 35, which is on Frugal Engineering, which is a Disruptive Innovation Paradigm in Product Development. Actually here, the frugality means basically what we indicate is primarily is the affordability and that happens due to the reduction, drastic reduction in cost and therefore, that creates a disruption in market and so, it is the cost disruption.

So, that is the kind of paradigm that we will take up in our discourse, which is a very important issue today because the affordability is an extremely important issue not only for our country, but for all countries and all emerging economies or countries in the emerging economies.

And also, section of people in the developed economies where affordability is major issue where which are low income country or even middle income countries there, this kind of a product which is not very expensive, rather inexpensive products are required and that would meet the need of a large number of people.

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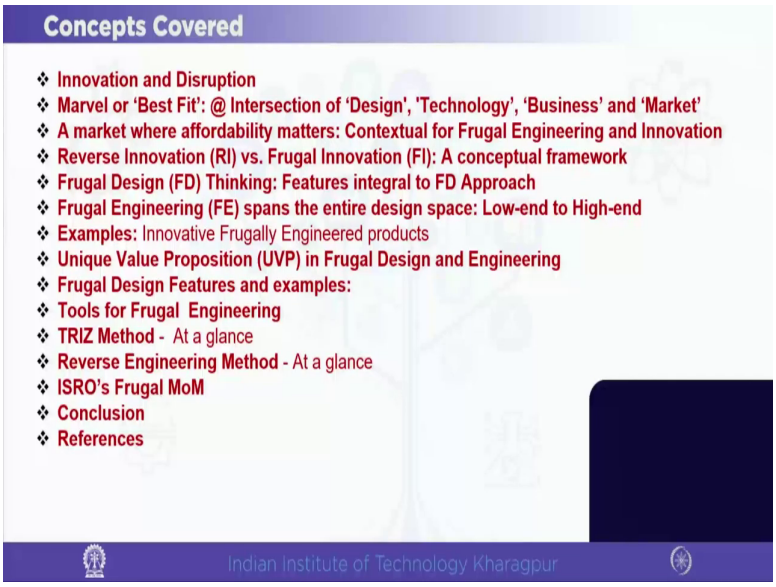

So, we will go directly with this basic premise into today's discussion. So, basically what we will do is that we will talk about what are the disruption, how it happens and then we will talk about the frugal engineering framework. And also, we would also see how this frugality which as I said is very pertinent for the emerging economy countries which are practically low income and constant with affordability issues.

But then those products can as well be exported to the western countries, the developed countries, developed economy markets where to cater to a section of people there whose income is also not high and that kind of innovation would be called reverse innovation.

Particularly here I would like to make a point here that innovation per se it is as the common belief or the notion goes is that it is a thing that happens in the developed world, in the

developed market a product is developed created and then it is sent to other countries emerging economy countries the innovation goes out.

So, basically it is kind of a triple down effect, triple down of innovation from the developed world to the emerging economy world. So, or which we called global south that is coming to the global south. So, that so, that is the you know trickle down innovation is trickle down.

What in reverse innovation we are saying is that certain innovation which is possible in a emerging economy and those can be exported to though to the even developed countries and that is for a section of people which would be benefiting from this kind of product which has high affordability and this model therefore, will be trickle up.

Earlier it was a trickle down now reverse innovation will be trickle up that it would be going from the emerging economy to the developed market. And well then, we would be talking about the therefore, how such design is possible in frugal design there must be certain value propositions we will discuss what those value propositions involved in frugal design.

And then we would discuss what are the tools available or and how what the tools we can use effectively in frugal engineering. But let me tell you that there are many tools which normally are used for general product engineering and product development and product design they can very well be used for a frugal engineering absolutely and there is no bar of using any tool. But there are certain tools specifically which are very very pertinent and which gives great advantage in terms of cost reduction particularly.

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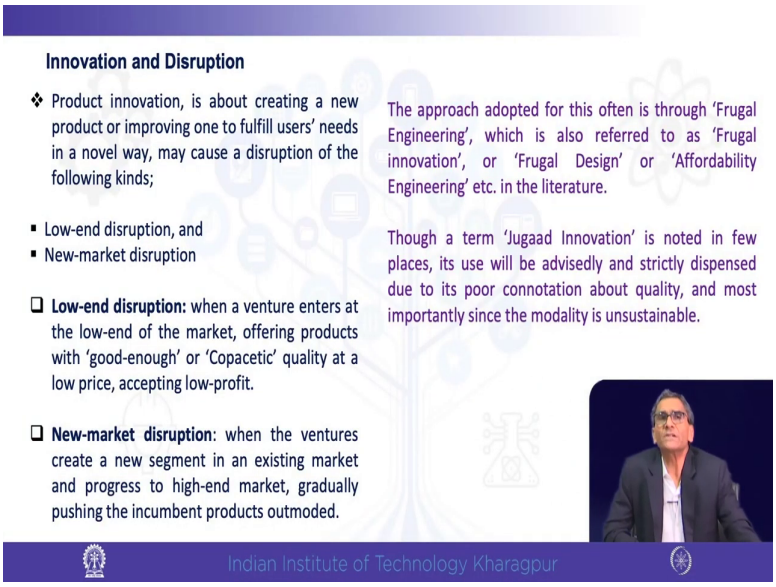

We will talk about those. So, first we will go to the disruption issue that as we said that there are two kinds of disruption one is the low end disruption which is our current focus one when a venture enters at the low end of the market offering products with good enough quality good enough means which satisfies the need it may not be the best.

Because best may need enough you know a cash outlay. For example, if I have to travel and stay in a hotel, I need not be in a seven star hotel all the time. I may be a stay in a place which is economic it may be a budget hotel. So, also you have seen the airlines now no (Refer Time: 06:24) just a just for cost of flying no foods nothing all are to be purchased.

So, those are the models that those are frugal models. Now, this good enough quality which we call copacetic this is actually our term that we have used. In fact, to we have better

publication with this term which is coming up in a book being published by Springer. So, here the quality at a low price and accepting low profit.

But then that though it is a low profit per unit, but since this demand will be more because of it is affordable then it will be made up from the volume. And new market disruption is when ventures created new segment in existing market that also is possible and then they grow into this.

