Indian Institute of Science
Bangalore

NPTEL
National Programme on
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Global Supply Chain Management
Lecture-05
Supply Chain Eco-System Framework:
Supply Chain & Resources

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And in the last lecture we have given the general world review of the supply chain ecosystem.

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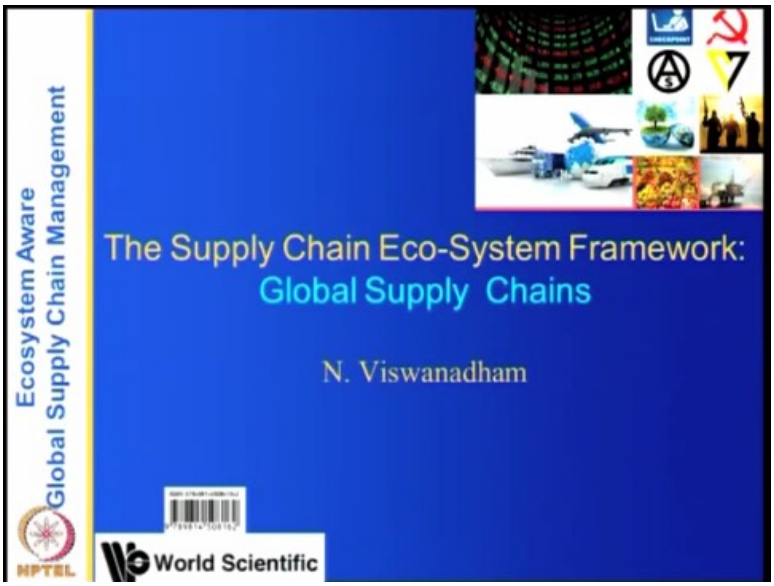
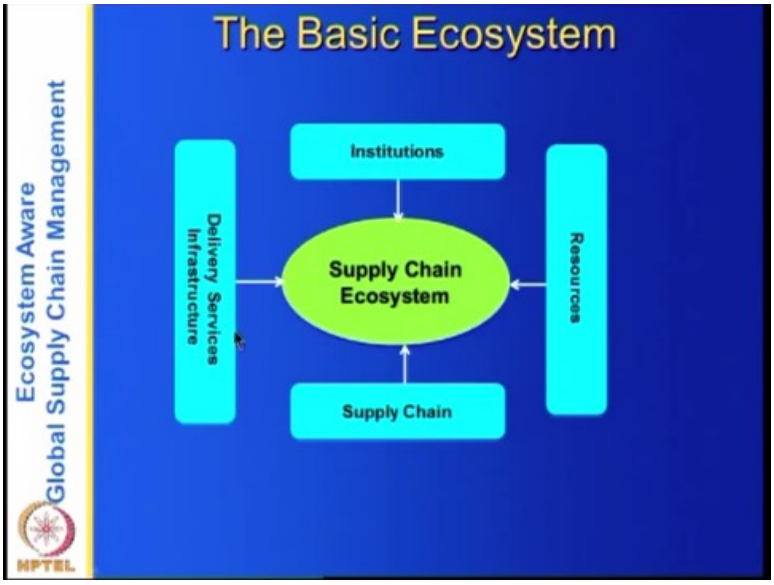
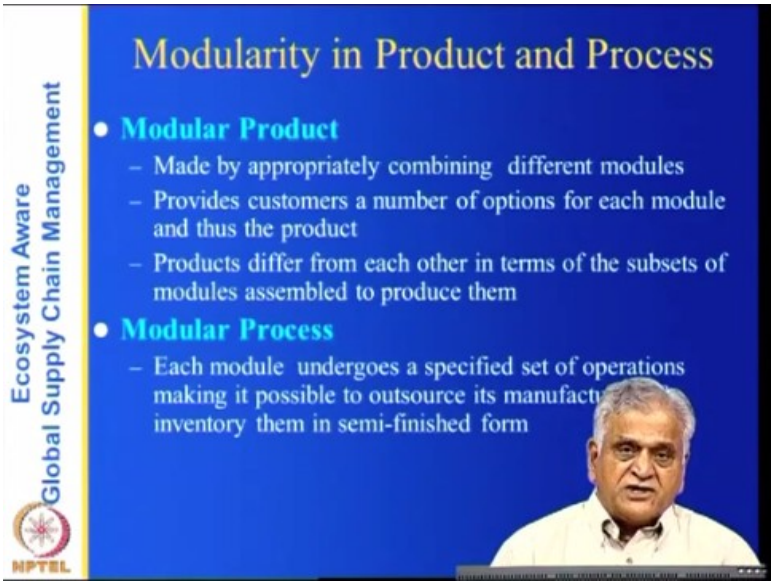


I will first present the ecosystem and then will talk about the global supply chains. We take two examples and one are the electronics and other one is the apparel. We study the various types of contract manufacturing firms that have evolved because of the globalization of the manufacturing supply chains and finally we look at modular organizations .As I told you before that the globalization is because of modularization of the products instead of making an integral product. You make modular products using modular processes.
We conclude this lecture with organization structures which are modular



The ecosystem has four elements: the supply chain, the resources, the institutions and the delivery and service mechanisms. In the next four lectures, We are going take each one of these and study them in detail as a part of the supply chain ecosystem. After these four lectures you will have a an idea of what the supply chain ecosystem is and how to proceed with both analysis and design.

We will first study the global supply chains.



Behind every product there is a supply chain. The modular product is made by appropriately combining different modules instead of making one individual module you have the various electronic items to which you combine into a make into a PC or you make into a laptop or a cell phone .This provides the customers a number of options for the product. In other words, you can change the product specifications but the product remains the same. In PC you can

change its processor or its the memory size according to the customer options and products differ from each other in terms of the subsets of modules assembled to produce them.

