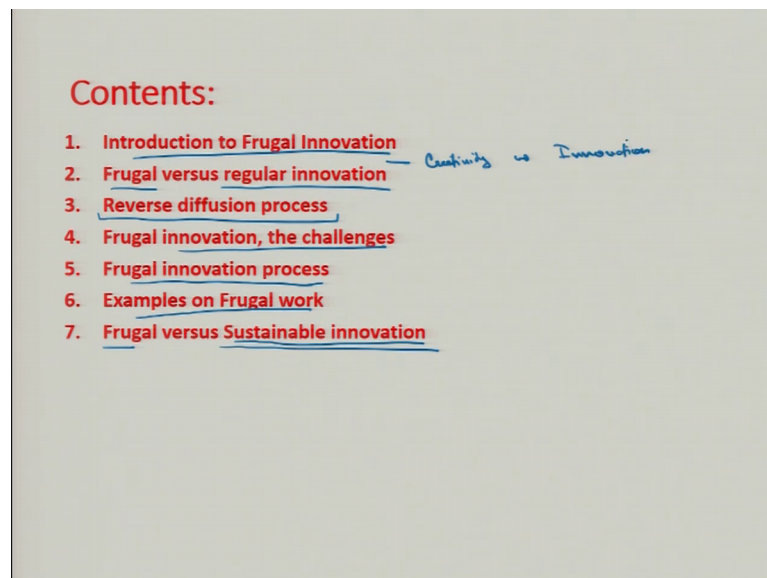


Advanced Green Manufacturing Systems
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Lecture - 16
Frugal Innovation

Good morning, welcome back to the course on Advanced Green Manufacturing Systems. We have discussed creativity in the last lecture. So, this is the continuation of that lecture and we will discuss Frugal Innovation in this lecture.

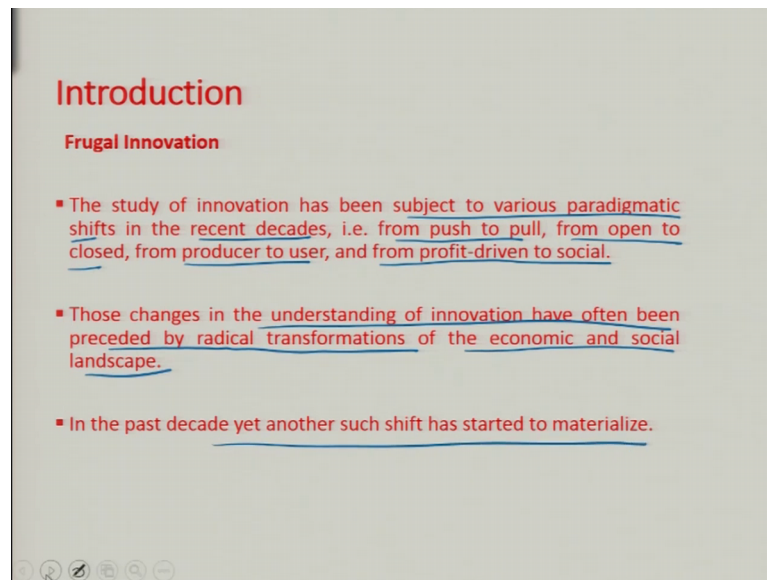
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The contents would go like this, I will introduce what frugal innovation, then we will see what is the difference between frugal and regular innovation, then we will see what is reverse diffusion process because frugal innovation is sometimes known as the reverse innovation.

Frugal innovation the challenges those are there for frugal innovation the process in frugality, examples on frugal work and frugal versus sustainable information which is a prime concern in this course.

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What is frugal innovation? Frugal innovation is reducing the complexity in the products or making the products out of scrap, making the products out of the things which are available around. Frugal innovation has a beauty that it does not have a great scientific background behind it. It is just something that is we copy from the products which are available in the market for instance one product is one of the vendors he developed a microscope costing one dollar. It was just a paper on the paper the lenses were there when we fold the paper, it develops in such a way that the eyepiece and the objective lens are aligned and one can see the space. However, the power was not their concern the you know quality of the product was not the concern, but that was a frugal innovation.

One of the vendors in India one of the creative guy I could say, he developed a refrigerator which is known as miticool. He developed a refrigerator out of sand and it can insulate your food or the items from the atmosphere up to some level. So, this is all frugal innovation we will see what is frugal innovation and we will also see some frugal products here. The study of innovation has been subject to various paradigmatic shifts in recent decades from push to pull, from open to closed, from producer to user and from profit driven to social.

Earlier what happened people just produce the products and pushed in the market those were all sold now if we impersonate to purchase a pen there hundreds of competitors if I

need to find a pen there is hundreds of competitors which are already in the market we cannot just push the product whatever is the available.

Now, the producer it is all consumers market is were these day, we say because consumers can choose which product to buy or not those things are there. So, those changes in the understanding of innovation have often been preceded by a radical transformation of the economic and social landscape. In the past decade yet another such shift has started to materialize.

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Introduction

Definition

- As a process, frugal innovation discovers new business models, reconfigures value chains, and redesigns products to serve users who face extreme affordability constraints, in a scalable and sustainable manner.
- It involves either overcoming or tapping institutional voids and resource constraints to create more inclusive markets.
- Simply, frugal innovation provides functional solutions through few resources for the many who have little means.