So, one thing I would like to tell you many people somehow talk about frugal engineering I mean other terminologies they are used also frugal innovation frugal design those are fine. There were some people say a call it Jugaad innovation which we actually do not think it is fitting because it actually conveys the message of poor connotation about quality and most importantly it is not sustainable.

So, if something is not sustainable, we will not discuss. So, Jugaad is not our scope and we will not discuss and if and when we are saying frugal, we are not by any chance meaning it Jugaad. I am clarifying at the beginning because in literature we will see that plenty of references like this, but for our requirement and purpose we simply will not touch it.

These spacecraft which has gone to mars it cannot be sent with a Jugaad method or mentality it is actually frugally done with systematic engineering for cost reduction, alright.

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So, then we move on to the frugal engineering term actually the term was coined by Carlos Ghosn who got inspiration from the design of the car TATA Nano and he coined the term that frugal engineering Andrea Bencsik though over a this TATA Nano perhaps has not done very well.

But then the the idea is that philosophy that principle or precepts are actually have become a very important and those are being practiced by other auto manufacturers and it has been reported by Andrea Bencsik in one of these articles in 2016. And so, the Western R and D model is being reviewed by and this kind of approach is being considered.

Here let me tell you when we are saying cost reduction it is just not simply doing something which should be done, but we are not doing it is not arbitrary cost production. So, it is there is the purpose is that that it is actually defeaturing or removing the non-vital features because in

products often we find that a particularly the western world when then new products are launch declaim that ok, we are adding this feature the cost is up and all that, but then that those becomes expensive models, but then new features are coming.

But many of the features are not used. We used as a car here or in many parts of the world which can run at 200 kilometers per hour, but that is the design that has been made people are buying that car, but no one is running. Do you think in our most of the in most of the countries road condition is that it can be used no.

So, defeaturing is important and by defeaturing by actually focusing on the core features which are essential features a vital features, if we focus on that and only attend to that and address them then the cost drastically goes down. So, that is the objective, but under no circumstances it means that though it is become being made cheaper the quality is being compromised no rather it may be that since we are reducing the number of features complexity is being reduced and then its performance is going up.

So, quality or reliability is going up that also is possible. However, I mean if for a say a 50 percent reduction in cost if say 5 percent qualities or reliabilities compromised maybe a group of people still would accept that. So, here the idea is that increase in demand because of this affordability advantage would increase the a number and that will bring economies of scale and that is what is the you know important.

By the way I would tell you the Carlos Ghosn I say the Carlos Ghosn was the chief executive officer of Renault Nissan which is the leading auto manufacturing company in the world. So, what we need now you know when we are talking all these, we need to understand ok fine I mean we are talking about volume etcetera, but how much is the volume? Why is the market do we have that much of volume? Do we have so much of demand that is the question.

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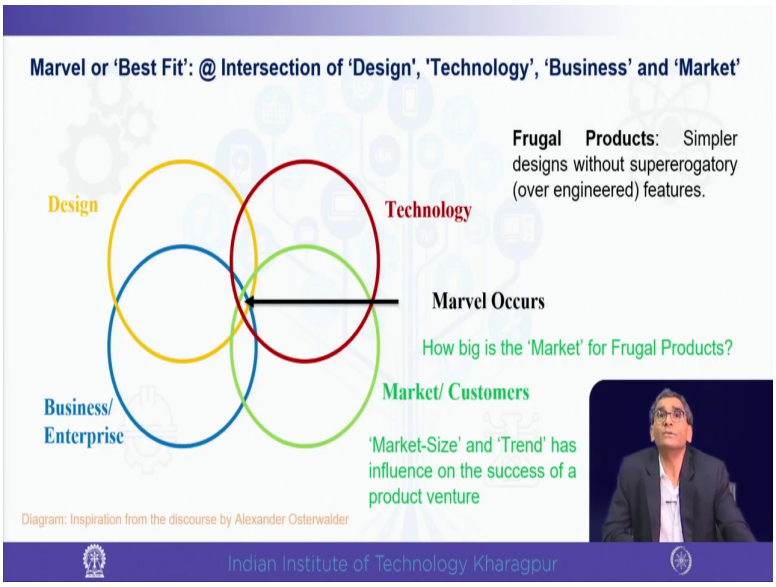

So, let us examine them now whether there is a demand or not, but before we proceed to that. So, we are talking about when you are talking about demand we are talking about the market. So, here before moving on to the exact demand analysis or finding we would just like to touch on this because as we know that design technology and of course, the business the entrepreneurs we are talking about as I said how we big is the market for frugal products.

So, because the market is a component when these four intersects, four aspect intersects then the magic happens, then they you know real you know gain happens the best fit happens. So, as you can see the intersection as which is to be produced without supererogatory or over-engineered features and that is where the marvel occurs.

Now, so if that is the case, we have to examine the market what is the market, how big is the market as we have just now started discussing. So, we so here we see that design technology

market so, we will have to touch we said that we will talk about the frugal engineering the technology aspect the design frugal design aspect. So, we will discuss them.

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Now, quickly I mean now about the market as I said the market is that it a the emerging economy countries total if you put together world is having a customer based of say more than 5 billion imagine out of a current world population of 8 billion.

And this was this is based on a survey done few years back by PWC in at that time when the population was about 7 billion it was found that that the middle was 4 billion and you just if we take one more billion at the lower end. So, 5 billion so, it is a large volume of customer. So, if we can do something here then there is no draft of business.

In fact, the western companies are actually trying to target this market and if I will give you quickly several examples where you will find particularly the world-class companies the world leaders are actually entering into this area of business this frugal products and to capture this market to capture this big market.

Now, so, here so, the affordability as I said is important, but also, we would not lose sight on the quality because quality is the fulcrum and we have just touch upon the reverse innovation part if we consider that then the market can be even more insights, alright.