Like a modular product, modular processes undergoes a specific set of operations making it possible to outsource manufacturing and inventory them in semi finished form. For an automobile you have sub- assembly items like a door or an engine and the process on which this is manufactured.
The module is manufactured using the workflow of modular process that is standardized and which is standardized. This means that the equipment that is needed to manufacture the sub assembly is standard. Because of the standardization we will be able to outsource but the sub-assembly.

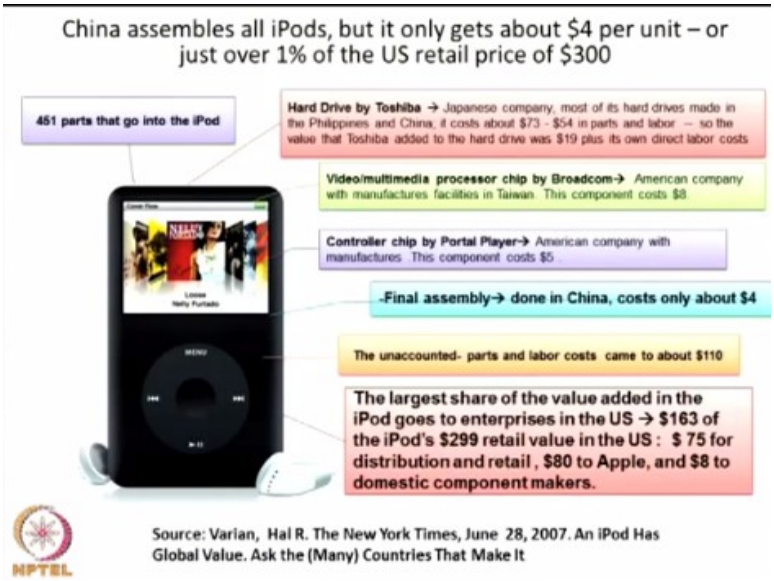
To manage the modular products and standardized modular processes you have modular organization structures and modular supply chains . I have shown in the first lecture a multi-tier supply chain diagram which is a modular supply chain and standardized component manufacturers have become IP monopolies and feel global market power .

For example Intel chips, Windows Operating System, Auto components , Auto engines these are all the monopolies is the IP intellectual property is in these components. But anybody can take this particular components from the market and they can assemble them into a particular product. Products have thus become commodities with the availability of codifiable and easily replicable knowledge about assembling the final product.

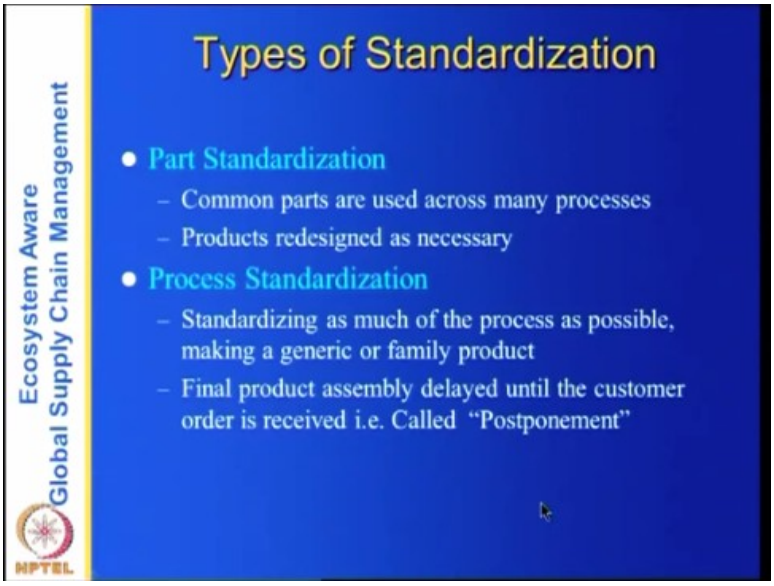
The strategy competitive advantage for assemblers like Dell ,General Motors, Nokia and others moves from the factory to managing the global supply chain and social capital with the stakeholders. The brand for these manufacturers comes from managing the global supply chain

and also the social capital with the stakeholders which actually means that the intellectual property for any particular product lies in the components, in managing the entire supply chain by the assemblers and finally the connections the supply chain global supply chain owner or the OEM has with its stakeholders .

So you can see the change that has happened over the last ten decades from 1913 when Henry Ford has started a vertically integrated enterprise to a globally dispersed manufacturing system. Today the competitive advantage has moved from the ownership of all the facilities to the managing the global supply chain or making the vital components that are needed for the products .



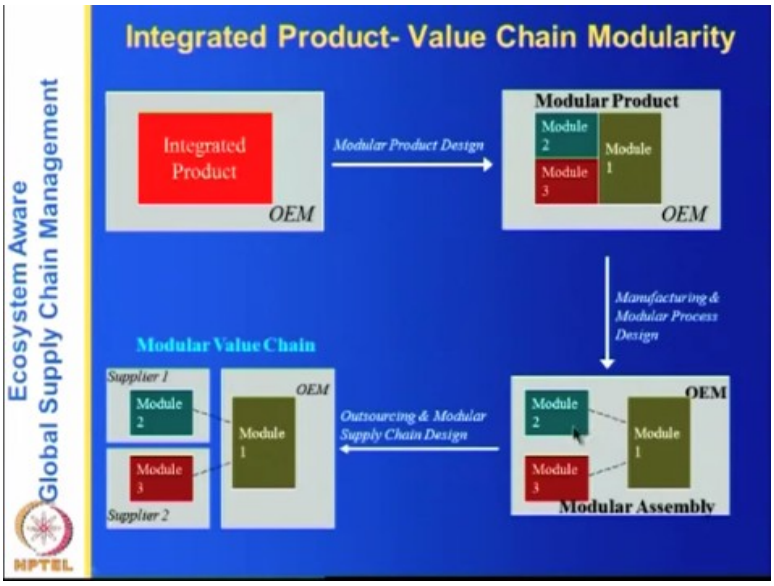
China assembles all iPods but it gets only $4 of unit and just over 1% of US retail price of $ 300. The largest share of the value in the iPod goes to the enterprises in the US. So you can see how much profit the US manufacturers can make from this particular diagram.



