Indian Institute of Science
Bangalore
NPTEL

National Programme on
Technology Enhanced Learning

Global Supply Chain Management
Lecture-28
Green Supply Chain Ecosystem Analysis

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So we are going to today marketing supply chain ecosystem analysis.

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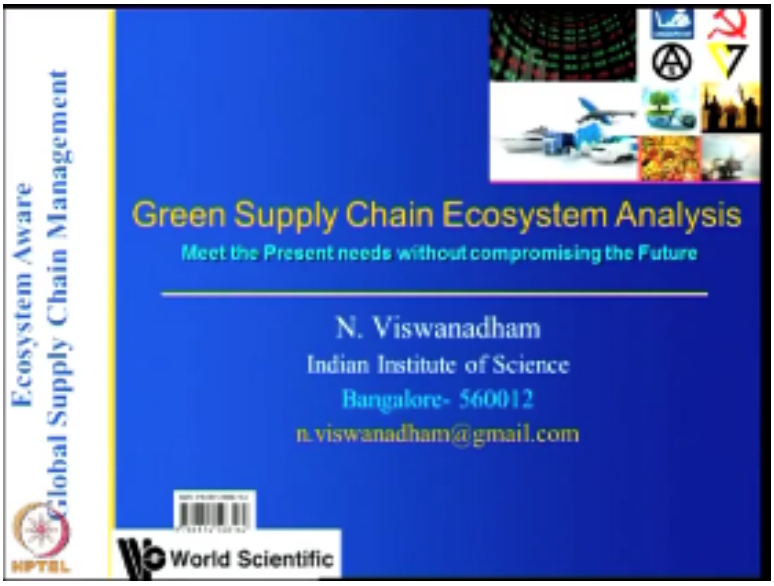

As we start in the last class we start today objective of green supply chain ecosystem is to meet the present needs without compromising the future, so since the supply chain or basically the generated of worth product and services it is important the supply chain to be degree and we will do we have gone through a several basics of green supply chain analysis but we are going to do today is the map the ecosystem for a green supply chain.

And it consability differs from the ecosystem of the ordinary supply chain because there are several new things added in addition to being the supply chain in the analysis ,so let us see next one over how to map the supply chain here.

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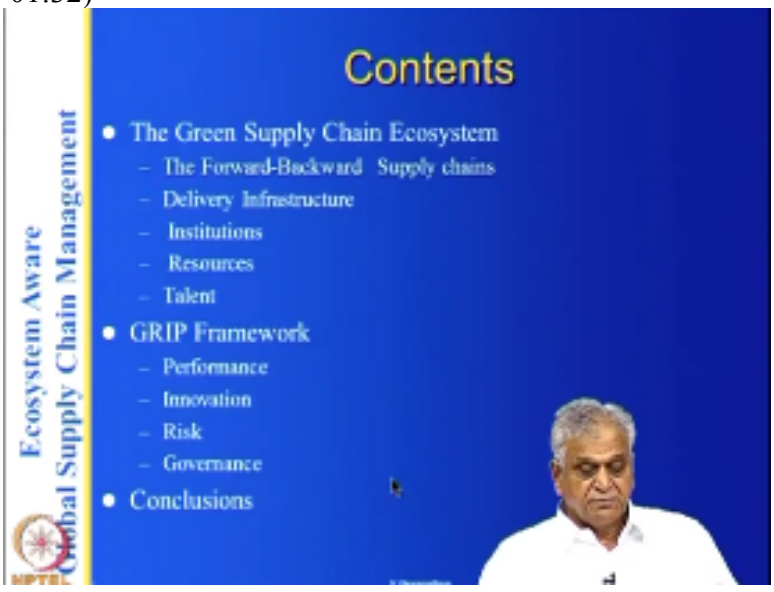

So the contents of these lectures all away map the green ecosystem supply chain and there is a forward backward supply chains basically in ordinary supply we have only forward supply chain that is basically goes from suppliers to the consumers lot as in the green supply chain there is what is called recycling in other words the products that are disposed of by the customers there will get back to informed of materials or rebismaite and so on.

And back into the supply chain where look at that and what delivery in infrastructure here in addition to the ordinary supply chain which as in the bound of bound logistics and the software and all that in the progress green supply chain what is called a reverse logistics and also we have look at what are the kinds of recreation that fact to be green supply chain actually recreation actually effect on the functioning supply chain and resources.

Resource minimization whatever the resources whether water, land or something and then maintaining the quality of the resources the third polite diagram what are the fundamental green supply chain so one could be replies and also the talent that required for the green supply chain management is much different from then the ordinary supply chains, so the talent which are the human talent is different and where to see how does the green supply chain movement pickups.

What are the kinds of talent that is needed then the second of this lecture we will do the grip frame work this is performance innovation risk and the governance and will conclude the lecture and let us look at the green supply chain map.

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Now so the green supply chain ecosystem.

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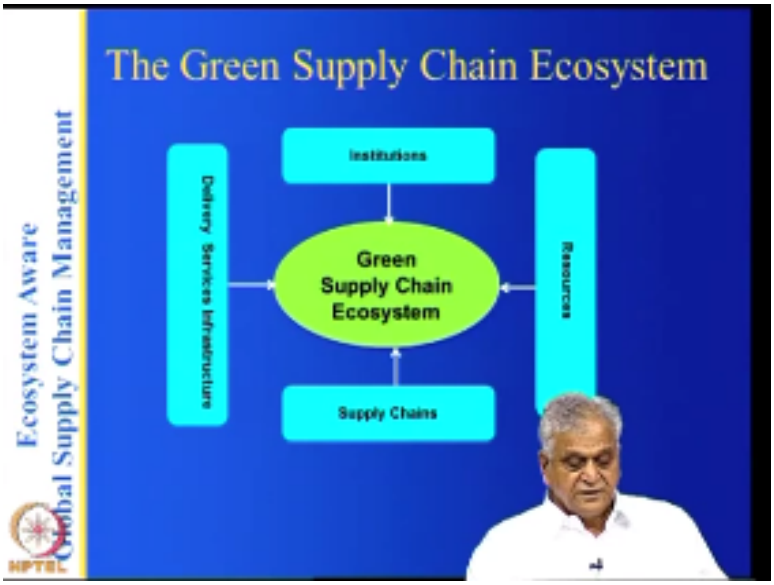

Basically you have the green supply chain ecosystem and of course the supply chain resources and institutions and delivery service mechanism here you have basically innovations Co-Evolution as well as the risk propagation you should understand the Co-Evolution for any evolution of the green supply chain you require the corporation of all the partners it as to be collaborate effect between the government and all the surfaces one.

If you want to same resources keep them, evaluate without using them and the institutions you required government regulations and of course you require delivery mechanism like transportation and others which as to be green that means free from the green house gases and also supply chain partners should collaborate is not enough if the supply chain manufacture or disputed the screen.

You have to have every partner in this supply chain to be green so the Co-Evolution comes like this resources are getting depilated or getting polluted so the social people or the social group they get into the act or government makes a there is resolution same that it has to be green as to be followed and should be polluted and all that and the supply chains start acting and of course the green delivery.

In all those comes in and all the people have to corporate so generated from somewhere from the resources pollution and the people complaining about it and asking for better resource management here by the companies it goes to be government and then it basically gets as resolution by government and basically to start this one, so basically coordination the similarly the risk propagates even in the as the ordinary supply chains even here so let us look at.