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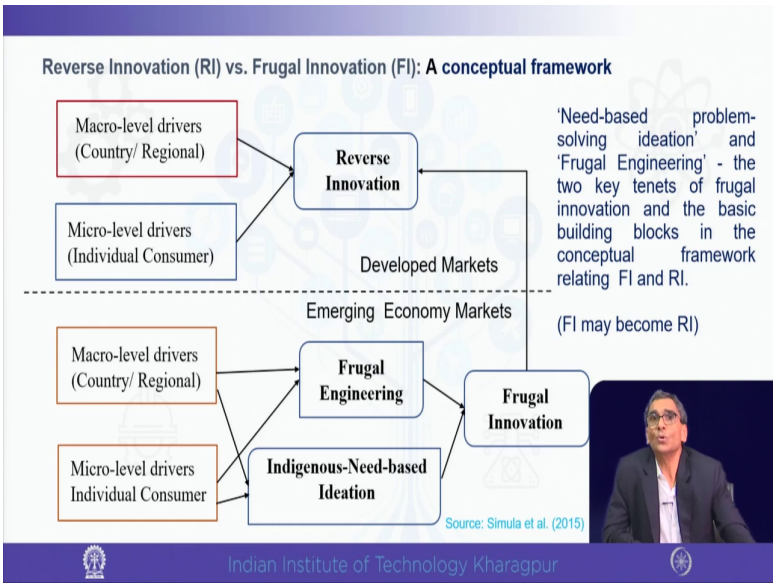

So, quickly our coverage on a reverse innovation as I have already said that reverse innovation happens when the from emerging economy it goes to developed markets and this frugal innovation goes into the developed markets. And the it is to understand that frugal

innovation is rooted in two things one is the frugal engineering that methodology that we will be discussing.

And also, the local need that indigenous need based ideation then how the we have related design thinking how the empathy for that need is important how it is addressed. So, the indigenous need-based ideation and frugal engineering these two creates frugal innovation and that some of those innovations goes into the reverse innovation.

Maybe with some additional of one or two more features may not be all can be can (Refer Time: 16:50) for reverse innovation to suits the you know requirement of those advanced countries and on the left side you find that micro level, macro level etcetera which means the national level or regional level economy vis-a-vis individuals capacity.

So, that happens in both this thing economies both in emerging economies as well as developed market which influences this frugal engineering and needs etcetera which we can see here. We need not read much into this because we have already understood what reverse engineering reverse innovation is that is what is the (Refer Time: 17:26)

So, our focus is that we if we can do a good frugal engineering job and develop a good frugal product then there is a scope of reverse innovation that is export. Basically, that export brings foreign currency that is important that you and also it would make many import substitution if you very carefully look at it.

And that is what is today's India's need and the Atmanirbhar Bharat that we are talking about actually we will come from this efforts. So, a frugal innovation frugal engineering and through that if we can reach reverse innovation and all it is route to Atmanirbhar Bharat or Self Reliant India, alright.

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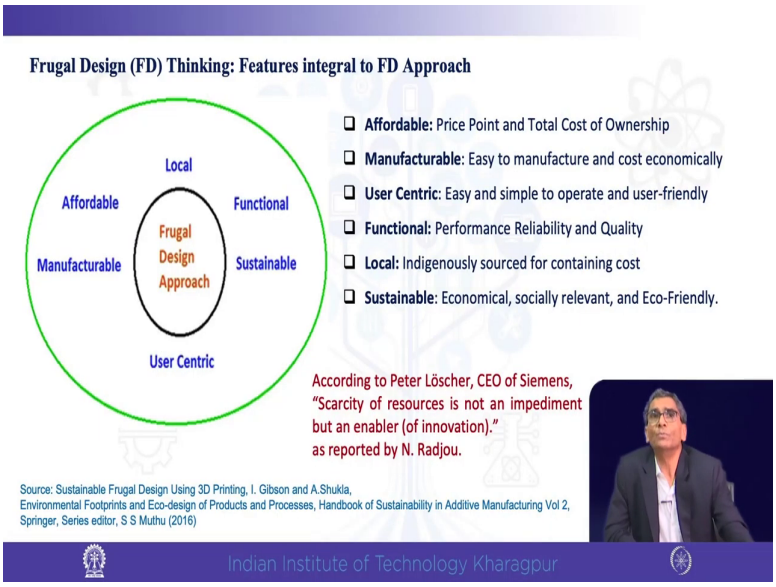

So, here very quickly we would see that the frugal design thinking has the features which are very easily understandable. I will not go into the detail and they are affordable which means a price point is low, cost of ownership is low. We will go into the detail of the some. Manufacturable which is easy to manufacture and cost economically it can be manufactured.

User centric you remember that we did in design thinking which is user-friendly functional; the functional means its performance should be good reliable and good quality functions. Indigenously it should be source. So, if something is not imported or brought from elsewhere it can be locally made with local resources it is always cheaper.

So, local and finally, sustainable that it should be socially relevant it should be economical and it should be eco-friendly it is not that we are making something cheap therefore, it would pollute the environment it would create more emission or it would do certain you know

affluent generation. So, that is not what is intended. So, these are the aspects that we have to keep in mind in the frugal design approach.

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Well, here it is nothing but the least of certain examples. So, here I mean what basically in this slide I am going to tell you is that frugal design space is I mean very wide I mean starting from pen to write with or pencil to write with to aeroplane or to ship or to even spacecraft all are coming under the purview of this frugal engineering.

I tell you why. So, here that is the list say from spacecraft to small refrigerator. So, from say car now we are talking about car Nano principle is now used by Kwid or Logan to cost reductions from the car to incubators for infants from electrocardiogram to a scanners ultrasonic scanner for X-ray machine to Prosthetic Limb all everywhere the frugal

engineering principle design principles can be used also in modern cases with a frugal innovation is possible with IoT or artificial intelligence which saves cost and time.

Well also there is a concept called bricolage which means not to invent new things, but there are many things which you can assemble and assimilate usually give a very useful product. So, you remember we were talking about the design revenue innovation. So, in the course of design revenue innovation this particular aspect will be highlighted which talks about that how just not going chasing technology how by doing design good design this good product can be realized.