The types of standardization that are required are the standardization of parts, common parts used across many processes, and process standardization. Products are redesigned as necessary The memory can be 16 GB or 32 GB and the cost varies based on that. So what happens is that they strips are of the same size but the memory capacity changes .

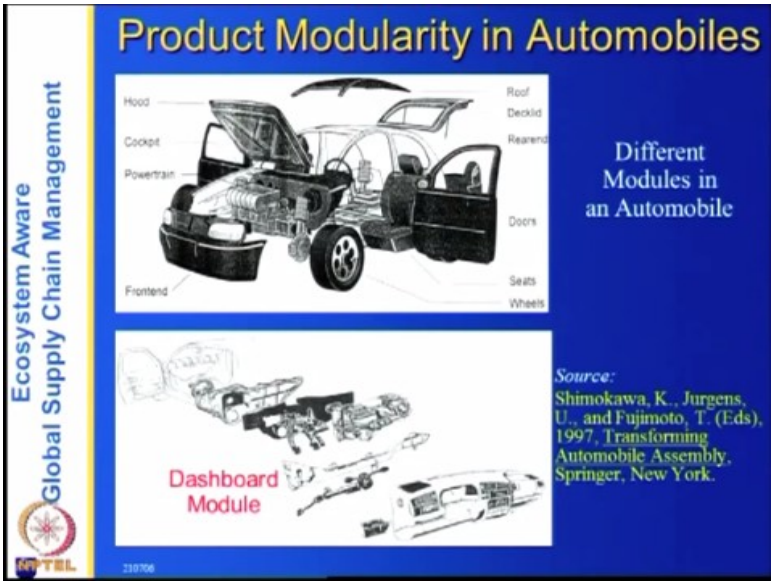
if you standardize the processes then it is easier to outsource and also by standardizing you can easily automate the particular process using IT and other technologies and the final product assembly can be delayed until the customer order is received.

It is called postponement. If you order a laptop from Dell they will wait until you have paid the money they get the cash and then they will assemble the particular product and deliver it to you within 24 or 48 hours. The process and product standardization and modularization help in making this possible .



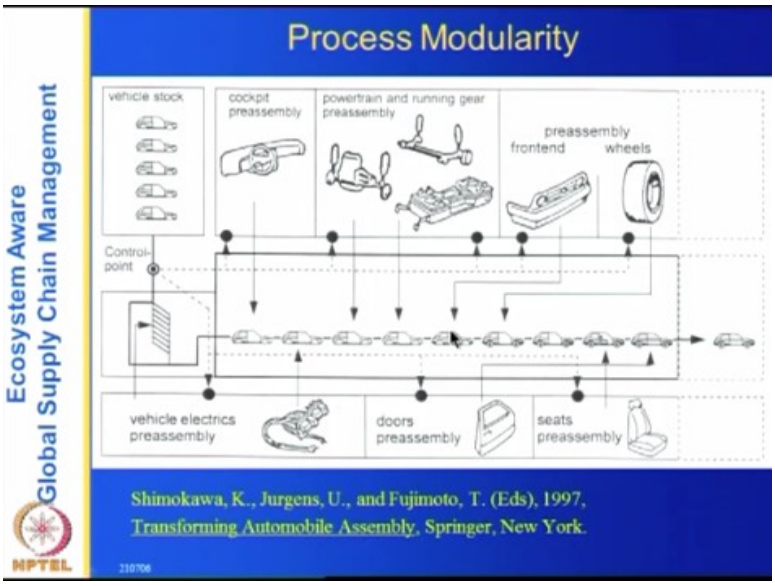
So if you look at the integrated product value chain, the product is made out of three modules: module 1, module 2, and module 3. They are all made by the OEM but it is a modular product but they are assembled by OEM himself .

The third stage is that modules three and two are made outside and OEM has module one. The modular assembly is made by the OEM. You can outsource module 2 to a supplier and module 3 to another supplier and make module 1 out of this .So you are basically making a modular value chain by outsourcing and designing your supply chain properly.



Now let us look at some examples like automobile. The car has different modules such as the roof, the deck lid there at the rear end and the doors, the seats, wheels, the front end, the power train, the cockpit and the hood. Each of these are manufactured by different manufacturers.

So each of these modules are manufactured in different countries by different suppliers.You can see it very clearly in this diagram that automobile has four maybe five thousand different parts and maybe about 100 different assemblies



Now what about process modularity? The assembly process modules are shown here. These two diagrams illustrate the product and process modularity for automobile manufacture

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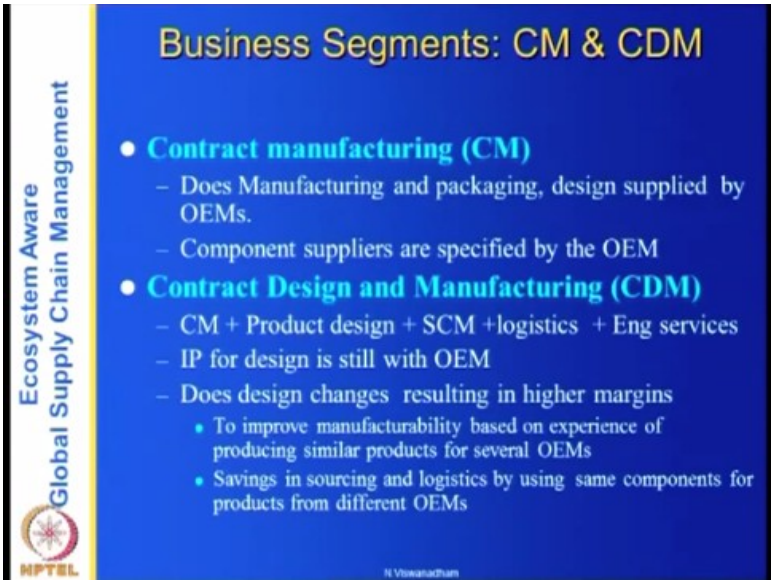
Let us look at the electronics manufacturing firms.