Bhatti, 2011

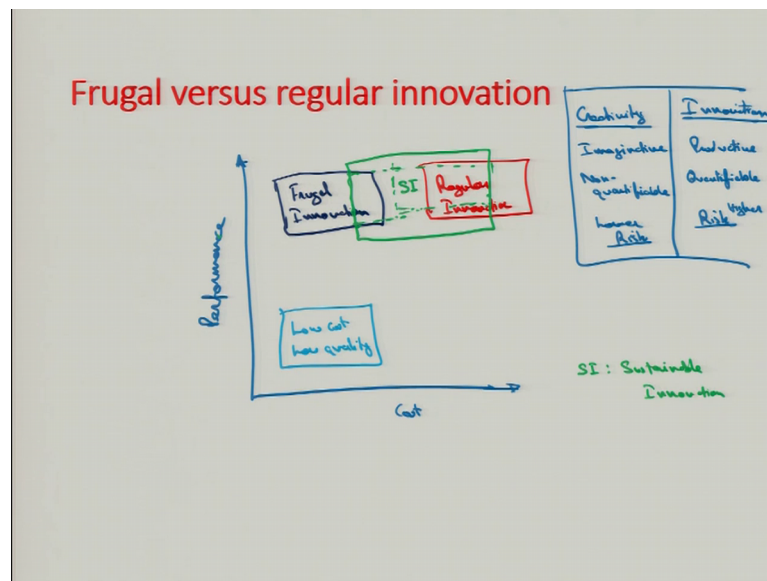
This is frugal innovation frugal innovation as a process, frugal innovation discovers, new business models, reconfigures value chains and redesigned products to serve users who face extreme affordability constraints in a scalable and sustainable manner. You see there are certain features here it is number 1 is new business models, number 2 value change reconfiguring of value change number 3 is redesign.

Users who face extreme affordability constrains, the frugal innovation the basic definition is generally it reduces the cost of the goods and tends to provide the goods available to the maximum or to the masses ok. So, it involves either overcoming or tapping institutional voids and resource constraints to create more inclusive markets, this is the definition given by Bhatti in 2011.

Simply frugal innovation provides functional solutions through few resources for the many who have little means. A few products which are developed by big companies those are also called frugal examples I could quote Nokia 1100 when it came to the market, it to had a it has certain features such a rough and tough mobile that people call it a frugal innovation. Many people or almost maximum number of people can afford this product then Tata Nano car it was also a kind of frugal innovation.

But when we are talking about frugal innovation and sustainability, will see the products those are developed from the resources those are just available around us and they are also green. They had less embodied energy in them they produced less pollution and the material is biodegradable. Those things discussed how frugal is also sustainable. Frugal versus regular innovation before frugal was a regular innovation I would like to add one more topic here, creativity versus innovation because we just had a look on what is creativity.

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So, I like to differentiate between the creativity and innovation. This is creativity and this is innovation. Now, what is creativity? Creativity is an act of creating new ideas, imaginations and possibilities. Innovation is introducing something new to the market when using the creative process something is generated, you know it is generally said if you generate 100 ideas there are only two, which are actually producible. If out of those two one product is there, which can actually serve the purpose that is innovation. In a

way I can say if in creativity, if any idea gets an application that is innovation. So, I can say the definitions I have just said. So, I can say the process here is it is imaginative and it is productive ok. Innovation is also quantifiable quantifying certain techniques are being discussed by Professor Deepu Philip in this course.

Innovation is quantifiable creativity is generally subjective, it cannot be quantified all the creative ideas cannot be quantified, but yes we can have a number of ideas which can help us to develop something out of them and innovation is aided by creativity. So, this is non quantifiable for the maximum number of times ok. Then is creativity is rating to something new and into innovation relating to something introducing something new not only thinking. Also there is risk in innovation creativity for just speculating the risk is low; risk is lower and risk is higher here higher risk, lower risk.

This is the difference between creativity and innovation, again creativity is the characteristic of a person to generate new ideas, alternatives, solutions and possibilities in a unique and different way, why innovation is an act of application of the new ideas, which creates some value for the business organization, for the government, for the people that is innovation.

Now, what is regular innovation and what is frugal innovation? In general innovation we just had number of ideas R and D departments are keep on working in their projects and they produce number of prototypes and there is high cost involved, I would just say frugal is a low cost innovation in this case. So, I can say if this is the performance and this is cost, this is the regular innovation. So, here we have the cheap products or low cost low quality and if we ought to get the equivalent performance in the lower cost, that is known as frugal innovation which means frugal right. So, this is a major difference between frugal and regular innovation in frugal innovation I can even put a chart here.

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	Frugal	Regular
Cost	Low Cost / Medium Performance	High Cost / High Performance
Users	Entrepreneurs (Risk takers, creative) Social movements Sustainable Innovation	Entrepreneurs, R and D (large orgs.) (Risk takers)
Process	Open Process	Closed process
Users	Laggards, late followers	Early adopters, Innovators,

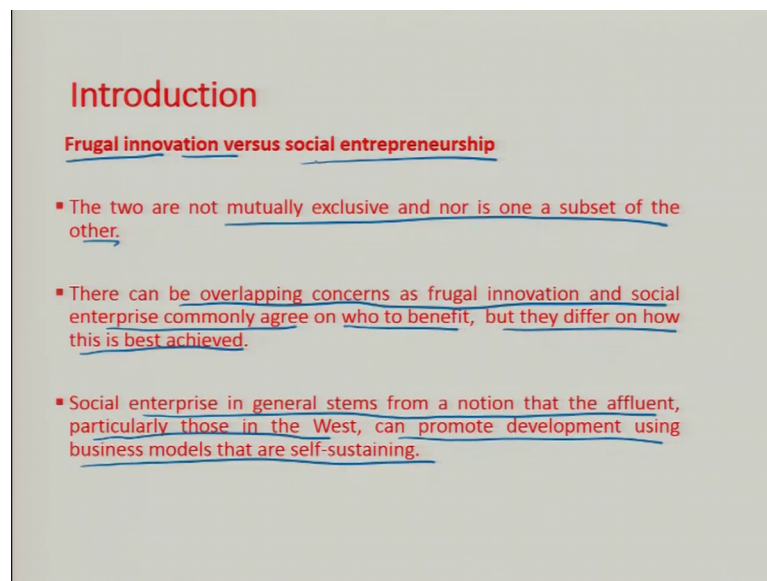
In frugal innovation and regular innovation what is the difference? The environmental the cost is one thing is this is low cost, this is high cost high performance. This can be low cost and medium to medium to high performance. The sources for the standard innovation or this regular innovation is the entrepreneurs or R and D departments this is our this is in the large organizations those who can afford certain failures.

Because, we if we are thinking of innovation sometimes there is certain experiments which we need to conduct and we fail for the multiple times and in the end we might get something that is usable. So, in that case large organizations or entrepreneurs who are risk takers and these entrepreneurs are here as well ok. They are risk takers and apart from them they are also creative right.