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Now, I move as I said I am moving onto, but I will not spend any time on this because it is basically intended for you to look at later to look at the examples because there are many examples at present, but in shorter what I will tell you is a all frugal because say for example,

instead of computer they are using for this electrocardiogram machine by general electric they are using printer which is used for bus ticket printing I am giving one example.

So, they have been able to reduce the cost by 10 times which original cost was 10,000 dollar is now as 1,000 dollar and it is being used in several rural and semi urban areas in India which was developed here.

I will just keep on telling the examples details you may study, but this is to give you the idea of what frugal engineering is examples that is all I mean I cannot go into all the detail here; obviously, you do not expect that and that is not the purpose of today's discussion examples are many 1000s.

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So, I am giving you some of the examples like said here is a tractor which is very low cost tractor cost 2 lakhs rupees which has been developed by CMERI Central Mechanical Engineering Research Institute which is CSIR organization and that is used for that is called 'KrishiShakti' and that is used for the you know agricultural purpose and for farming as well as transporting etcetera.

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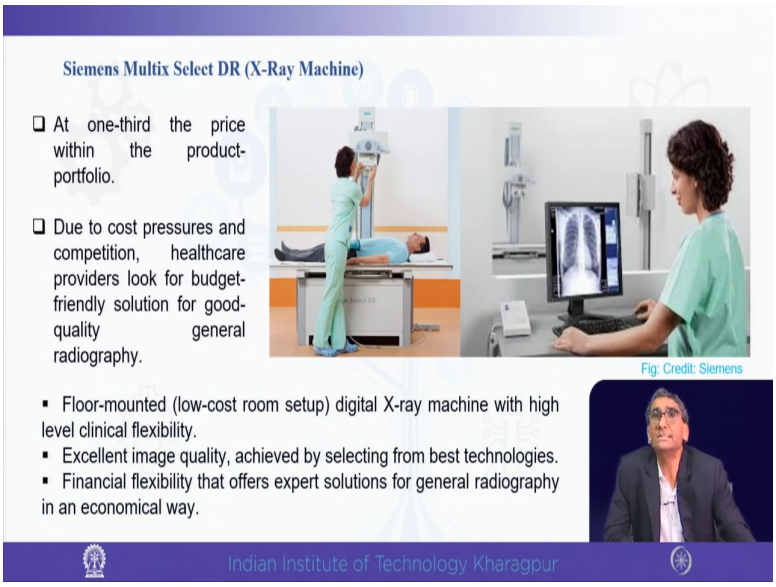

I am just giving you the examples just see what is the you know scope and (Refer Time: 23:23) see here the Siemens multix d r X-ray machine what they have done is earlier if you had noticed that the X-ray rooms were having huge structure beams and all.

So, the cost of infrastructure was really very high instead what they did was a you know floor mounted device which reduce the cost to a great extent and the digital X-ray machine with

high level clinical flexibility it is possible excellent image quality and the cost is drastically reduced it is actually one third the total cost if you look at.

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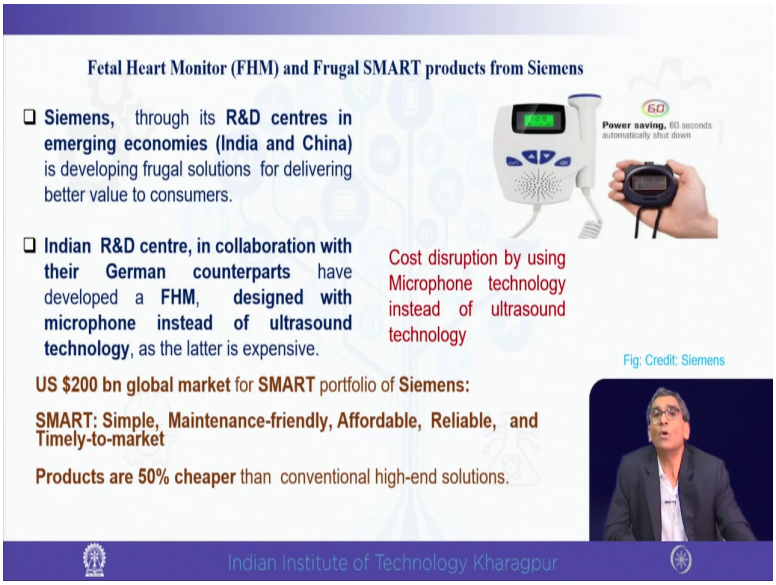

So, imagine I mean I am giving certain examples of frugal engineered products one is the fetal heart monitor which is also by Siemens and by the way I mean I would like to tell you that just for Siemens they assess that for their this fugal category product as a market of 200 US billion US dollar. I mean they call it smart in the sense that it is simple maintenance friendly affordable reliable and timely to market they call it smart.

So, look at the portfolio how big the market is. So, if anyone is trying to do it here. So, that would certainly (Refer Time: 24:48) a lot and that reduce the cost to half 50 percent is the cost. So, it is a cost disruption in the fetal heart monitor where they are using microphones

say for example, instead of ultrasound technology. So, just by using the available technology which is much cheaper much inexpensive the cost has been reduced drastically.

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In coming to the prosthetics here you see that perhaps you all have heard about Jaipur leg or Jaipur foot which is to use prosthetics on the left side you see that young boy is has lost his leg and therefore, he is using this prosthetic and possibly you may recognize the lady who is in the middle who is a very famous dancer, but she dances with wooden leg.

Sudha Chandran if you remember her and see the quality of the prosthetic is so good that one can dance using that prosthetic leg. So, this is one great example. The credit goes to Dr. Sethi and Master Ram Chandra Sharma who actually developed this and that has changed that has created a revolution in prosthetics that is absolutely wonderful fascinating.