EMS firms (electronic manufacturing services) are a set of companies that design test manufacture distribute and provide return and repair services for electronic OEMs.
The OEMs have out sourced manufacturing to contract manufacturers and also to SMEs in manufacturing and product design space.

So there are three kinds of electronic forms one is CM which stands for contract manufacturer the ODM original design manufacturing CDM contract design manufacturing or the three popular EMS segments.



The contract manufacturer does manufacturing and packaging only, the design is supplied by the OEM. The component suppliers are specified by the OEM. In other words the orders for the components from tier 1 tier 2 and other suppliers are all given by the OEM.

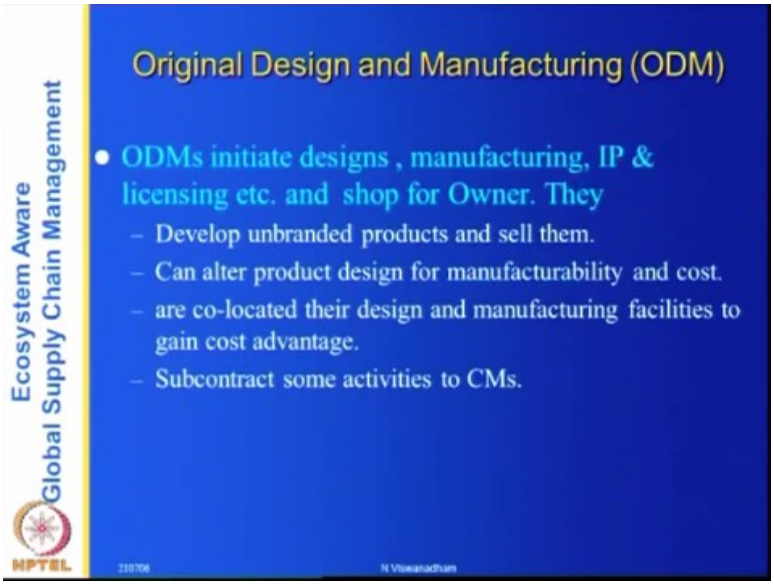
The manufacturing and packaging are commoditized activities and these two activities that are done by the contract manufacturers. If technology or product design changes, they have to replace the equipment or modernize the equipment and train your own staff. All that takes a lot of time and money .

The contract design and manufacturing (CDM) does the contract manufacturing work which is manufacturing and packaging, in addition does the product design as well as manage the supply chain, the logistics and ,engineering services

Here the intellectual property is still with the OEMs since the design is supplied by the OEM the rest of it is done by the contract design manufacturing unit and so does design changes. Thus CDMs gains a lot because they can work for several OEMs.

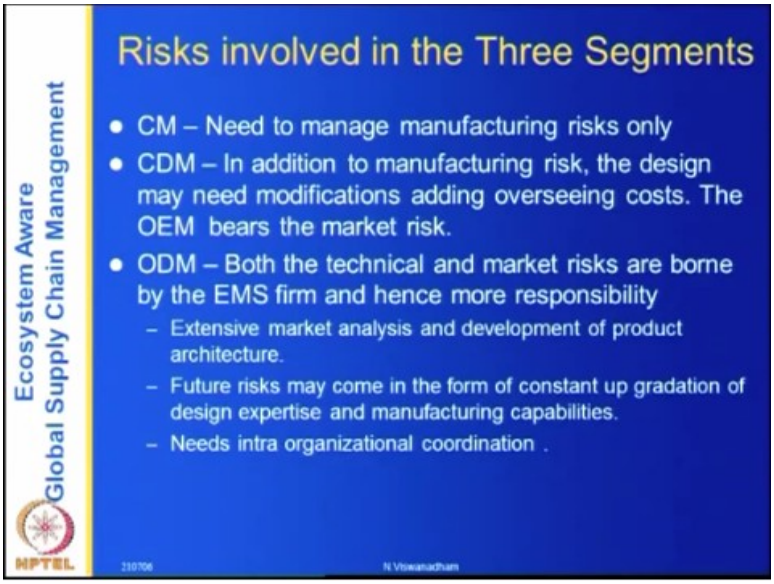
The CDMs can improve the manufacture ability based on the experience of producing products for several different companies and can obtain savings in sourcing and logistics by using the same components for products of different OEMs. .

The contract manufacturers can be a risk factor for the original equipment manufacturer since OEM is giving the design and depend on the CDM to supply the final product. Then OEM is hollowing out its capabilities.



The original design and manufacturing (ODM) initiates design manufacturing IP and licensing etc and shop for the owner. For eg., you produce a cell phone and go to Nokia hey I have a cell phone it is of the brand here and I can give it to you for this particular price you can label it as yours .

ODMs develop unbranded product and sell them and can alter product design for manufacturability and cost to gain cost advantage and subcontract some of the activities to contract manufacturers. Big retailers like Wal-Mart can basically have their own brand. Original design equipment manufacturing company can create Wal-Mart cell phones Wal-Mart need not have to do anything except give its name



If you are CDM. you are just doing the manufacturing, so if there any defects in your manufacturing processes and because of that the product has some defects then you get into problems otherwise you are not responsible for any other risks.