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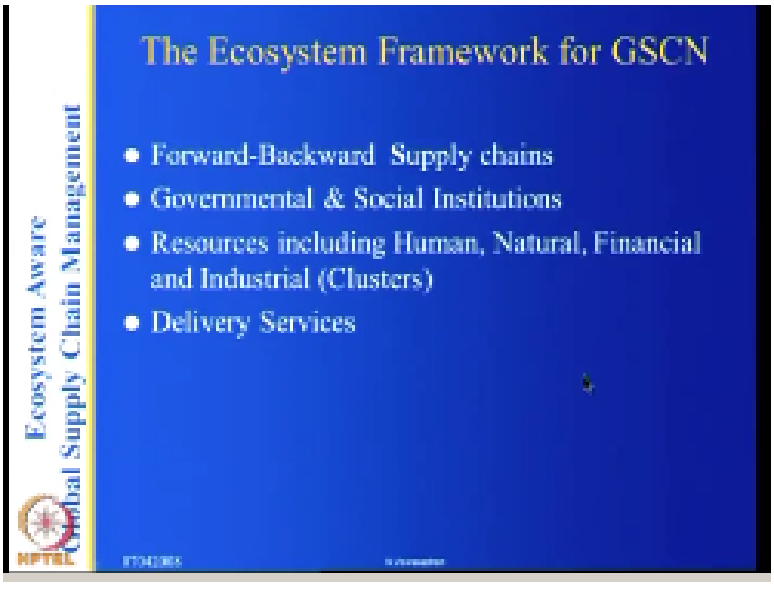

Each of chain and it will come back risk issues later what are the forward-backward supply chains.

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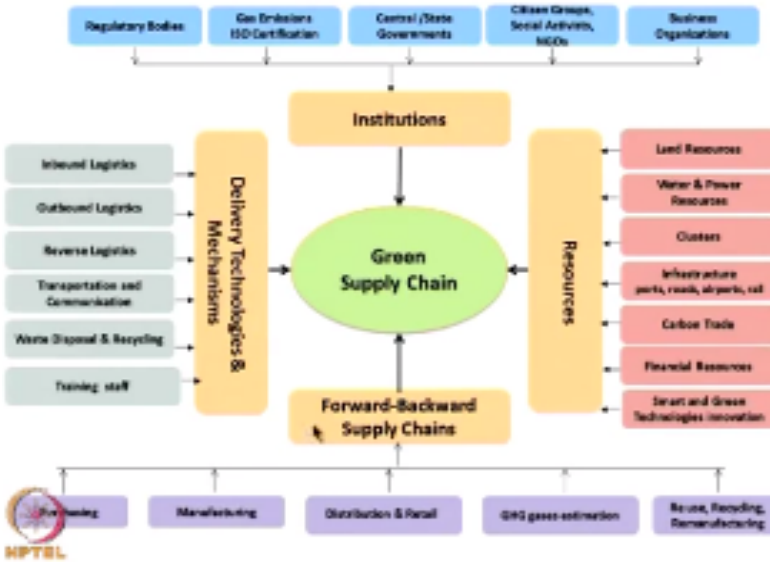

So the green supply ecosystem map is we have the purchasing for a requirement which as the business process and then we have the manufacturing process we have distribution and retail these are the three important process nay supply chain and we have the GSH gases estimation as we said before it is important to measure before you monitor and you control and also reuse recycling re-manufacturing refurbishing and so on these are all the things forward –backward supply chain.

The forward supply chain usual is purchasing manufacturing and distribution retail is important usually consider but here the reuse recycling and re-manufacturing as why know already that the for example, the percurmanent and purchasing as the stone supply chain in words suppliers procured identified the logistics provider tell who prosecutors what and finally how much is required and rent for the delivery to manufacturing side and similarly the manufacturing multi-side or single side manufacturing it goes on after the manufacturing discourse the distribution.

So each of this have the rom ecosystems and reuse recycling re-manufaturing is the important part of green supply chain so look at and the institutions play a fundamental role regulatory bodies which regulate on it can be common credits or it can be EHC gas limits whatever and the gas solutions and higher certification and central state government and disional groups social actives and endows and business organization.

So these are the basically the institutions at whose support is needed for the green supply chain management so basically it is a important that we consider the institutions they are role in a green supply chain how in terms resources in land resources you have water power resources you have various industry cluster infrastructure octets roads airports and train and there is carbon trade mechanism it becomes a resource in a new resource or a the green supply chain because their financial supply chains.

Smart and green technology innovation you require education and institutions to do research on how to use high city to make the smart technology and then also make them there and so on and also if you look at the delivery mechanism you have inbound out bound logistics we have an additional reverse logistics reverse large logistics is basically take from a consumer rare to the supplier at transportation and communication these are come both them lot of GHG gases so transportation you have required green transportation.

Less transport and recycling because whatever municipal based or if industrial based the based has to be a recycle before it actually spoils the resources and lot of training that is needed for this act because you talking basically new technologies, you talking new innovations, you talking new practices so require trade basically if you look at the green supply chain ecosystem you have the four elements forward-backward supply the resources and situations and delivery mechanism all this effect the green supply chain performance. So let us look at one by one .

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The forward-Backward supply chains or green supply chain management is basically green purchasing +Green manufacturing +Green distribution + Repair +Re-Use +Re Manufacturing +Re Cycling so there are four that RES that are important so these are retail reuse Re-manufacturing and Re cycling these are the four important things and they form the backward or the reverse supply chain and of course we have to have even the purchasing it has to be green ,green manufacturing as to be green distribution.

And need to be green and the forward supply chain has dual objectives the forward supply chain optimizes cost and performance of all the processes from product design to custom delivery that is the primary objective of supply chain that is the farmer supply chain takes care of you take a care of the supply demand matching, you take care of lead times, you take of low cost to requirement of the customers and make them available in the resource wherever and so on.

So basically the requirements are forward supply chain the remind to say that innovations we are dealing with the backward supply chain that optimizes the environmental performance of the forward supply chain so in other words if you are using resource the backward supply chain need to look at how to minimize the use of those resources and if you are using some electric power you have to basically backward supply chain looks at how to make that green if you are using cold finds clans can you use solar power or can you use mills and how to do actually manage.

The power supplies to be green? So there are issues that are connected with the green issues. And all that become responsibility of the backward supply chain is important even without the green regulations. Because it actually optimizes the use of resources optimizes actually the use of delivery mechanisms minimizes the cost and solve. So the twelve objectives is becomes important here.

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And these each house in supplier design include recycling which is collecting use materials disassembling into materials that would plastic glass and processing them. So what do you mean by processing them. Either you make into raw material and fielded back into the supply chain to the suppliers are you can basically despot it off. Are you can use disassemble them and use some of the parts which are useful.

As spare parts for the material repeal. Second one is reuse which is connecting use products from the field, and selling them at reduced prices. So this basically in the electronic earners for all the laptops, cell phones and phone this is big things you collect to use all products from the field. And replace them and refurbish them and let sale them is a use prices.

And remanufacturing is collecting used products, repair and test for quality, before reuse. That is remanufacturing. So materials and components recovered from used products reenter the same forward supply chain along with the new materials or components.