Then social movements sometimes some social requirements like clean India if we can say or produce or make in India, these things sometime leads to frugal innovation if some social movement is there ok. Then sustainable innovation right; the process here is open in frugal innovation, here it is the closed process. This is the difference between frugal and regular innovation also the users if we see the chart the product life cycle chart we had innovators who can who takers who buy the products which are which is just in its infancy with when the product is just introduced in the market, when the product in major in that time majority level laggards buy those products. So, those laggards can buy these products as well.

So, this is regular in regular innovation who uses the products? It is used by the innovators or early adopters early adopters or innovators the people who have high income, higher education or high risk taking people. This is generally used frugal innovation is generally used by the laggards or late followers. So, this is the difference between this is cost, this is the innovators who actually innovate the sources, who innovates say this is the kind of process and this is the users right.

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Introduction

Frugal innovation versus social entrepreneurship

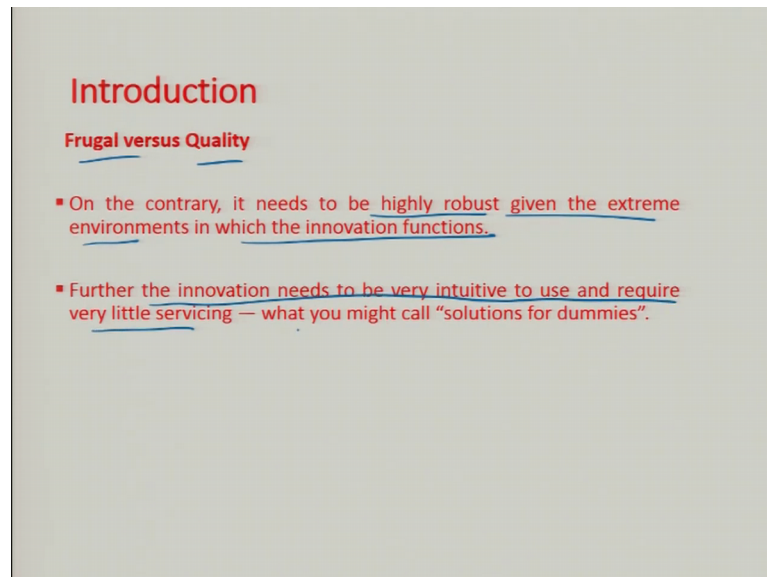
- The two are not mutually exclusive and nor is one a subset of the other.
- There can be overlapping concerns as frugal innovation and social enterprise commonly agree on who to benefit, but they differ on how this is best achieved.
- Social enterprise in general stems from a notion that the affluent, particularly those in the West, can promote development using business models that are self-sustaining.

Now, frugal versus social entrepreneurship; that the two are not mutually exclusive nor is one subset of the other, mutually exclusive means which the two items are mutually exclusive that not at all dependent upon each other they are not even mutually is not even one is subset of each other. So, there is some interaction, there is some overlapping there can be overlapping concerns as frugal innovation is social enterprise commonly agree on who to benefit, but that differ on how this is best achieved. Social enterprise in general stems from a notion that the affluent particularly those in the west can promote development using business models that are self-sustaining.

For example in IIT Kanpur, the alumina is supporting certain practices here recently we have given rupees 5000000 to an entrepreneur who has come up come up with an idea in agriculture business;. in agriculture business, in medical sciences in sustainable development all those things. These are provided by the people who are IIT alumina and who have who like to contribute something to society. So, the innovations which are

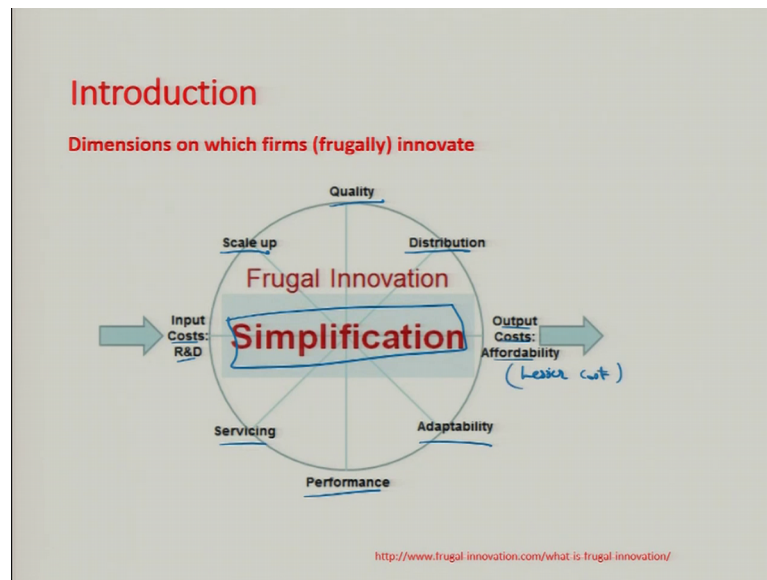
happening the entrepreneurs ideas the people apply for this funding and the interview happens and all those things are there and this is frugal innovation that is supported by the social entrepreneurship and the people who can provide the funds a frugal versus quality.

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Now on the contrary the frugal products needs to be highly robust, given the extreme environments in which the innovation functions. Further the innovation needs to be very intuitive to use and require very little servicing what you might call solution for dummies.

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There are certain dimensions on which firms can innovate. They can innovate based upon quality, based upon the servicing adaptability, performance as I have mentioned before the output costs affordability now the input costs are their R and D in the output cost is there when simplification happens, this is known as frugal innovation simplification in a way that, we reduce the cost some facilities are compromised, but more people can afford that.

We reduced sometimes we do not consider the cost we induce something green we have a process that is able to produce the product in a greener way or we have greener material and people love to purchase that, that is sustainable innovation. Now that is sustainable innovation this is frugal innovation in which we have all these parameters we can scale up distribution, all these parameters simplification happens and the output cost is lesser affordability means lesser cost, these are the dimensions in which frugal innovation happen.