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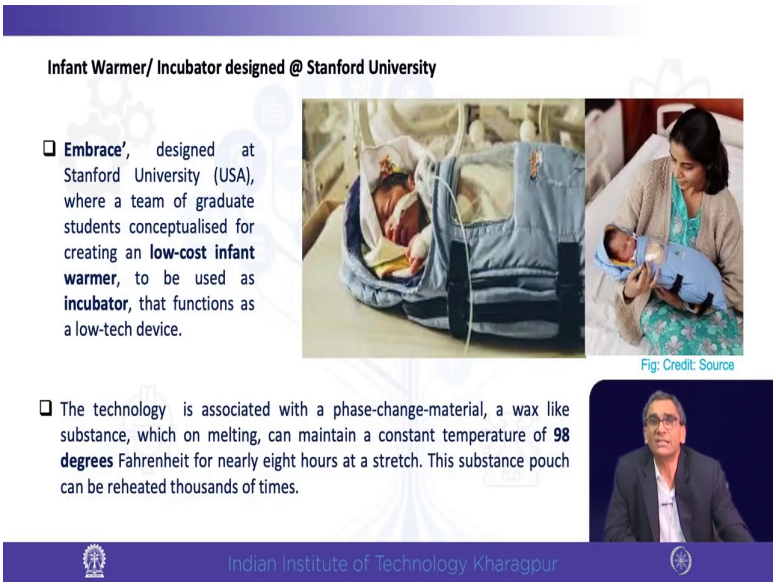

You study those details. Now, babies are in particularly developed developing countries are suffering from different many inadequacies that they do not have good incubators and all. So, if there are not good incubators how to make them work and how the babies would survive.

Embrace had the name of the product that came up came out at Stanford which is a infant warmer which uses a kind of a wax kind of a material which is a basically it is a an phase change material that we use and when it melts then it can hold the temperature for pretty long time maybe for 8 hours or so and the temperature can be reached let say 98 degree Fahrenheit. So, in that the babies can survive. So, these are low cost development, but that is immensely impactful it has huge impact.

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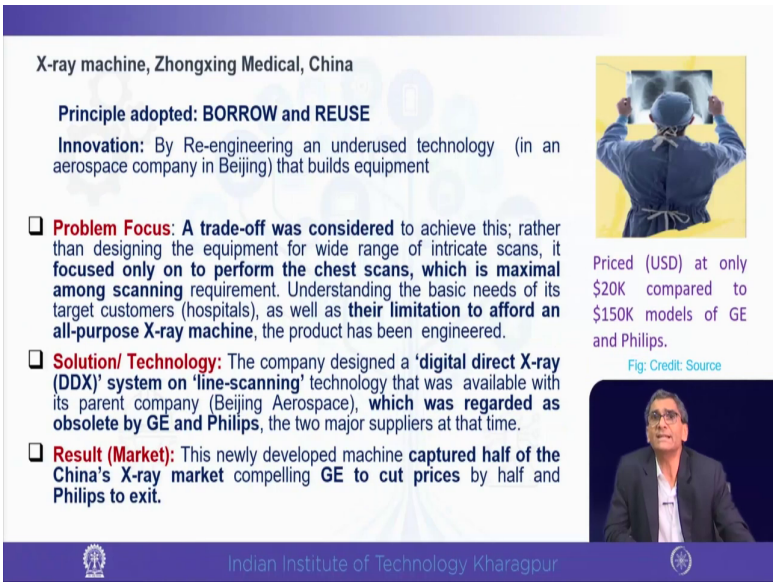

You can see I mean these are certain examples this is another example of a Chinese X-ray machine. What is the example is that? See a an a good I mean a full fledged X-ray machine will have the capability do all kinds of X-rays. But they found that that majority of the X-rays are chest X-rays.

So, at least for chest X-rays they could found find out a cheaper solution how they had you know technology available with the parent company which is an aerospace manufacturing company they there that was under used was not much used they took that and they use it for X-ray development X-ray machine development purpose.

So, it is a digital direct X-ray system online scanning. So, they have developed this, but it can do only chest X-ray, but the cost you see that it is it has become 20,000 dollar and the a Siemens and the Philips and the general electric cost used to be 150,000 dollar.

So, their focus was problem that what is exactly the problem that is the chest X-rays is the maximal one solution of technology that they used cheap available technology they did not even go for a high and sophisticate technology and the result is that they could capture 50 percent of the market in that domain and GE General Electric had to cut down its price to half and Philips simply left that competition they could not survive.

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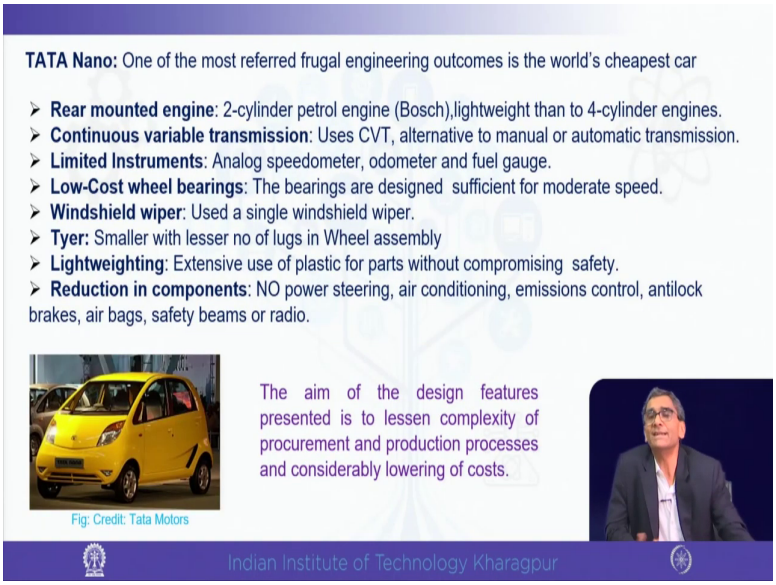

TATA Nano, I do not want to go into further detail perhaps you all know the story of TATA Nano being in India, but then I have just jotted down many things what the TATA Nano features are where say for example, they have used one wiper instead of two the two cylinder

petrol engine instead of four say no power steering or air conditioning no anti-lock brakes not airbags.

So, by that the common people could afford. Now that the principle I am again telling you those TATA Nano has not prospered for different reasons, but new variants are coming, but the philosophy is traveling worldwide. I have already referred that this is this has been said that the Kwid and Logan and many car companies are using that concept and precepts.