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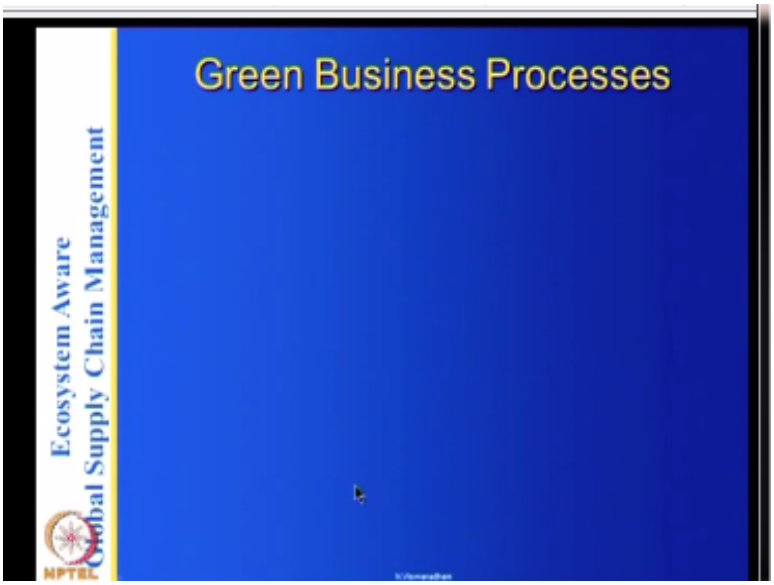

So there features become very important:

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Of course we did not considered the repair is the part of a remanufacturing that whatever the material there would see are feature slides the how these things enter into the forward supply chain. So what are the green business processes is:

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One is green procurement that is acquisition of product and services that minimize environmental impact over their life cycle of manufacturing, transportation, use and recycling or disposal. So basically it acquisition of products and services. And green manufacturing is

production process using efficient technologies that generate little waste or pollution and have low environmental impact.

So it is very important manufacturing is follows all this three principles that is little waste low environment impact and energy efficient technologies. And so basically you have to use these three. In bound logistics which is in bound logistics is very important basically it has in delivered from the all the suppliers to the manufactures and transport mode selection. In other wards which is the transport you are using rail or ship or track or air what.

So you should have co bourn fit print of the transport mode and select it the properly. Rail and barge are energy more energy efficient than road or air cargo. So depending on your time requirements you have to another requirement you have to basically QKR the mode selection. Outbound logistics as basically from the manufacture to distributers centers to the retailers criteria for green logistics such as fewer shipments, less handling, shorter movements, more direct routes, and better space utilization tradeoff with delivery time, responsiveness, quality and cost.

So basically you should see that there is a complicit here you wanted to be green you wanted to inventory because you want less number of deliveries. More number of deliveries means you less inventory and just entire. But means you have you have spending more carbon in your transportation. But the hand you know if you have fewer shipments and less handling on shorter movements.

More direct modes and better space utilization that tradeoff with delivery time, so the basically the time response with next quality cost and delivery time the basically have a conflict with the green requirements. So anyway the conflicts are a part of the game, so you have to basically look at the optimization of one waste the other.

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So what is green procurement?

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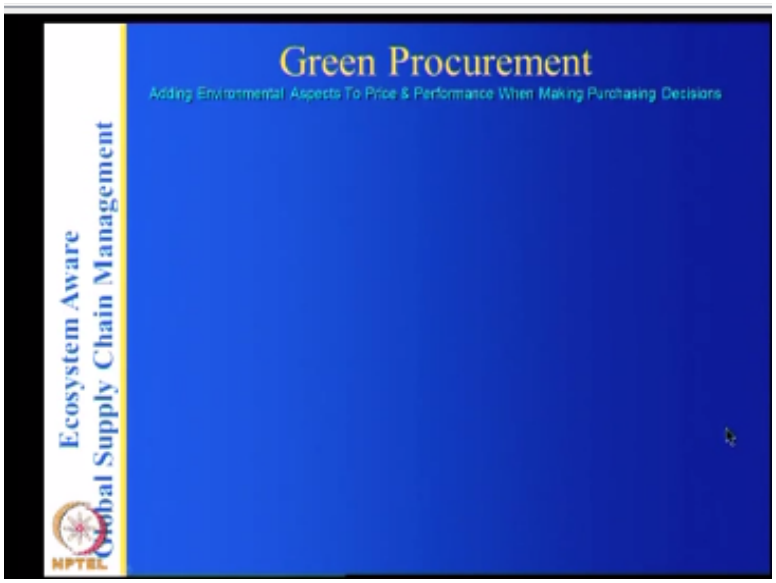

Green procurement is purchasing includes vendor selection material selection outs sourcing negotiations, buying, deliver scheduling, and Saur. And green procurement is selection actualization of products that services that minimized, negative impact over the life cycle of manufacturing, transportation, and recycling of all disposals. In all wards if you take product lifecycle it involves manufacturing and transportation use recycle and disposal.

Write so all those then you have to have to minimize the negative environment impact power these lifecycle of the product. And examples of environmentally preferable characteristics are

products and services that conserved energy and water. Minimize generation of waste and relives of pollute acts. Products makes from recycling materials and those can be recycled. Energy from removable recourses such as bio files, solar and wind.

Alternate fuel vehicles products used alternative to hazardous toxic chemicals, radioactive materials, and bio hazardous agents. So these are easily certain than the environment preferable alternatives. So the big wind is whenever you designing your system design the product so that whatever goes into the product is recyclable. It other wards you connect usually extract after the project productized it is disposed of you can easily extract materials from their first thing. And second thing is wild manufacturing is use little of the sources. Has possible and thirdly wile zooming the wile entire life cycle of has design to the use concern minimized the environmentally impact.

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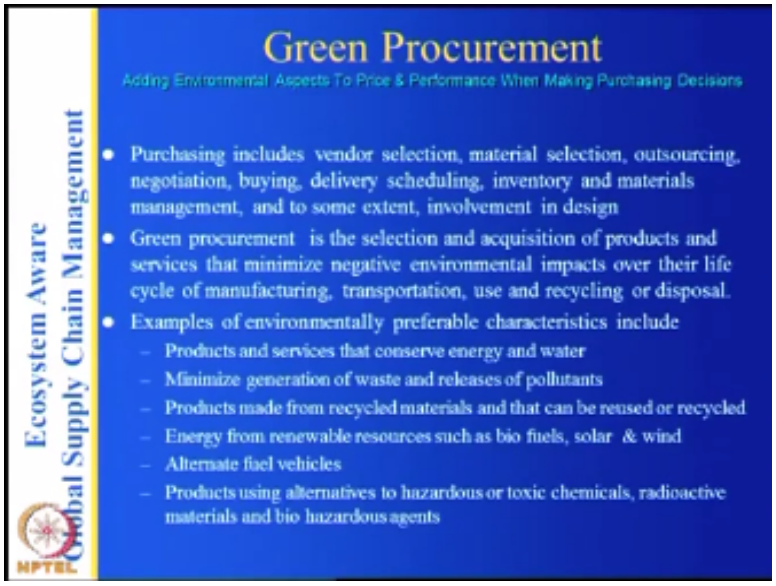