In the case of ODM both technical and market risk are borne by the EMS firm hence more responsibility .

Future risks may come in the form of constant upgradation of design expertise and manufacturing capabilities. We have seen particularly in electronics how things are changing; from PC to laptop to tablet to cell phones there has been a tremendous amount of technology change. If you were in the ODM without any kind of a brand then it may be you need intra-organizational coordination to solve any risk problems.

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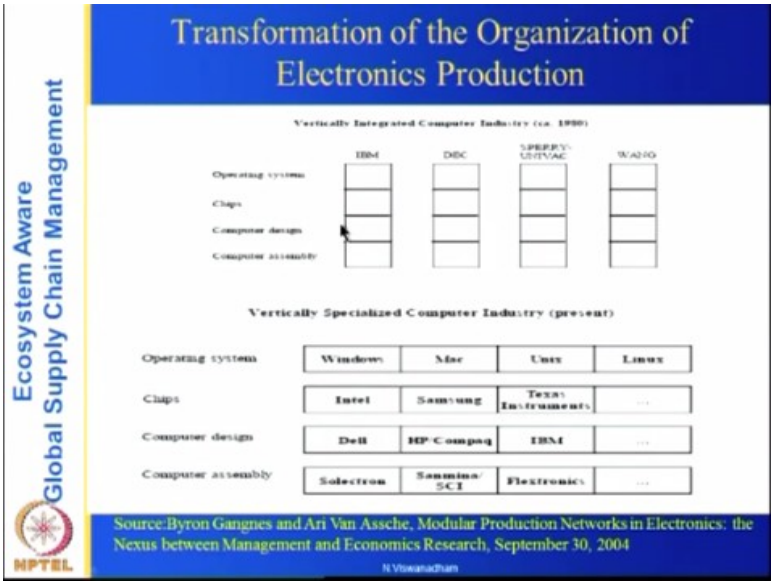
The assembler or CMT (cut make and trim) :The designs are supplied by the customer like Reebok or Polo or Wal-Mart and the manufacturer cuts and sews the fabric into garments.
Original equipment manufacturing: customers provide the design and specifies the raw materials OEM sources and finances the fabric, provides all the production and packaging services for delivery to the retail outlet .
Original design manufacturing :organizes and coordinates design of products, selection & purchasing of materials in all stages of production such as cutting sewing trimming packaging and delivery of the finished product to the customer.

We have seen so far that in the electronics and apparel sections, there are three kinds of organizations that is the contract manufacturing original design manufacturing and so on. But then what about other verticals? If we take auto vertical is it possible to distribute it like this. Auto is a typical where the modular globalization has not to happened, what happened was only a regionalization rather that is where horizontal outsourcing or horizontal integration has happened in the auto industry .

What is horizontal integration if you have a company like General Motors or Hyundai or somebody they will go to India or China and set up their own factories and source local components. The part heaviness makes it has to be delivered via ships and it cannot be airlifted. because of all these reasons auto supply chain is more regional than global

On the other hand in the apparel as well as the electronic SCNs, it has become more global so once you have products which are modular and then the processes which are modular and organization structure can be modular.

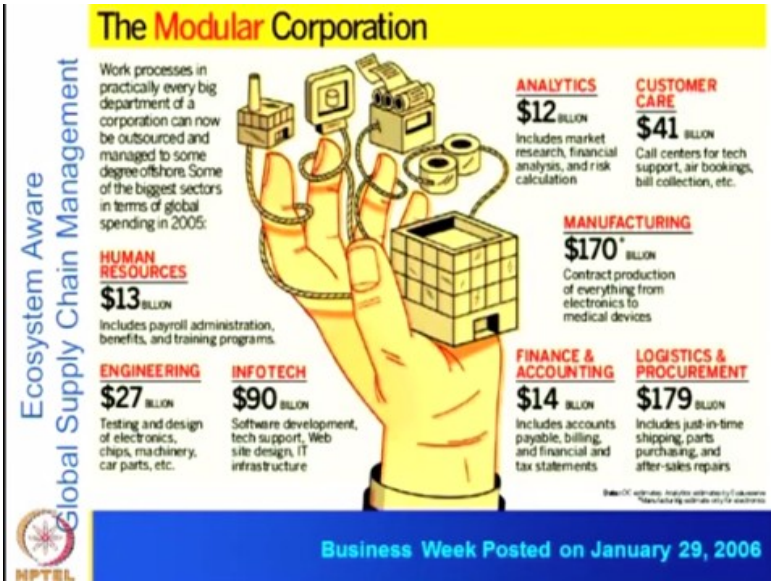


In electronic industrial, earlier we had vertically integrated computer companies like IBM, Sperry UNIVAC Wang and they have their own operating system they make their own chips they have their own computer design and they have their computer assemblies .

Electronics which was vertically integrated has now changed it to vertically specialized computer industry which means that operating system is Windows max Unix Linux and the chips are Intel Samsung Texas Instruments and others and you have computer design Dell HP IBM and so on or Lenovo and computer assembly so electronics Flextronics and SEI and so on so it is all done by the contract manufacturers here .