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The slide is titled "Reverse diffusion process" in blue. Below the title is the sub-heading "Frugal-Reverse-Cost-BOP Innovation" in red. There are four bullet points in red text, each with a blue underline. The first bullet point states that frugal innovation is also called reverse innovation. The second bullet point is a quote from Immelt et al., 2009, warning that if GE doesn't master reverse (frugal) innovation, emerging giants could destroy the company. The third bullet point notes that the overarching theme of frugal innovation is simplification in process and outcome. The fourth bullet point states that there are many connotations for 'reverse' which are similar to frugal innovation in both process and outcome.

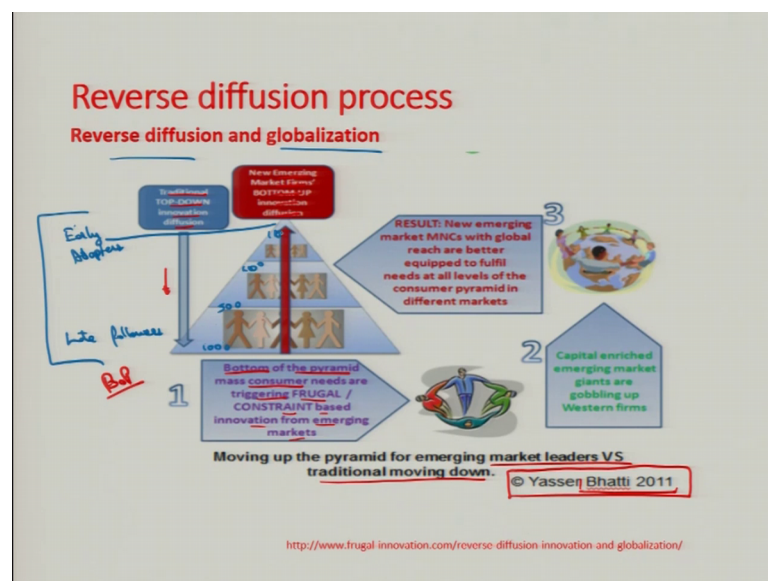
Now, frugal reverse cost base of pyramid innovation what is this? The frugal innovation phenomenon may also be called as reverse innovation. If GE does not master reverse or frugal innovation, the emerging giants could destroy the company it was said by Immelt. Reverse innovation is like benchmarking; if you know benchmarking is looking for the best practices and working.

According to that what about people are doing for instance iPhone is there in the market people have produced the phones which looks like iPhone, but those are not original iPhone there is phones which are available they can function equivalently not exactly same similar functions can happen. That is kind of reverse innovation though this cannot be set as a typical example, but the best examples for reverse innovation can be any product that is simplified and the cost is reduced that can be reverse innovation.

Although there are several dimensions to frugal innovation the overarching theme is simplification in process and outcome. They can be many connotations for reverse, which are similar to frugal innovation in both process and outcome. I will discuss about reverse engineering in some detail, reverse engineering is something we copy the product we get that 3D, scan for instance if I need to produce this product. I can scan this thing I can get cad model and that can be produced using additive manufacturing or any with other ways that is reverse engineering

Reverse innovation is a similar thing in which we innovate the idea, there are certain things which still need to be reverse engineered justified if something is patented if some technology in iPhone is patented the rivals cannot copy that. So, reverse engineering has to be very careful we cannot copy the thing, but just we can produce the similar patterns, that is reverse engineering. Reverse innovation is a similar thing reverse diffusion and globalization.

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The moving up the pyramid for emerging market leaders versus traditional moving down. Now general traditional is moving top down innovation diffusion it happens in this way. So, base of pyramid is, but bottom of the pyramid process this is known as BOP process in that what happens? New emerging market firms and bottom up innovation and diffusion happens and mass consumer needs are triggered using frugal or constraints based upon innovation emerge from an emerging markets.

So, this results in new emerging market with global reach which are better equipped to fulfill the needs at the levels of the consumer pyramid in different markets and this is taken from a reference you can read the work by Yasser Bhatti to have more information on this.

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Reverse diffusion process

Frugal-Reverse-Cost-BOP Innovation

- Firstly, frugal or reverse innovation integrates specific needs of the bottom of the pyramid markets as a starting point and works backward to develop appropriate solutions which may be significantly different from existing solutions designed to address needs of upmarket segments

Silicon India, 2010

- The context in which this innovation is seen occurring in lies in developing markets.
- It is a clear adaptation to the often poor local infrastructure facilities with respect to energy delivery systems, water access, transport infrastructure, digital access.

Now, frugal reverse cost bottom of pyramid innovation again. Firstly, frugal or reverse innovation integrates specific needs of the bottom of the pyramid markets, as a starting point and works backward to develop appropriate solutions, which may be significantly different from the existing solutions designed to address needs of upmarket segments. This is just I said we try to imitate and produce similar results and solutions should be different. So, as the legal constraints are not breached.

The context in which this innovation is seen occurring in lies in the developing markets. It is a clear adaptation to the often poor local infrastructure facilities with respect to energy delivery systems, water access, transport, infrastructure and digital access. Small applications like mobile banking people were not able to reach banks very easily in remote areas if there is some network the internet is accessible digital assesses there that is also frugal innovation.

Energy delivery systems providing power to the people in the rural in the remote areas can we devise something the methods. So, as the low cost power could be delivered to their people are working on this, then water access transport infrastructure all these come in frugal innovation.