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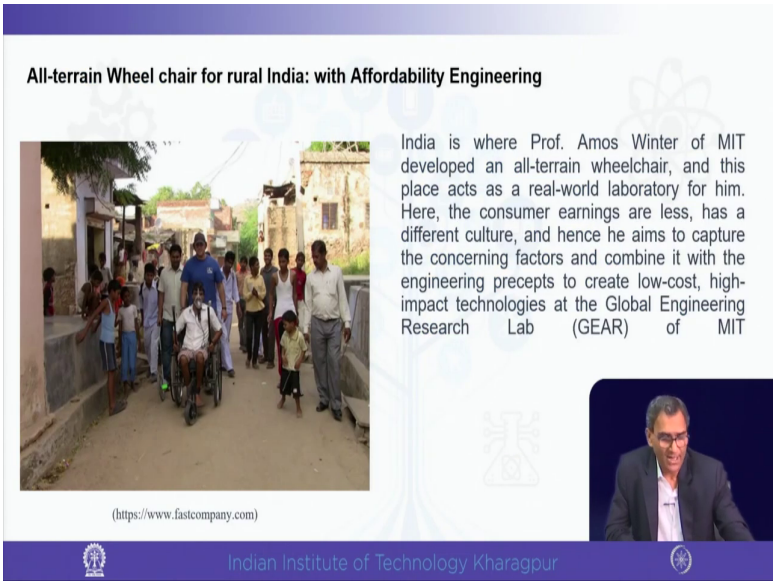

Here I would still I like to present one more example which is the Professor Amos Winter of MIT he comes to India on regular basis and the Global Engineering Research Lab GEAR is working on this which is creating all-terrain wheelchair for Indian people. So, this is very important problem that he is trying to solve because the rural roads and are not very even and

good. So, if it can travel you know in all conditions that would be very helpful for people you can look at the picture how in rural India that is being tried under.

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So, this is and they are just quickly two more Indian example one is Chotukool that that every refrigerator which does not require any compressor it works with a fan that fan is used in a computer and that that cools that this through evaporation and all. You see that lady is carrying that refrigerator on her head. So, you can understand how small it is.

So, that is one example and it is of the purpose I mean it is his it can keep that thing for say maybe a couple of days which is absolutely necessary for just saving fruit and other things otherwise it would be food waste. Aakash tablet many of you already know that it is a low cost tablet that was created in India by a company called Datawind and provided by government of India which actually help many students.

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Now coming to the value proposition. These are the main or core things that we will be discussing and as a designer this is the thing that one should focus on. It is that it should be value driven that is; that means, first is the upfront pay the price will be low, but the price also is low and then also the total cost of possession also is low or the total cost of ownership also it is called that is the price plus maintenance and repair plus consumption if whatever say it may be fuel it may be electricity.

So, all these throw their life cycle that cost would be less and also it should be eco friendly because if it creates a emission. So, that also involve certain cost of removing (Refer Time: 33:00) and all. Optimized performance with robustness this is very important because in our kind of economy and country where there are huge variation power cuts are happening

voltage fluctuations happening temperature variation from one place to another is extreme dust etcetera is there.

So, it in spite of all these it should work. So, that is one thing. Complexity reduction is important too much of complex let us say remote buttons. So, there was no many buttons people most of them do not know which button works for what. So, the simplicity if can be introduced it will be very useful.

So, and that is called elegant simplicity it should aesthetically be good, but it should be user friendly and elegant simplicity. And finally, as I said economies of scale because of the demand will go up and from that the revenue and the return and profit will come affordable excellence results from the unique value proposition.

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I would skip this slide much because all those things I have already explained and it is written there the in detail as I have already told you those things, I have explained those are all written here like say fuel and maintenance and all those things are written. So, you read that in your accordingly let us say for example, fan or refrigerator that consumes electricity car consumes fuel and so on and so forth.

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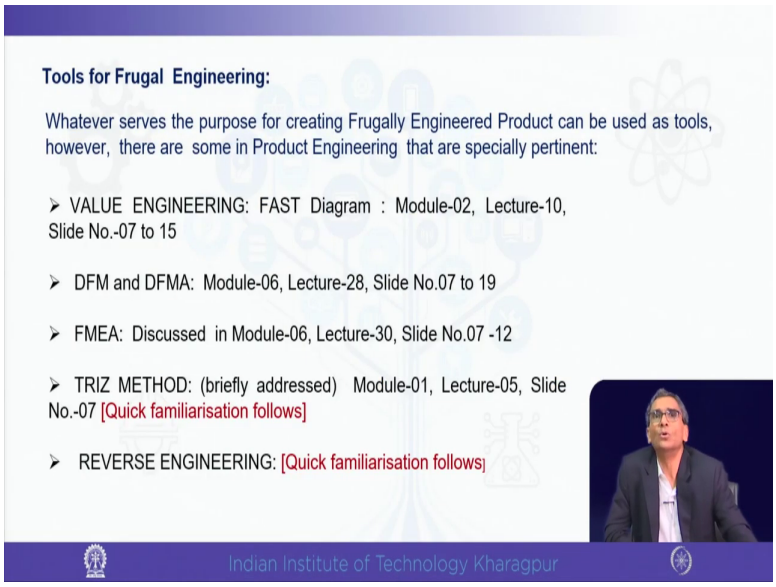

So, we will go to the almost towards the end that says that what are the therefore, tools we should use to do this. There are certain tools which are very useful outer many tools of product engineering one is the value engineering the fast diagram mostly which I have we have already been discussed in module 2 in lecture number 10.

If you look at the slide number 7 to 15 you will find the discussion on value engineering. So, I am not repeating it here. Similarly design for manufacturing or design for manufacturing in

assembly this say this was discussed in module 6 lecture number 27 slide number 7 to 19 Failure Mode and Effects Analysis FMEA that was discussed in module 6 lecture 30 slide number 7 to 12.

There are two other important tools which are called TRIZ method though briefly it was start in module 1, but a quick familiarization is required I will just do that shortly. And also another tool called reverse engineering not reverse innovation earlier I has spoken about reverse innovation which is a different thing reverse engineering is another thing I which I will explain do not confuse between reverse innovation and reverse engineering these are two different things.