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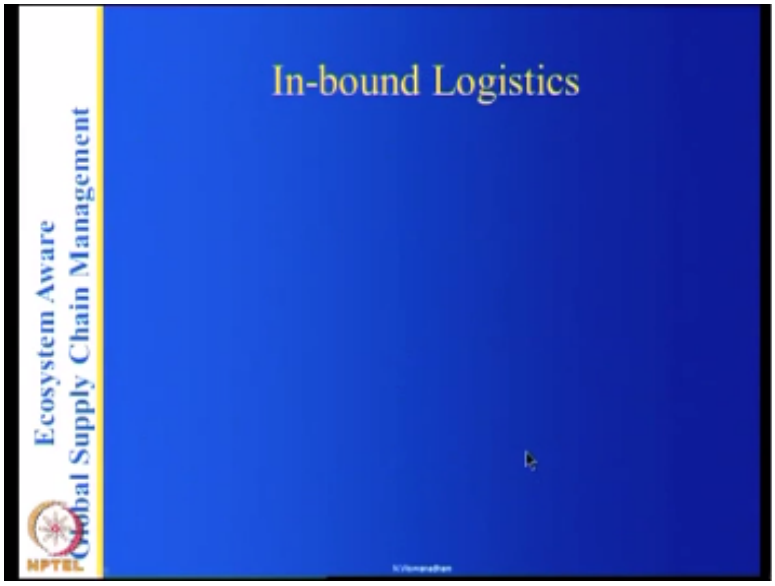

So in bound logistics basically the just in time practice is to lessen the amount of inventory by delivering in small batches. Less ware housing and more fuel consumption and traffic congestion. Traffic congestion because the vehicles are moving if this supplier ii is outside. The city in one part of the city the manufacture the another part of the city then the vehicles are moving around. And freight consolidation full load freight delivery may lead to longer lead times but environmentally preferable.

In other wards if you want to wait the clackers full loaded it may take a weak so that means you have keep to one week inventory. So that it warmer times. But you are basically making less straps so it is environmentally differently. The transport mode decision affects the traffic congestion and air pollution both directly and indirectly. Rail and barge use energy more efficient than road haulage.

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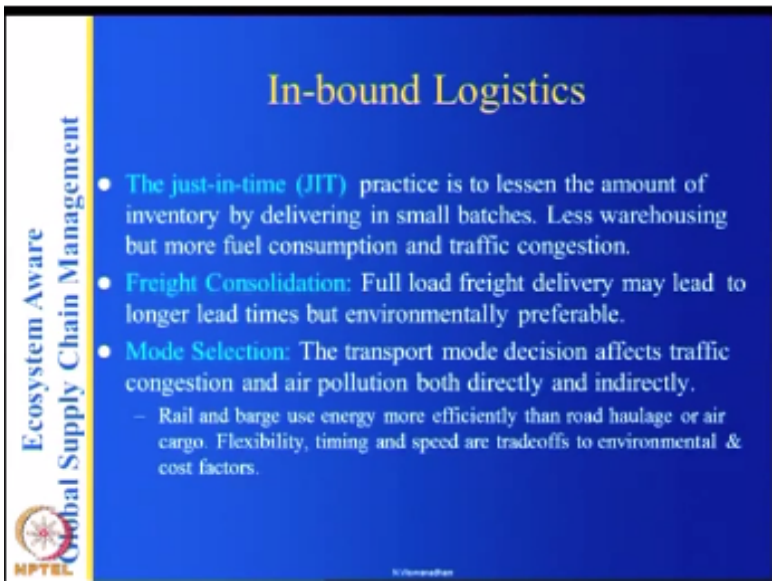

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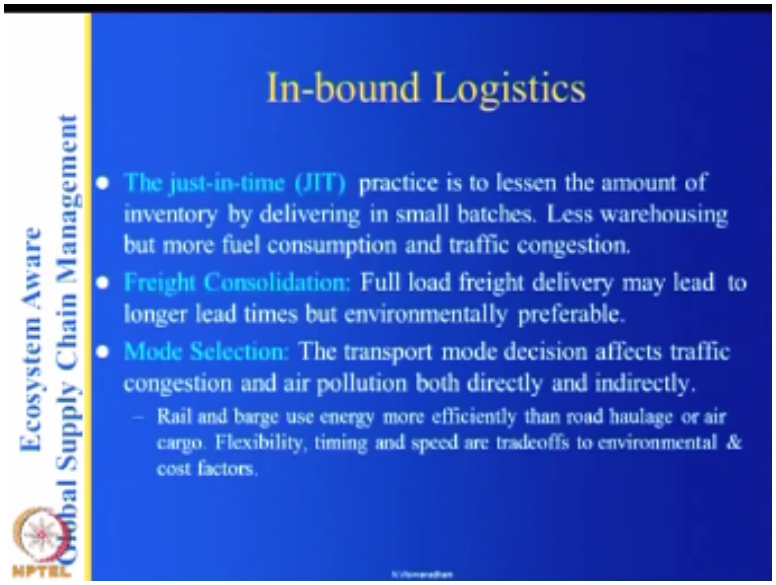

So but of course you have you know road haulage has more flexibility it can directly taken to the site, into the factory site. The track and go to the factory site. Where has typical strain you have to take from the strains ration? You have to haulage to by again the track are loading all these factors. So basically there are the issue of timing and speed and cast and so many manual handlings concern. So it is green manufacturing:

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Is basically production process should be highly efficient inputs. The fuel sample we seen in case of cement the established war cut forty hundred degree centigrade. And same thing happens with the refineries and steel factories and so these imports energy efficient technologies that relatively lower environmental impact and generate little waste or pollution. Particularly in the continue process is even in facts is like auto and sawn all the components lead to be proudest from the steel.

And steel becomes a basic material for leads so if you work at to the car the auto, automobile green gases that are remitted to vendor presser production process if you do considered the steel you considered during the manufacturing and solve. So basically the production process should be highly efficient and inputs. And energy efficient quality control at vendor site and before processing of all inputs and concentration on high percentage of recyclability and recoverable. So it can lead to lower costs, reduced environmental safety expenses, and improved corporate image. So remanufacturing is important but extant.

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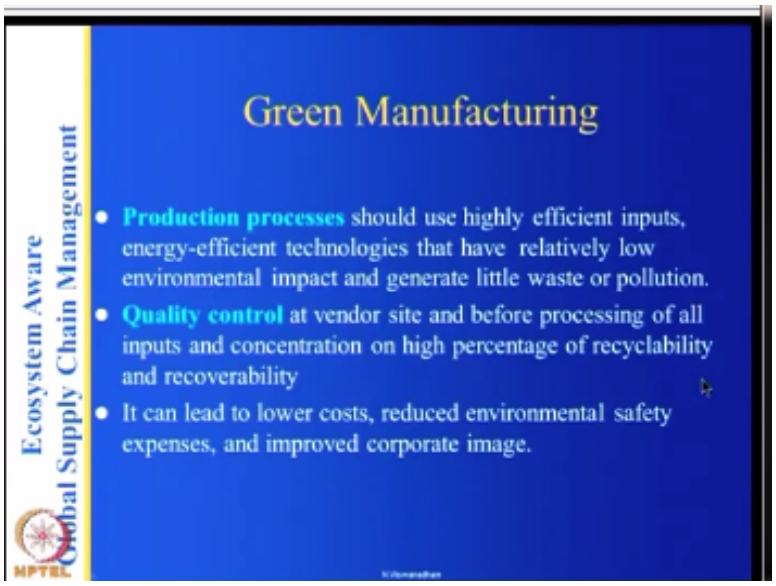