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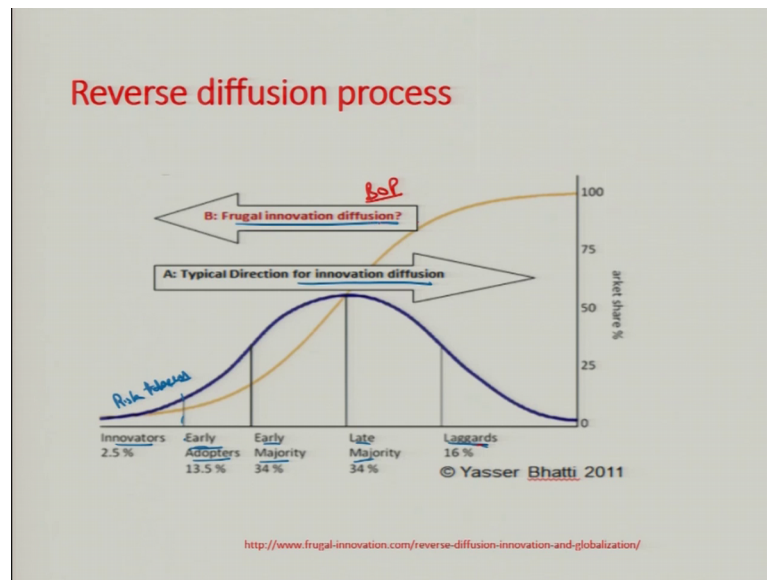
The slide is titled "Reverse diffusion process" in red. Below the title, it says "Frugal-Reverse-Cost-BOP Innovation". There are three bullet points, each with a red square icon. The first bullet point is "Secondly, there is a reverse process of diffusion among consumers." The second bullet point is "Innovation is often perceived in the developed world as technological revolutionary products tried and tested by innovators and early adopters." The third bullet point is "Trendy and expensive products are accepted by the top of the pyramid first which then get trickled down to the masses or early and late majority consumers." To the right of the second and third bullet points, it says "Rogers, 1962". At the bottom left of the slide, there are several small navigation icons.

Now secondly, there is reverse process of diffusion among consumers, innovation is often perceived in the developed world as a technological revolutionary products tried and tested by innovators and early adopters. Trendy and expensive products are accepted by the top of the pyramid first, which then get trickled down to the masses or earlier late majority consumers.

As I said at the top of pyramid is these are early adopters at the top, we have early adopters and we have the late followers. This is the difference which are quoted for the frugal and regular innovation. In general innovation what happens only a few people what is here in the pyramid it is a number of people here. It is for instance if we have 100 people here, we would have 50 people here, we would have 1 person here 10 persons here ok.

I can increase the number this is 10, 100, 500, 1000. So, the early adopters any new innovation that happens because huge cause you invested in inventing a new product or in the regular innovation that would be high cost only a few people can afford that that starts from this process that is top down general innovation in late in frugal innovation maximum number can afford because that is low cost.

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So, this is again typical direction of innovation diffusion and frugal innovation diffusion. This is his lifecycle product life cycle if you say these are innovators, early adopters, early majority late majority laggards ok. This is people who are risk takers, if the product does not go well for instance when Indica car came into the market, it did not had a great performance I am talking about something a few one or two decades back.

People felt that it is not giving a great performance it was a four gears car people thought that a fifth gear should be inculcated. It was people were rich takers would purchase the new car, then the car made certain changes and the fifth gear came into the came into picture and the car had the maximum sales in certain years among all the cars in the same group.

Now, here I was talking about the consumption patterns, this is BOP approach bottom of pyramid maximum or people who are laggards purchase this product and it goes from the right to left in frugal innovation diffusion ok.

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Frugal innovation, the challenges

1. The first challenge, i.e. resource constraints, refers to the resource scarcity that prevails in the developed markets.
2. The second challenge refers to a variation of resource constraints that rather than being faced at the upstream part of the value chain, concerns the downstream part.
3. In moving beyond resource constraints, Bhatti (2012) addresses the institutional context as the third challenge to innovation that exists in emerging markets.

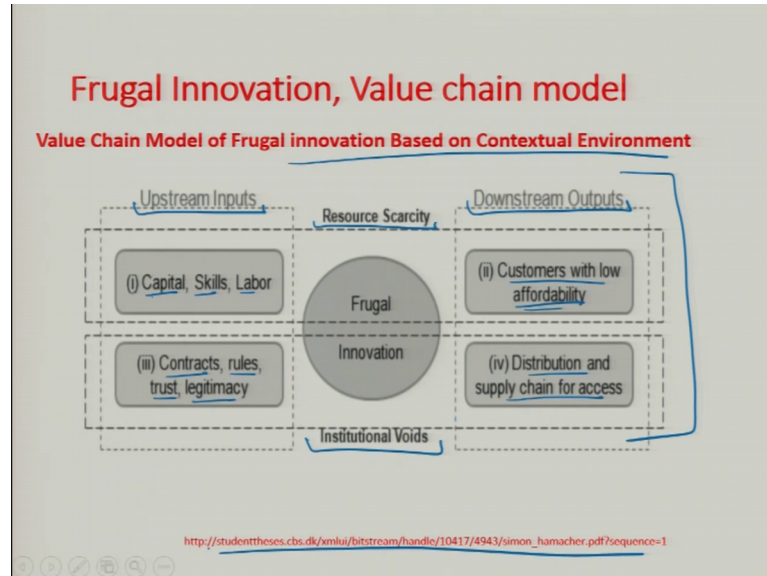
There is certain challenges in frugal innovation. First is the resource constraints refer to the (Refer Time: 25:37) resource, scarcity that prevails in developed markets. Now the certain resource constraints because of which frugal innovation is embarked upon either the necessary sources are simply not available or people lack the means to assess them this is challenge. Second challenge refers to a variation of resource constraints, that rather than being faced at the upstream part of the value chain concerns the downstream part.

But this is with the you can we know that poverty is all present in India you know the poverty is as you know poverty is all present in the countries which are developing and innovators have to realize that the affordability constraints, that is lack of purchasing power can pose yet another barrier to innovation these are the challenges in frugal innovation.

Now, in moving beyond resource constraints, Bhatti addresses the institutional construct as the third challenge to innovation that exists in emerging markets. What they say that while the features generally stifle business activity by increasing transaction costs and therefore, represent a major hurdle for the multinational companies and entrepreneurs and they at the same time create an ideal context for rethinking once prevalent assumptions about innovation. So, there are certain big players those can come into the picture and may intervene if some small entrepreneur comes up with a new idea. We can

say the big fish will eat the smaller fishes. So, those are the challenges in frugal innovation.

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So, frugal innovation value chain model the value chain model for frugal innovation I would not discuss this in detail, but yes you can go to this link and discuss and read more about this. What is there in value stream, their upstream inputs and downstream outputs are there. We see the value in terms of frugal innovation, the upstream inputs here are skills labor and capital contracts rules trust legitimacy then institutional voids are there.