And quickly so, we will nearly complete with these two tools this is, but that would be just a glance right now we because there are you can understand each tool discussing each tool you take a huge long time and that may be a course. So, if needed you can learn that later and, but here the job is to my job is to tell you I thought that is important to you to know as a designer, as an engineer if you want to use it where to go what kind of things you need and where it is available and how can it be used and what is the application.

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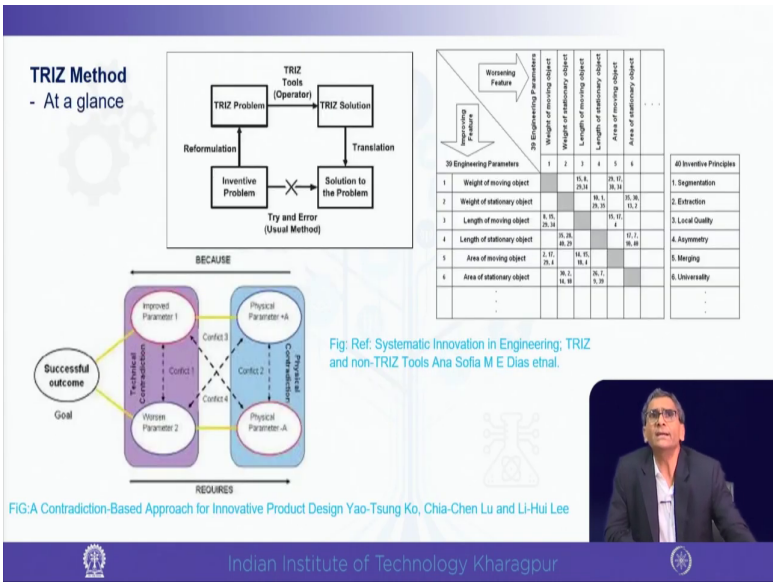

So, with that idea I am keeping the TRIZ method the first is you see that the concept is that if you have a problem there is a solution in practically a large number of cases someone some somebody has already solve it may not be for exactly your problem, but for some other problem, but you can use that solution for your problem that is a beautiful observation by (Refer Time: 37:07)

So, here the idea is that. So, so it is not if you have a problem here you see the first diagram if you see inventive problem and solution. So, it is trial and error no trial and error what rather can be done is to make it economic that inventive problem can be converted to a TRIZ problem; that means, to a general problem from a specific problem to a general problem.

And for a general problem there were too many problems general problem means there may be similar many problems and there are many solutions. So, one of those problems will have

some kind of a solution and out of those solutions you can pick up your solution. So, what I am saying is from a specific problem you are going to a host of problems which you have called general problem or a host of large number of problems and from similar problem similar problems.

So, and the how the similar problems has been solved and one of those solutions may be useful for you that is the methodology of TRIZ which has gained huge popularity. And here I am not going into the details now, but there is a thing called contradiction that is very important say contradiction means if I want to if I want to say for example, increase strength of a material of a component then its length or diameter is to increase.

So, when I am trying to do some good here some worse is happening elsewhere weight is increasing or volume is increasing or material consumption is increasing. So, there is a contradiction matrix which is on the top right I am just showing you the glimpse that is why I have written at a glance I am no I have I am no way telling you that we are discussing in detail I am just giving the impression what it works because whenever you need you can now go back to find out where to use how to use.

Now, here there are 39 engineering parameters. Now the engineering parameters we Google you will find there are 39 different engineering parameters and there are already established it is already established solution 40 solutions are available. And so, here you see the idea is that in the contradiction matrix you would find that inside boxes there are certain numbers written what those numbers are those are the solution numbers. So, so solutions are provided 40 solutions provided in a serial number 1 to 40.

So, say if on the first row if we see the third column 15 8 29 34 it means weight of moving object if we try to improve what worsens is the length of moving object. So, so if we try to reduce something increases. So, so, 15 8 29 and 34; that means, these are the serial numbers of the solution which through which the problem can be solved. So, it is a systematic problem solving approach.

At this stage I will not go beyond this because this contradiction on the left side you would see that this is a technical contradiction and physical contradiction say something to be increased to do that, but then if it increases then it is actually to be shortened. So, it is a length. So, physically it is creating a contradiction. So, at this stage I think it is not to be explored any further unless you come across a problem otherwise many one TRIZ there are several discourses maybe there are many lectures on discourses on TRIZ itself.

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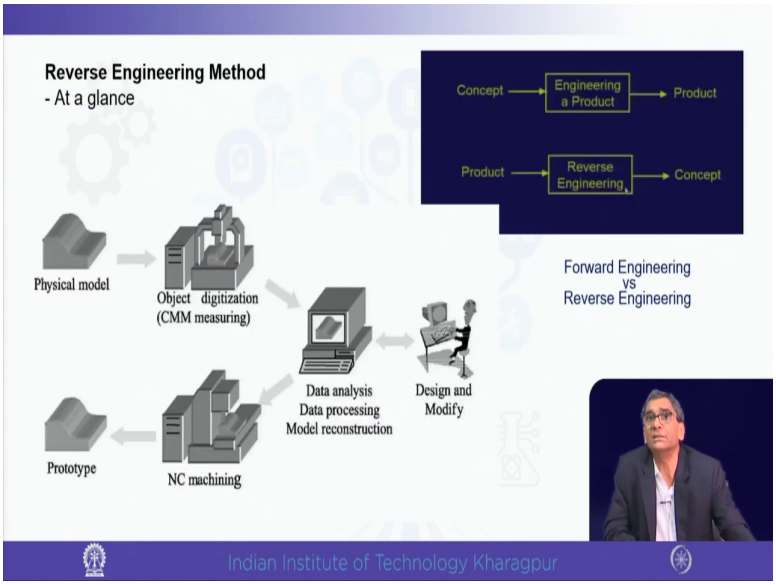

So, and also reverse engineering itself. So, I would rather touch upon this concepts and move on. So, reverse engineering is what? What is forward engineering? Forward engineering is that we create a concept as we were discussing from that we go to the you know prototype, development and then product.