Similarly distribution and outbound logistics:

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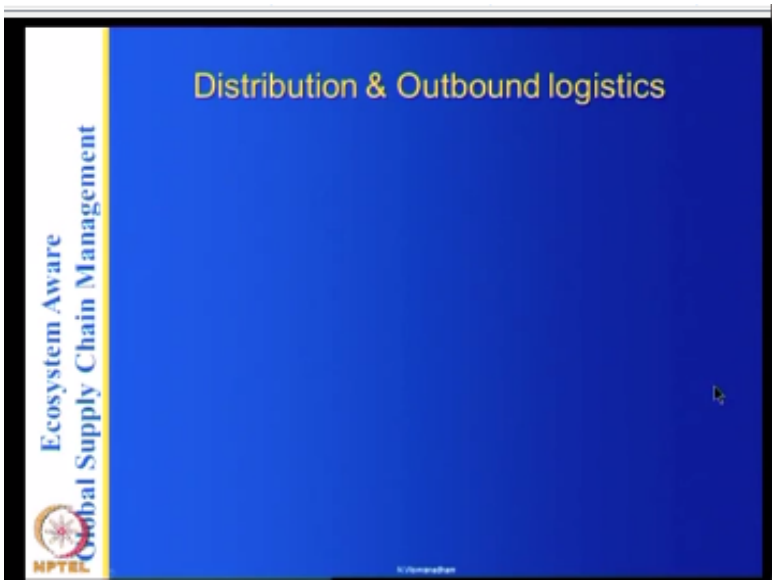

Is the movement of finish products from production to consumer and typical outbound logistics decisions high there directly or you want to use hub and spoke, all of you want to directly shape them you need more vehicles and they may be halftrack cloths, they may not be halftrack cloths but another hand but if you use hub and spoke and then all the vehicles takes them their and then you can basically manage the fulcra cloths.

And central warehousing is distributed network inter model or single mode third party services are private lead. So you want Uren filet to you want to use third party services. So these are basically outbound logistics decisions and you have to say which one is green. While at the same time which one is efficient which is low lead times and also low cost. Outbound logistics criteria that are a part environmental planning include fuel ,shipments, less handling, shorter movements, more direct routes, and better space utilization so but each of this trade off delivery time responsiveness quality and cost so you can always see the conflict between the responsiveness delivery time cost and so on with your green criteria so if you want very efficient system and you want to follow UJTTQ and whatever process is that your following earlier and keep less inventories and so on.

Then you may end up with less screen if you want to keep clean then you have to innovate yourself how to make both objectives and make the both criteria and how do you actually resolve the conflux, the conflux resolution is a big issue.

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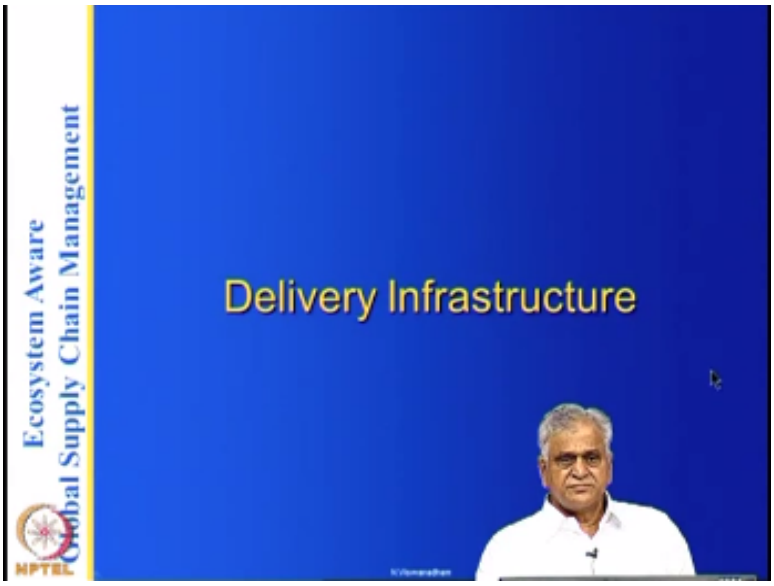

So if you look at the delivery infrastructure.
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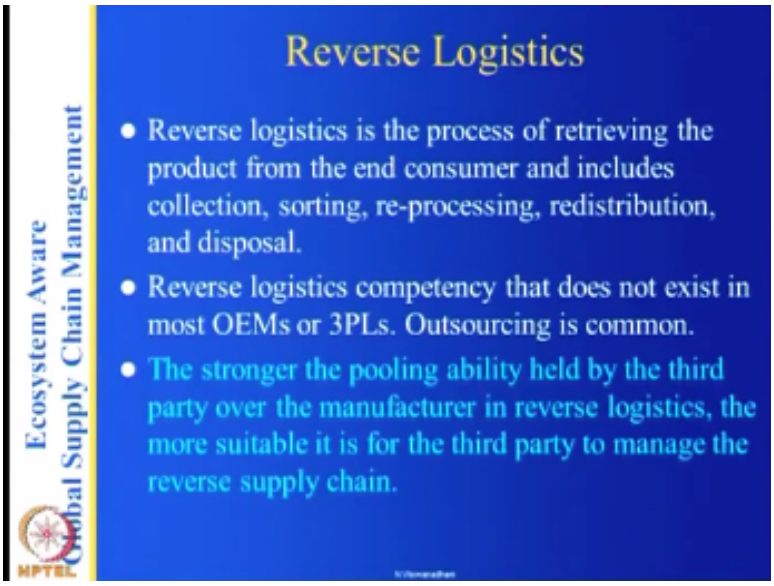

The delivery infrastructure is the reverse logistics here and in the reverse logistics we have the process of retrieving the product from the end consumer and it includes collection, sorting, re processing, redistribution and disposal I think one should understand that the reverse logistics is a highly conflux process compare to the inbound logistics, the inbound or the distribution logistics that you have is a planned activity otherwise you know how much material is moving in advance.

From how much is coming from the supplier how many trucks you need when and where and so on and when it is needed and the other end at the manufacturing site but in the reverse logistics case what basically taking products which are disposed by the consumer so the consumer what is the property consumer disposes of the product that and you have to collect it you have to sort out you have to reprocess, redistribute and finally you have to dispose out.

Of some of the things and then you have to basically reprocess some over the stuff so the reverse logistics competency is a competency that does not exist in most OEMs or 3PLS so if u for example most of the OEMs original equipments manufacturers they ablest they basically handle their own logistics they have private fleet and their own their own drivers and they have their own logistics departments and they manage their own logistics.

But here the reverse logistics are you going to manage the same or you want the outsources but here it all depends on this one we are going to see two or three examples where both are possible but outsourcing is much common here why it is because you know how do you know the

customer at this post of and this flight where does the customer dispose it off, dispose it of may be nearby his house so you have to classically collect all those.