People are working in frugal innovation recourse resource scarcity is there like consumers with no affordability and distribution and supply chain for access are the outputs here. So, this is value chain model for frugal innovation, we try to improve the value of the product. So, as it is affordable it is distributed in the way that the people can afford it in a way and also will try to have sustainable innovation in this.

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Frugal innovation process

- 1. Knowledge of the local context**
 - Various scholars conclude that the process of frugal innovation appears to require a high level of embeddedness in the local context of the target market. Suppliers / Market
- 2. Collaboration**
 - The collaboration with external partners throughout all phases of the innovation process, and often from various geographies and industries, seems to be another crucial part of the frugal innovation process.

Now, frugal innovation process first thing is knowledge of local context. The one who is working in frugal innovation cannot think of the global availability of the things because the things has to be available in the local market, he has to purchase something that is around something that is within his reach something that is accessible ok. So, various scholars conclude that the process of frugal innovation appears to require a high level of embeddedness in the local context of the target market. Market here also you can say both market and supply suppliers and market both are recommended to be local then collaboration.

Collaboration with external partners through what all phases of the innovation process and obtain from various geographics and industries seems to be another crucial part of frugal innovation process first thing is knowledge of the local context what is all available. What is the thing that people demand can I have a mix of two or three different phenomena or contextual products and develop something or can I use something to develop something that is equivalent that can cater the needs of the customers in a proper way in an equivalent way. So, those are the knowledge of local context, then is collaboration with the people those who can help this is the second part.

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Frugal innovation process

Purpose of External Collaboration in the Frugal Innovation Process

Purpose	Elaboration
<u>Cost</u>	It (External Collaboration) helps considerably in reducing the cost of ownership for the consumer (Tiwari & Herstatt, 2012b).
<u>Knowledge</u>	It enables access to proprietary knowledge and crucial technical and/or market know how thereby shortening the learning curve, reducing the innovation risk and ultimately increasing the quality (Soni, 2013).
<u>Promotion</u>	It enhances the brand image and the quality perception among the population (Tiwari & Herstatt, 2012b).
<u>Distribution</u>	It allows improved access to an otherwise extremely dispersed customer base (Tiwari & Herstatt, 2012a).

http://studenttheses.cbs.dk/xmlui/bitstream/handle/10417/4943/simon_hamacher.pdf?sequence=1

Now, the purpose of external collaboration of frugal innovation process is cost knowledge promotion and distribution all these are enhanced using external collaboration. It is the external collaboration that helps considerably in reducing the cost of ownership of the consumer. The knowledge it enables access to proprietary knowledge and crucial technical or market know how thereby shortening the learning curve, reducing the innovation risk and ultimately increasing the quality promotion.

It enhances the brand image and quality perception among the populations. Distribution it allows improved access to and otherwise extremely dispersed customer base. So, distribution if we have the specific customer, the base collaboration would definitely help in that.

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Frugal innovation process

3. **Clean Slate Approach**

- Frugal suggests that frugal innovation is to be approached with a 'clean slate' approach.

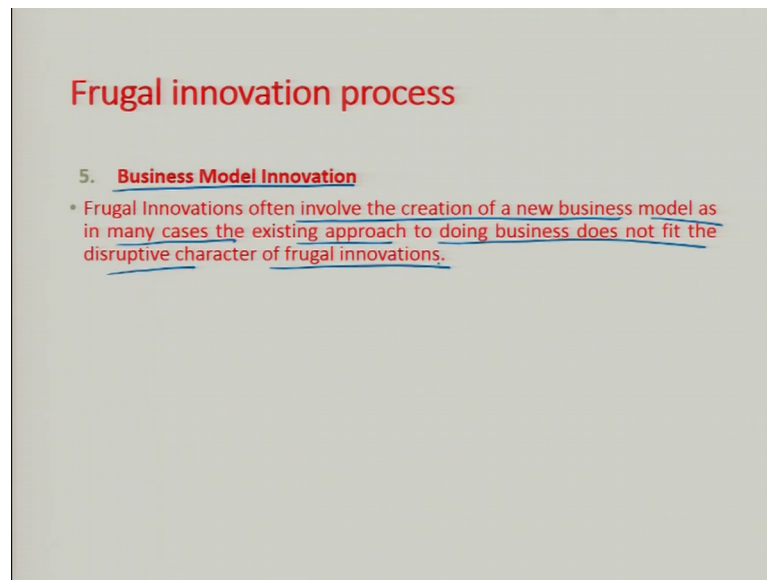
4. **Using existing Technologies**

- Arguing for a clean state approach does not mean that firms pursuing frugal innovation should discard existing technologies entirely.

Then clean state approach what is clean state approach? Frugal innovation suggests that frugal innovation is to be approached within a clean state approach. Now it is important to note that clean state does not refer to stripping down of an existing product, but rather to approaching an innovation with an open mind state and starting from scratch using scrap using something is available that is clean state. It is not completely creativity, when we are we completely formed at the proven fact. We have something in mind, but because we are going to sell something to them in the market that is the clean state approach that has to be practiced here.

Now, using existing technologies; now arguing a clean state approach does not mean that firms pursuing frugal innovation should discard existing technologies entirely whatever the technologies are available locally or that we can do something at a rural level, at a domestic level those have to be appreciating and are to be used in frugal innovation.

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Next is business model innovation this is the last step in the process. The frugal innovation often involved creation of new business models as in many cases then existing approach to doing business does not fit the disruptive character of frugal innovations. Now business model means distribution, the production, general based on business model is there is something that we purchase we produce then we market and we sell. Ways of marketing are to be devised, ways of purchase have to be devised something a different business model has to be developed in frugal innovation.

So, this is frugal innovation process; next I have certain examples in frugal innovations those are very prominent in India.

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First example is mitticool. Mitticool is a ultimate example in frugal innovation, this is Mansuk Bhai who was a clay task man; he identified the cooling properties of clay and came up with this refrigerator that can keep the things cool. So, it became a instant hit in his village at first and later it was it had no look back it was it had a great market in India.