Reverse engineering says that no already a product is available say this mouse is available this mouse is available. So, I want to create a mouse. So, how do I create if I can reverse engineer this, I can come to the diagram of this today I do not have the drawing of this I do not have the drawing of the mouse, but this mouse if I do a reverse engineering say using a laser scanning system and if I can capture that cloud data and through that system that is available here.

So, if we can capture and put it and as a CAD drawing. So, from the product we go back to the drawing and the purpose is just not to do a copy the purpose is if we do not if we want to save time quickly develop something already if something is available in the market competitors do that. So, pick up something look at what is a (Refer Time: 42:43) and, but then try to improve a product that is the most important thing which is called reengineering.

Reengineering is very important that just not copying copy it go from the product to the drawing then improve and that is exactly what is shown here on the diagram on the left you would see the physical model that the objective object that I was showing as mouse. The physical object is digitized by the Coordinate Measuring Machine CMM which is a laser based or optical based, but it can be tactile it may be you know non tactile both type it can touch and or say for laser it does not have to touch.

And. so, it goes into the data analysis and processing system and here I was talking about the design and modify on that you make the modification that whatever the drawing finally, comes out from the product from the product we are going back to the drawing. It is just reverse you see from normally we go from drawing to the product, but here we are going to the drawing from the product.

And then after doing the reengineering modification improvement and all we again send back to the system for manufacturing that improved version which is the NC machine or CNC machine as you know and then the prototype is created. So, it is just the reverse and it is a one good way and all the countries who have progressed a lot in developing products be it Japan,

be it China you perhaps know that they did huge reverse engineering in their you know industries and many products they brought out.

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So, I would conclude today's discussion practically saying that this you see that it is the Mars Orbiting Mission ISROs frugal MoM it is called frugal MoM Mars Orbiting Mission which caused one tenth of the cost of maven created by NASA and what they did is that instead of directly a screenshot from earth to mars they actually use to that technology of moving it around the earth for about a month and then went there.

So, that a fuel consumption was less that was a technology I mean not going into detail of the technology, but I am saying the concept and very interestingly that it was supposed to be there only for 6 months, but trust me the quality is so good I mean quality also has to be good as I am speaking now as we are discussing it is still up there orbiting around mars the quality is so

good and the report tells us that it will be there for some more time it is very fascinating. So, it is a frugal engineer product through a Mangalyaan it is called.

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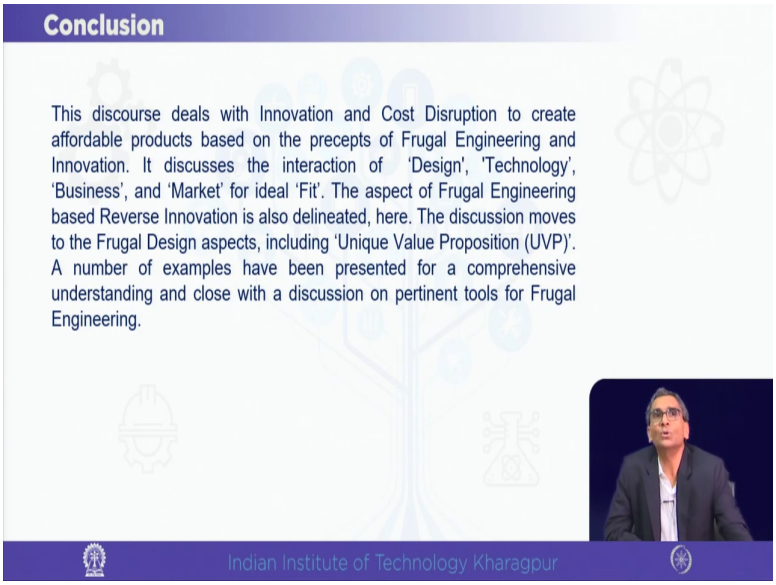

So, I would conclude saying that so we understand that this is a very important thing for emerging economy markets this discourse deals with innovation and cost disruption create affordable products based on precepts of frugal engineering and innovation it discusses the interaction of design, technology, business, market for ideal fit the aspects of frugal engineering based reverse innovation is also delineated here.

The discussion moves to the frugal design aspects I have for unique value proposition we have discussed; a number of examples have been presented for a comprehensive understanding and they we are closing close the discussion when the pertinent tools.

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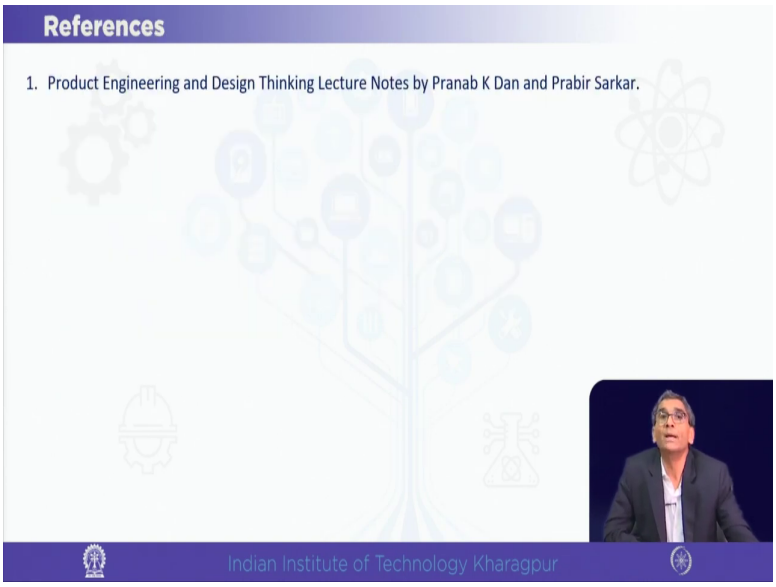

And this is the reference. So, I am sure that you have been inspired and motivated with this kind of a work that our countrymen require and also a huge population in the world requires more than 5 billion and I am sure that you would be interested to work with them and this discourse certainly would help you. With that hope I would hope that I would expect that some of you at least will try a few things to develop a model or a product.

Thank you very much for your patient hearing and I am sure that you will do good with this.

Thank you very much.