And you have to sort what it is and the costumer where it dispose it off in a gently gunk yard so many items so you have to sort them and you have to basically re process and so on, so basically the reverse logistics is a competency that is not this one but what one need to do is to look at what is the kind of product we are dealing with now for example you are doing with laptops something then you know the reprocessing is using in our reverse logistics.

It comes on services and so on but another hand you are dealing with some products which are not worthy then it becomes reverse logistics becomes this one so the stronger pooling ability held by the third party over the manufacturer in reverse logistics, the more suitable it is for the third party to manage the reverse supply chain so here the other word being want outsource or you want to do it yourself.

This is the question that is often faced in the reverse logistics so it depends the amount of business that you have and you have the confidences to do this and you have the scale in other words if you have products which are sold somewhere and it is not enough to maintain the reverse logistics capability you do not have enough volumes to keep your reverse logistics people and the equipment busy and may not be worth it.

But another hand if you supply if you give it outsource this to the third party he can pull from several manufacturers and then he can get the scale so reverse logistics is this just coming up and it is a competency and that need to be improved in the name of the green this one.

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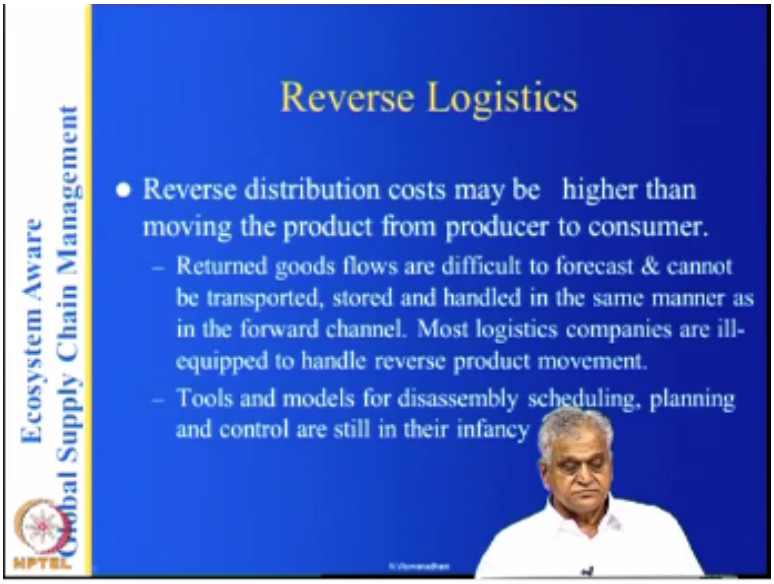

So if you look at reverse distribution costs may be higher than moving the product from producer to consumer now the reverse beats because you know in the Bundy or moving the products from the producer to consumer so basically dealing with the determine almost determine situation in other words you know how much consumer or the retail shops need you know when they need and you know where the material is available where it is in the manufacturing site or a distribution center and so on.

So you can plan your transportation from end to end using but in the reverse distribution you are basically there are lot of uncertain associate with this because it has to move from consumer back to the producer and it get in from consumer to producer you have lot of uncertain you do not know where the consumer is going to dispose it off and how many consumer are going to dispose it off and many particular locations you need to have enough volumes to take it back.

And these are the issues that will increase the cost if you want to do the recycling and returned goods flows are difficult to forecast and cannot be transported stored and handled in the same manner as in the forward channel you know in the forward channel your talking of the finished goods which are basically to be sold to the consumer they are well packaged and well identified with the either RIFD tax or labels.

That is the forward channel it is easy to handle most logistic companies are ill equipped to handle the reverse product movements that is because you do not know where the product is you do not know 0where who is the manufacturer and several other issues because the labels may

have gone so are also you do not know how to decide handle the whole thing and then make it into products and all that there are lot of decision that need to be done.

For the retailers particularly dealing with returns product returns and also product which are basically of the dispose off so these are fundamentally two different things product return are the ones that are return somebody buys the products and afterwards he returns it although in a good conditions in that he did not like it but in another hand they disposed off products are the once the material are the product is not working it is not functioning and you are returning it.

You are throwing it away as junk so these are all issues in the reverse logistics and tools and models for disassembly, scheduling , planning and control are still in their infancy well above one can see the issue about why it is still in it is infancy it is user mayor that you know it is a conflux problem and people never had for this because it is conflux and it is not worth people thought not for that time but now with the green environmental regulations people are carrying about the reverse logistics.

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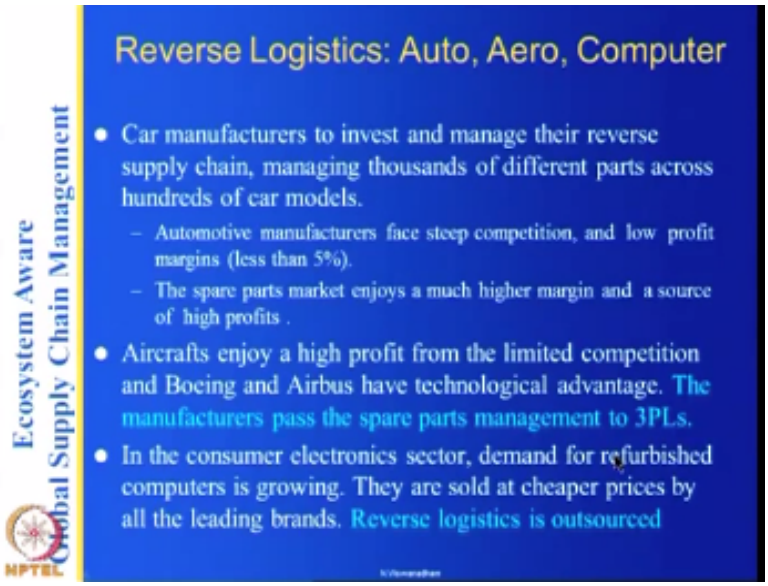

So reverse logistics in auto, aero and computers now let us look at the three examples car manufacturers to invest and manage their reverse supply chain, managing thousands of difference parts across hundreds of car models you know the car models change every year and the cars they need they repair so you need the pair parts of them and the pair parts are much more

expensive than the original parts so automotive manufacturers they try to basically keep the reverse logistics with them.

The pair parts market enjoy much higher margin and source of higher profits and also in the forward direction they make only 5% this one because there is a sleep competition and low profit margins so it is a typical situation that you have the volumes are large in auto manufacturing and pair parts business is very good very highly profit above and you basically in the forward direction to make only 5% of profit.

So the survey says the reverse logistics is much more profitable so car manufacturers try to keep their reverse logistics along within their company for basically subsidiary which handles hospitals so you will find most of the surveys manufacturers most of the car manufacturers have their own dealers doing servicing aircrafts for example are basically they are less competition four or five of the Boeing airbus and others they have technology advantage and they enjoy high profits.

Because of the limited competition and manufacturer pass this pair parts management two to three years they inter come difficult some time the aircraft itself carries some of the pair parts but the pair parts sometimes need to be air lifted from some place so basically somebody like FEDEX and others they manage their pair parts managements for their crafts and their they have identify regional centers for keeping warehousing this pair parts and they basically manage from there.

In the consumer electronics sector the demand for refurbished computer is growing and they are sold at cheaper prices by all the leading brands reversed logistics is out source here basically brand because the original product is expensive and refurbish product all most like one tenth prize and so basically people to buy because it is cheaper and reverse logistics it out soured.