So, his factory is producing other kitchenware out of clay, this village entrepreneur has recognized and awarded by national and international organizations. So, certain traits of the innovator or the frugal innovator he should be able to build circular value networks. Most company today operate linear value in the change in which products are designed, produced, sold, consumed and end up in landfills. So, circular value network is when we produce something that can be recycled and reused this is something happens in frugal innovation.

So, in frugal innovation one can think of reusing recycling and all those steam in sustainable manufacturing, but this is mitticool as one of the examples.

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Next example is motorbike tractor; this is developed by a guy who turned a motorbike into a tractor, you know he is showing his field using this motorbike. So, he found the things which are around him things which are around him he had a motorbike he cannot afford a tractor, he developed a gadget or an attachment with his motorbike and is working in his field this is frugal innovation.

Frugal innovation does not have a grade or a calculator scientific background, only thing is that if we use that it worked in India this is known as Jugaad; Jugaad is an Hindi word. So, this is when we try to mix two or three things together and we try to imitate something original, something there is no market that is frugal innovation I think this is this is making you more clear how frugal innovation happens and what is exactly frugal innovation.

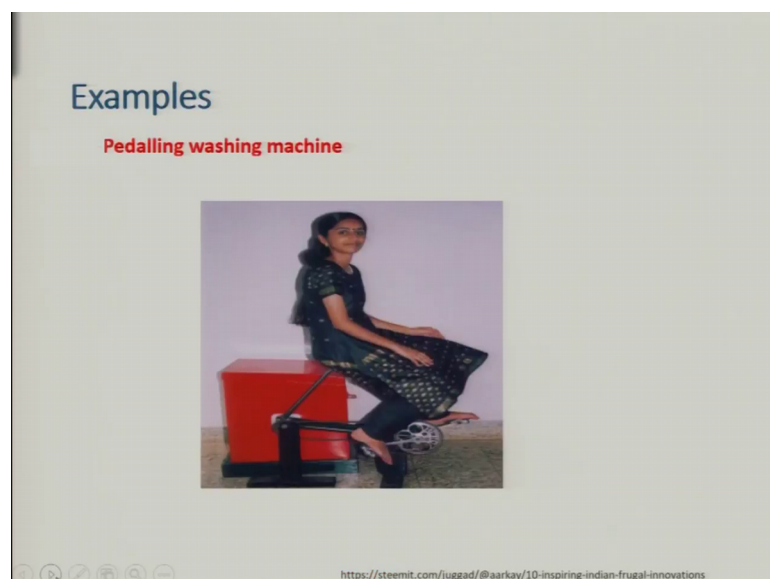
So, in just 30 minutes this motorbike tractor can flow in a acre of land with a meager two liters of fuel. So, this Bullet Santi has helped to increase productivity by cutting the cost of labor or bullocks to plough the land his invention is has and a patent in India and in US as well.

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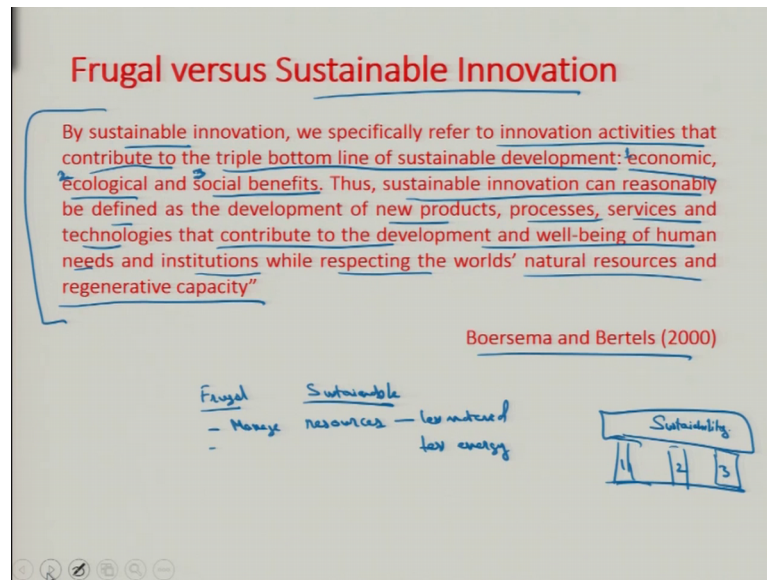
Next example can be Jaipur leg. This is a leg that is produced by doctor Sethi also known as Jaipur leg it is a rubber base prosthetic leg for the people with below knee amputation. So, this invention led doctor Sethi to win the awards in 1981 and the Padma Shri by Indian government in the same year. So, the NGO Bhagwan Mahavir Viklang Sahitya Samithi that is based in Jaipur Rajasthan, the world largest organizations serving the disabled. It is receiving the government and voluntary support from home and abroad to enable the disabled to stand on their feet. So, this is one of the examples of frugal innovation.

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Then is pedalling washing machine. This lady Ramya she hated washing clothes she developed the washing machine, she developed a mechanism here and used bicycle to wash the clothes. So, she in she invented a washing come exercise machine she can exercise here as well and wash the clothes. So, this is frugal innovation.

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Now, how is frugal sustainable? If we say what is sustainable innovation sustainable innovation is something definition given by these persons, by sustainable information we specifically run an refer to innovation the activities that contribute to the triple bottom line of sustainable development that is economic, ecological and social benefits. If you remember I showed you this thing, this is triple bottom line, this is sustainability and these are 1 2 3 these factors 1 2 3.