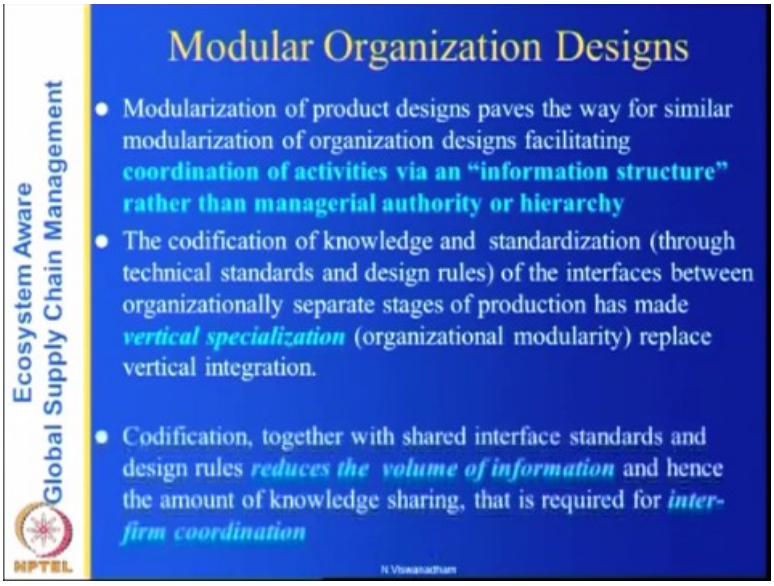
A single company is now replaced by several of these companies here so what has happened is the transformation of the organization here if you have a single company which is vertically integrated you have a CEO who is managing all the branches here on the floor managers and so on but here each of them Windows is Microsoft Intel is its own company making the chips .

Now we are basically having a modular organization structure because you are basically having an organization structure which is not by authority but by collaboration so the authority now is transformed into soft collaboration.



Now let us look a nice slide from Business Week in 2006 they the work processes in practically every big department in the corporation can be outsourced Human Resources; engineering testing; design of electronic chips and machinery, software development, tech support website design to IT infrastructure, analytics market research, financial analysis and risk calculation. You can outsource customer care, you can outsource manufacturing, then what is that you do you should have a capability to basically collaborate with all of them.

When work is done under one organization, you have a governance strategy which is vertically integrated where the authority flows from top to bottom. But here the authority is everywhere each one is an independent corporation. You have to weave them into one so that is where the governance of a corporation which has lot of outsourcing.



Modularization of product designs paves the way for similar modularization of organization designs facilitating **coordination of activities via an "information structure" rather than managerial authority or hierarchy**

The codification of knowledge and standardization (through technical standards and design rules) of the interfaces between organizationally separate stages of production has made ***vertical specialization*** (organizational modularity) replace vertical integration. Codification, together with shared interface standards and design rules ***reduces the volume of information*** and hence the amount of knowledge sharing, that is required for ***inter-firm coordination***

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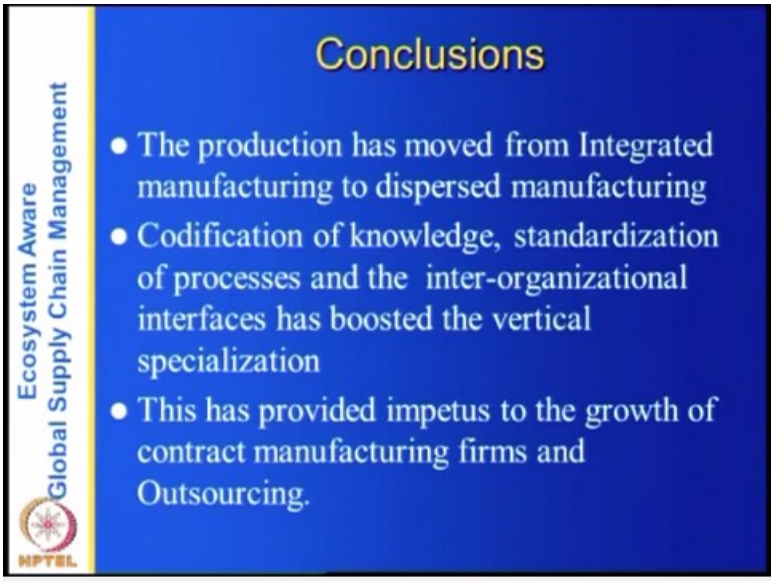
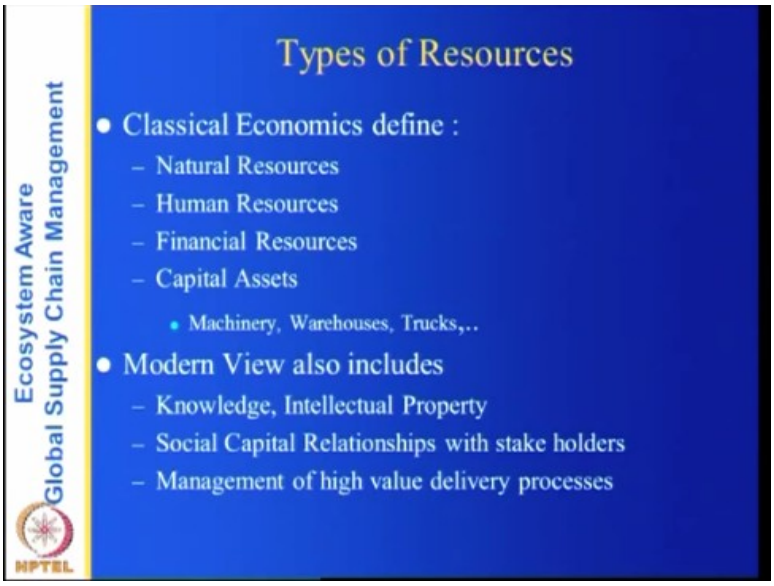
So there are two factors which basically made this outsourcing or vertical specialization possible and one of them is the standardization another one is the codification of knowledge and standardization of the interfaces and finally codification together with interface standards and design rules reduces the volume of information .



In global supply chains the production has moved from integrated manufacturing to distributed manufacturing and codification of knowledge, standardization of processes and the internal organizational interfaces are boosted the vertical specialization. This is providing impetus to the growth of contract manufacturing firms and outsourcing.

Now we are going to look at the types of resources and the industrial resources like special economic zones industrial clusters and so on and conclude this presentation .