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Let us look at an institutions are the here.

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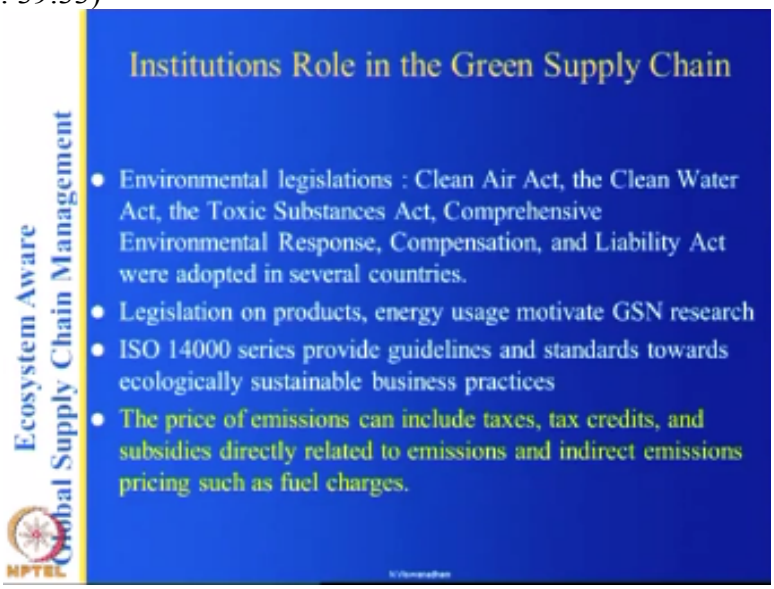

The institutions in the one there role in the green supply chain is a very important this one because environment regulations every company every individual need to fallow need to their act clean water act, the toxic substances act, compressive environmental response.
Compensation and liability act, were adopted in several countries so these are the last industries and individual need to fallow and registration products ,energy usage motivate GSN research green supply chain research is basically motivated by the legislation and products and energy usage.

ISO 14000 series provide guidelines and standards towards ecologically sustainable business practices for their standard available and the price of emission can include taxes, so the government can tax credits if you do less carbon emission subside directly related to emission and indirect emissions pricing such as fuel charges so the issue is the government can interfere in several ways this is threw the environmental legislation are prices of emissions like carbon taxes and so on and tax credits cap and trade we seen so the institutions players central role in the green supply chain and intact the most of the cases the institutions and in the name of course global worming the institutions and the WTO and world health and other organizations are responsible for this one.

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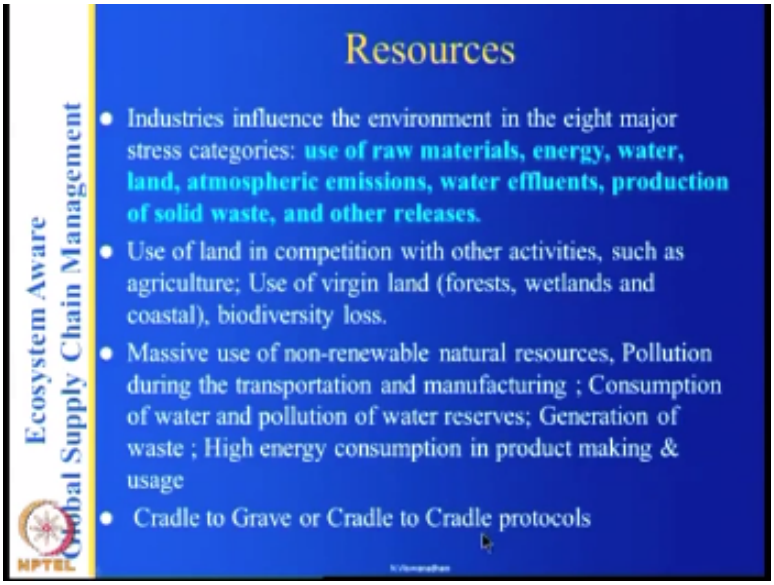

Let us look at the resources that are needed which is the very important element industries influence the environment in the 8 major stress categories use of raw materials use energy water land atmosphere emissions water effluents production of solid and other releases so the raw materials are resources usage is raw material energy water and land and thousand pollutant in atmosphere influence water influence productions solid ways.

In other releases which industrial influences the environment use of land in competition with other activities such as agriculture use of virgin land forest wetlands and coastal areas and there is a typically lot of biodiversity loss so you are the industry is basically is creating a problem.

It is using the land and which is if it is virtual land helping the atmosphere there as here takes the pollutes the environment massive use of non-renewable natural resources pollution during the transportation and manufacturing consumption of water and pollution of water reserves generation of waste high energy consumption in product making and both product making usage so these are all the basically the usage of the resources so cradle to cradle protocol use either to cradle grave protocol their use less resources when the product is using or cradle to cradle is where you generate the project and after the product dies or disposed of thumps back and re manufacturing use and all logistics.

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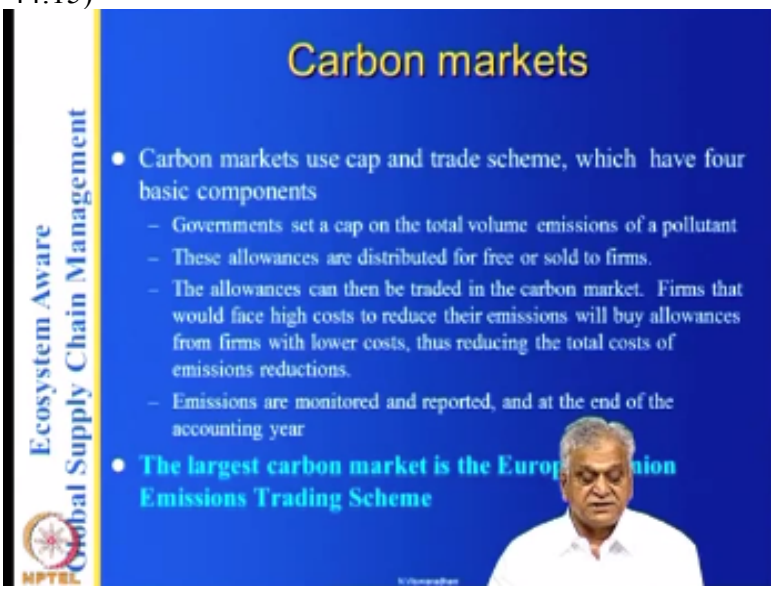

So there are also resources like carbon markets the carbon markets the carbon markets us cap and trade scheme which have four basic components there is governments and the total emissions of the polluted and these allowance are free or sold to firms and the allowances that can be trade in the carbon market that is the forms that would face high costs to reduce the emissions will buy allowances from firms with lower costs thus reducing the costs.

Of emissions reductions so that becomes a big trade although the once you have a cap and that cap that has to be mat but not individually by the companies either company but collectively by a certain companies the emissions area monitored and reported and at the end of the accounting year so basically there is a money or time firm during which these are monitored and reported so

the largest carbon market is the European union emission trading scheme so there a lot of turning that happens in the European union.