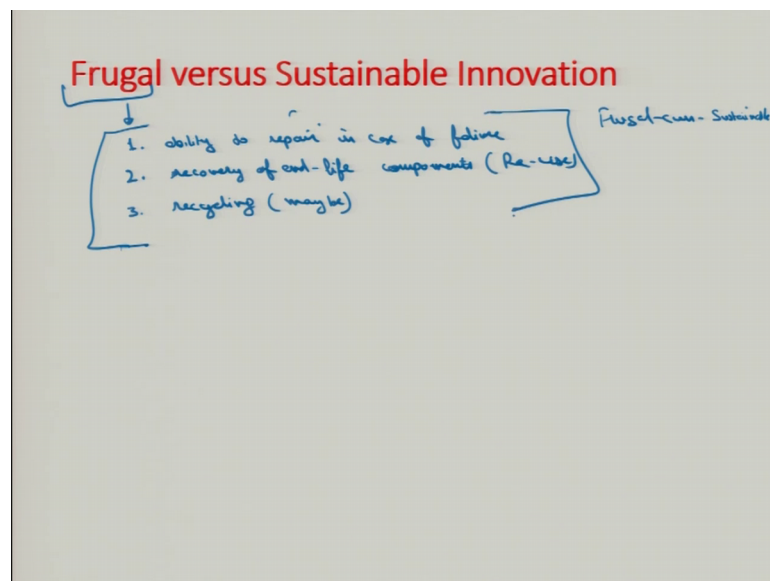
Thus sustainable innovation can reasonably the defined as a development of new products processes or services or technologies that contribute will development of well-being of human needs and institutions while respecting the worlds natural resources and regenerative capacity we have talked about sustainable innovation or sustainability before, how frugal is sustainable this is the point of concern in this lecture.

Now the goal in frugal innovation is to produce low cost products which most of the people can afford. The goal of sustainable information is to produce that is something environment friendly that has less carbon footprint, associated with it, but the frugal is also sustainable in a way we have frugal we have sustainable.

The first goal in sustainable information is to have positive feedback for the environment. But I believe that frugal innovation has some properties of environmental or sustainable innovation as well. In general frugal innovation is basically a new technological paradigm aiming to produce cheaper goods with minimum quality using local or cheap inputs.

Because, it saves materials energy in manufacturing and use the low price goods it contribution of fair management of exhaustible resources, so, frugal helps to manage resources ok. It uses less material, less energy. The cost if even some material is used the process is used that is having a little more cost associated with it I can put it here this is a regular innovation, I can put sustainable innovation here. This is SI Sustainable Innovation can be high cost it could be low cost as well, but it is having equivalent performance this is sustainable innovation. And frugal innovation can have some intersection with sustainable innovations becomes something like this is SI here, SI is sustainable innovation.

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Now, frugal innovation exhibits three important sustainable properties; is number 1 the ability to repair in case of failure repair in case of. Second is recovery of end life components, third is recycling. This is maybe this is kind of reuse these features of frugal innovation make it sustainable. So, this is frugal cum sustainable these are the features of frugal innovation which make sustainable. So, frugal innovation also fits well with the

base of circular economy in one sense frugal innovation as a new technology leaves a mark within the perspective of sustainable development, it seems to us that first statement that frugal innovation tends to modify technology, of technical change in greener direction.


So, in terms of environmental technology policy, because it know all the engine technology change frugal innovation creates a useful leeward to build up a transition towards a greener economy. So, though the production of cheaper goods which correspond well to the needs of poor in developing and developed economies, frugal innovation as a new or the emerging phenomena or the technology could boost consumption and push demand in a durable way. Sustainable innovation is directly related to new and generally green growth regime and frugal innovation can match greener growth and it is not incompatible with a strong growth model that exhaust natural resources.

So, final quote I can say frugal innovation is basically a new technological development, its characteristics lie in the space of technologies. Sustainable information has to match the firms objectives and with those with the stakeholders and the society.

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To recapitulate:

1. What is Frugal Innovation?
2. How is Frugal different from regular innovation?
3. What is Reverse diffusion process?
4. Challenges faced in Frugal innovation?
5. Value chain model, what is it?
6. How do we pursue is the Frugal innovation?
7. Some examples on Frugal innovations.
8. Frugal versus Sustainable innovation.

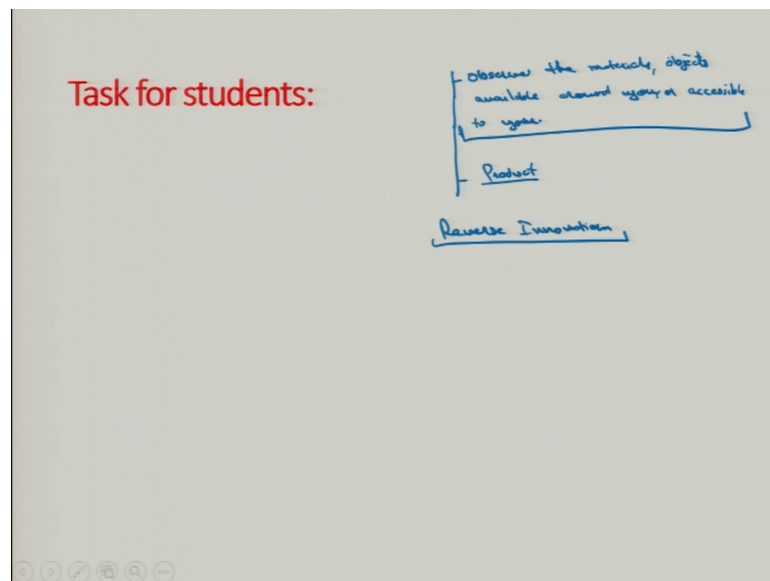


So, this is what is frugal innovation and sustainable innovation next to recapitulate we discussed what is frugal innovation, how is frugal different from the regular or standard innovation, what is reverse diffusion process challenges faced, in frugal innovation value

chain model, what is it certain inputs are there certain changes in value are there and certain outputs come.

How do we pursue frugal innovation certain broad steps are there, some examples of frugal innovation, we discussed and also we discussed frugal and sustainable innovation how can it be overlapping or it can have an intersection sets.

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Next I have tasks for the students in frugal innovation the product that you have identified try to observe the materials or the objects available around you or accessible to you and try to have a product made out of these you can do reverse innovation as well the product you have chosen you might have chosen pen, chair, shoe, table try to see the things which are around you can I make a table out of this crap that is available? Can I develop a chair with something that we need to throw?

So, can I see some table or chair that is available in the market for instance some chair is available, you just change the legs of the chair with something that is available with the sticks that you have at your home or something you have a thermo coal in the place of cushion can you develop a low cost or something that is usable for the people or for you, this can be one of the practice in frugal innovation. So, let us meet in the next lecture and we will discuss quality function deployment and this week's would end there, then will have design for environment and certain other aspects in green manufacturing systems.

Thank you.