Resources for supply chains can be categorized as follows:

Natural (mines, coast lines, fertile lands, rivers)
Human (skilled – technical, managerial, scientific)
Financial (banks, insurance, venture capitalists, supply chain financing, letters of credit)
Industry inputs (Clusters, utilities, land, water)

The human resources are basically both educated as well as the labor. Sometimes the technologies like automation replaces the human resources but the human resources may be needed to enable the technologies like the computers internet and so on internet gives you the connection but you require humans to connect .

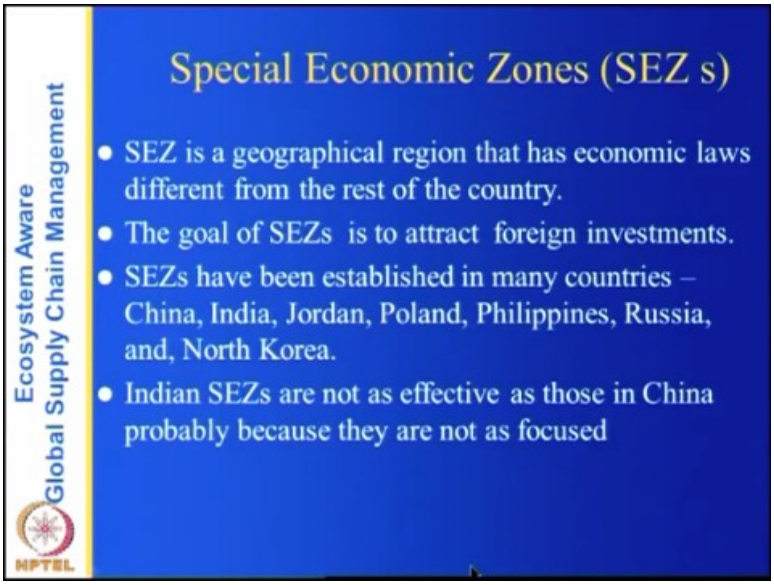
The financial resources are a part of the loans, they are a part to invest in their companies or as a part of the operational expenditure for letters of credit or for taking the loans for their customers and so on .

You have the capital assets which are like machinery warehouses trucks and so on these capital assets are one-time expenditure but their maintenance and also the interest you have to pay become the operating expenditures. The modern view of the resources includes knowledge and intellectual property as the resource R&D as the intellectual property becomes important There is also social capital i.e. our relationship with stakeholders because if you're globally dispersed company then it becomes important to have a good relationship with people

The resource landscape has changed dramatically. During the last century the prices of all natural resources like energy food water oil and the materials like steel all they came down very heavily. But if you look at the past ten years they have wiped out all the price declines that have occurred over a century and the prices have started increasing.

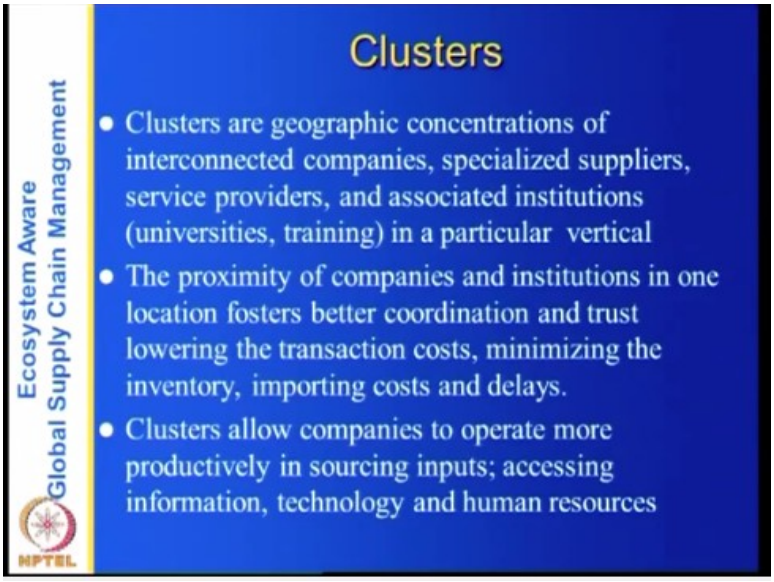
Today demand is soaring because the population has increased, the emerging markets are industrializing so with the more automation more industry expansions the resources like oil, energy ,water they are become very important. New sources of scarce and extractions are expensive so shortage of one resource rapidly impacts the other.

So the world could be entering into the era of high volatile resource prices. But people may think that like we have solved all other problems earlier we will solve this problem also. But there is lot of uncertainty in terms of finding a solution



Special economic zones are geographical regions that has economic laws different from the rest of the country. In other words it is a region where all the resources are provided and where all the industry stakeholders are also present. The power, water and there is no scarcity and it has basically some tax incentives tax ops.Most of these special economic zones attract foreign investments..

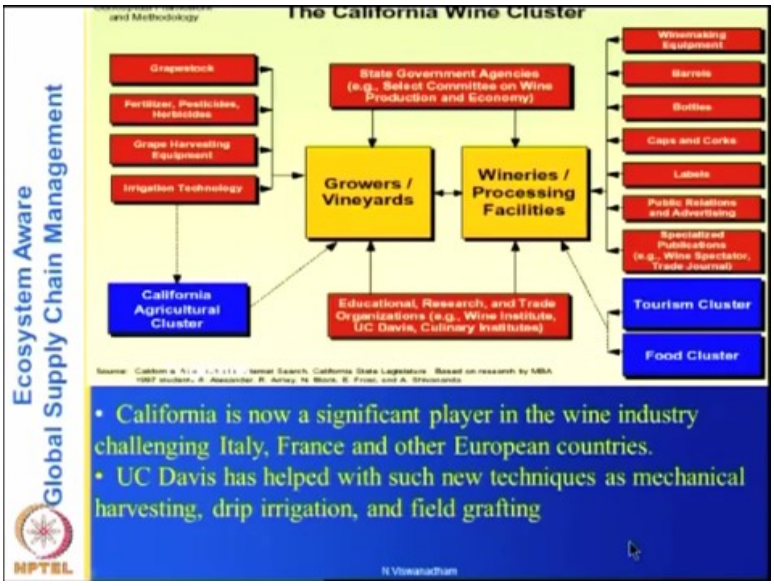
One of the very successful assets in India are the IT SEZs where there are there are electronic cities which were built in cities like Pune and Bangalore and Chennai and in Hyderabad and so on where SEZs will concentrate on the IT industry .