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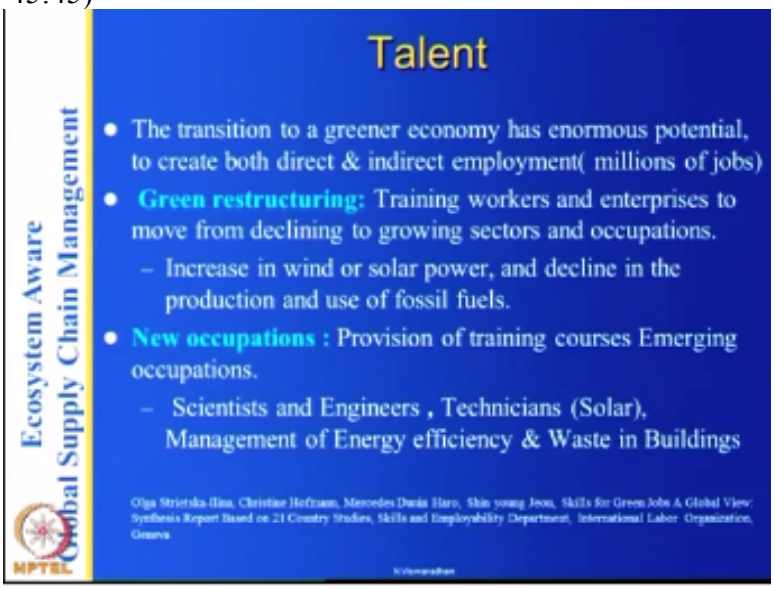

so we look at the talent this so this materials there is a skills for green jobs global view and there is a report you can report the look at that the transition to a greener economy has enormous potential to create both direct and indirect employment green restructuring basically training workers and enterprises to move from declining to growing sectors and occupations increase in wind or solar power and decline in the production and use of fossil fuels.

So we have to train more than more people in mean the solar project generation and you occupations provision of training courses emerging occupations scientist and engineers technicians management of energy efficiency and waste in buildings for example there the smart building great lot of things coming up and these on the new areas which require lot of research and also once things have been built the technicians maintain them and also manage.

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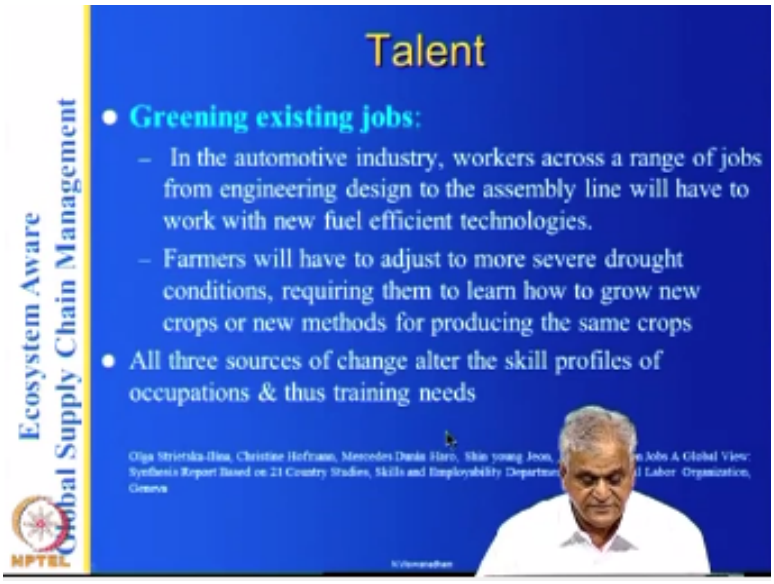

So Greening existing jobs in the automotive industry workers across a renege of jobs from engineering design to the assembly line will have to work with new fuel efficient technologies we have basically work with battery felt the barrier driven cars then you should see what that means basically interpretable workstations you need battery charges service stations framer will have to adjust to more severe drought conditions requiring them to learn.

How to grow new crops or new methods for producing the same crops one thing is to complain about the draught and the global warming another is to look have a draft I have a land piece of land what crops can I grow in this phase of firms does not require much water for how do I frame cop without limitless water so these are the kinds of issues that people have to consider and you require lot of talent of this all three sources of change alter the skill profiles of occupation and thus the training needs so we that the whatever the green evolution taking about it requires amount of skills sets and we need to train to these people for this so although people talk about green these training and other kind of things people have not use I do not know whether the governments are using very seriously so far.

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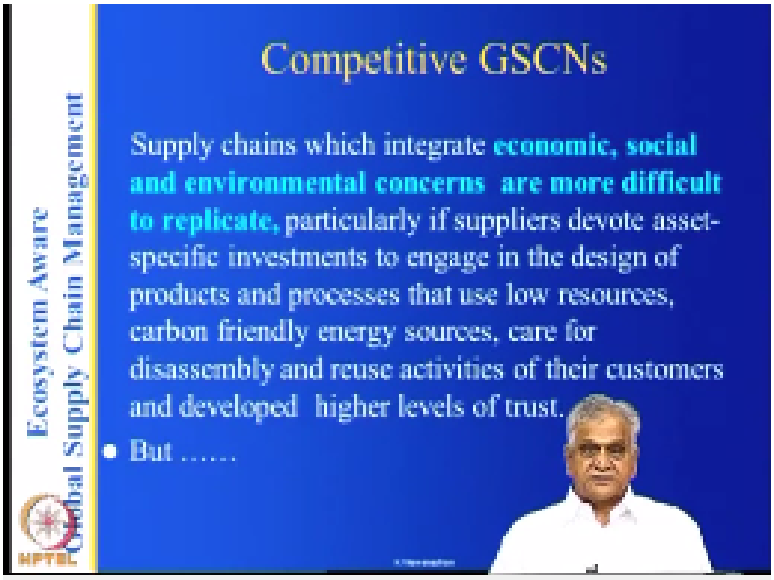

So once we look at this the pursing you spent lot of money and to make a green supply chain there as we have seen we have forward backward logistics we have forward supply chain and backward supply chain not our regulations we have to use less resources and new recourses which are an environmental requirement friendly spend lot of time getting talent and all that so why should the supply chain honors to do this.

And what to get in the return if I look at that the supply chain because the thumps highly competitive and now would you became a competitive supply chain it becomes nobody can immediate you so easily so if you are able to manage your supply chain which is green and if your customers like your products you have a competitive advantage against the people who are manufacturing the products which are not giving and when you do.

It is always obvious that other people your compotators are also want into enter into same Arena there also want to became green but it is that easy so supply chain which is integrate economy social and environmental concerns are more difficult to replicate because you have to spend hard time and your relationship with people to basically integrate all the economic source with triple bottom line with the economic source and environmental consign particularly the supplies.
Devote the as at specific investments to engage to the design of products and processes that use low resources carbon friendly energy resources for disassembly and reuse activity are there customers and developed higher level of software's so if you have supplies as a partners who does all those things for you to generate product which are re disassemble to generate product which are re consign the reusable and usually dis assemble then and you have high usage of trust.

I mean the while this is difficult if we can manage this then you became a highly competitive green supply chain and it is not easy to basically take you of and try to complete with you this because there is a lot of assets specific investments that your customers are made because wherever they using con power there are using solar power indiscrete solar power. Into the system all that takes assets specific investments so once they do all these than they become highly competitive requires lot of effort.

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