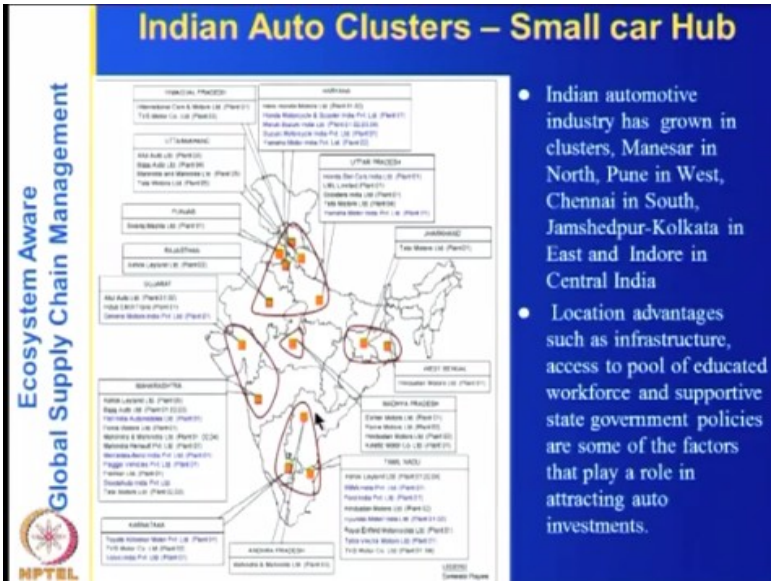
The industrial clusters are geographical concentrations of interconnected companies so you have specialized suppliers who have service providers and associated institutions like universities training institutions. If you have an auto cluster, then you have all the auto component people and the logistics providers will provide the trucks to transport the components from the supplier to the manufacturer and so on. The institutions in one location fosters better coordination and Trust lowering the transaction costs minimizing the inventory importing costs and delays.

So if everybody is at one place then of course delivery costs become minimum so the coordination cost. If you are basically sourcing from a cluster which is nearby then you can follow just-in-time philosophy you transport costs are minimal, your inventory costs are minimal and also your coordination costs are minimal .

So that is where the clusters are suggested as one of the innovations in the supply chains and clusters allow companies to operate more productively in sourcing inputs because you know the clusters are nearby so they can transfer now information as well as the employees and can accessing information technology and human resources also becomes very easy.

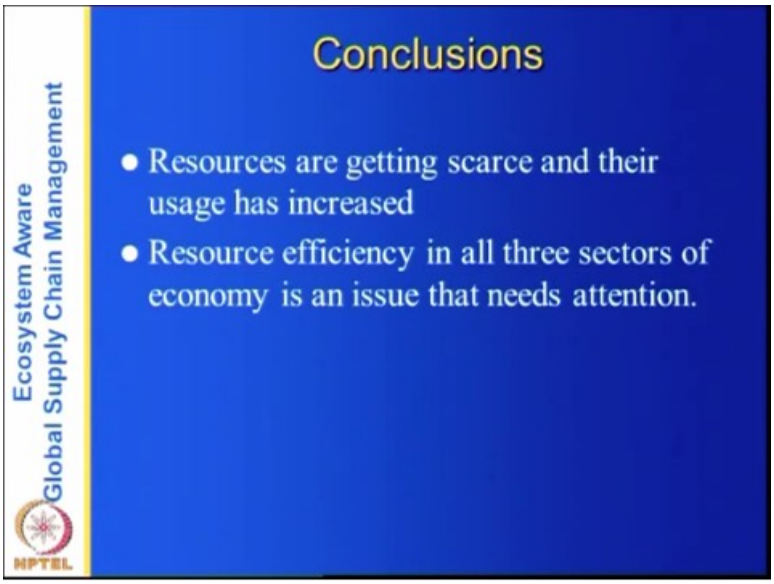


An excellent example is the California wine cluster with a large cluster of commercial wineries as well as several thousand independent wine grape growers. An extensive complement of industries supporting both wine making and grape growing exists, including suppliers of grape stock, irrigation and harvesting equipment, barrels, and labels; specialized public relations and advertising firms; and numerous wine publications aimed at consumer and trade audiences. A host of local institutions is involved with wine, such as the world-renowned viticulture and enology program at the University of California at Davis, the Wine Institute, and special committees of the California senate and assembly.



In India auto clusters are located in the east west north and south. In the South it is Chennai or Madras it is in the in the north it is Delhi in the West it is Kolkata and in the in the West it is the Pune Bombay region. you can find in this diagram all the state names where they are located .

So you have lot of supportive environment for making India small car hub and in terms of these clusters so the whole all the manufacturing in India is concentrated in four places.



One has to be extremely careful in the use of resources. They are getting scarce particularly the natural resources if you look at the mines, the oil, water etc is getting scarce. Mining of the metals aluminum copper and iron is becoming expensive. The food which is the agriculture that is also becoming expensive

That one need to observe is when you are resources are getting scarce it is important to have improve the efficiency of these resources use. In agriculture where you use less water less power and you know improve your fertility of the land and so on. In the manufacturing you improve your labor productivity you use less power you try to change the processes so that you use less natural resources In my view, the next decade well who has to concentrate on not resource exploration but resource efficiency .

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