Modelling and Analytics for Supply Chain Management
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Week 1: Module 2
Lecture 02: Introduction to Modelling and Analytic in Supply Networks

Good morning and welcome to module two of our course on modelling and analytics for supply chain management.

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Today, we are going to discuss about uncertainty and risks in supply chain. In my last lecture, I had mentioned that among the several issues that are confronting a supply chain, one of the primary one is the demand uncertainty and the supply uncertainty. So today we will elaborate on both these aspects and then dwell upon the concept of responsive supply chain, efficient supply chain, then agile supply networks and related risk hedging supply networks.

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So, let us start with the uncertainty on the demand side. Considering the demand uncertainty, you see, products can be classified into two major categories. One is primarily functional or primarily innovative and based on the demand pattern and the characteristics of the products, the strategy of the supply chain can be designed.

In fact, the structure of many supply chain is basically dependent on the product life cycle, the demand characteristics, the product variety, and the market standards for lead time. Based on this, all of these classifications of the products have been done and to suit the characteristics of each product types, the supply chain structure is designed.

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Let us first discuss about functional products. What do we know about functional products? Functional products have basically long life cycles of say two years or more. They have predictable demand with the low profit margins and low product variety.

And in this case there is low rate of stock out and hardly there is any price markdown. Okay. And if we look at a functional products, some examples are say the groceries, the packaged foods, which are being sold in the supermarkets, basic clothing and accessories, oil and gas, many industrial products and so on.

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Now coming back to innovative products, these products have short life cycles of say two months to a year. Unpredictable demand with high profit margins, high product variety, high rates of stock out and high price markdowns. If we look at examples of innovative products, we really find that these products have significant technology or design components embedded in them.

Examples include, say, consumer electronics, cell phones, computers, telecom products. Again, coming back to the brass tacks likes say fashion apparel and seasonal clothing, home furnishing, toys, these are plenty of examples of innovative products.

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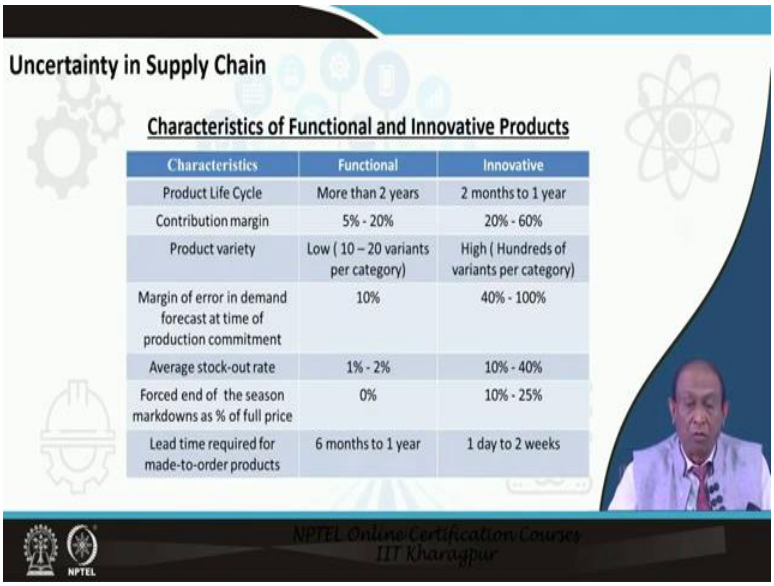

Now, if we look at the characteristics of functional and innovative products, okay, then we can really look into a comparative chart. Okay. For example, I have already mentioned that with respect to the characteristics say product life cycle, functional products have life cycle of more than two years. Hence, their demand is much more stable and predictable whereas innovative products, they have product lifecycle ranging from say two months to one year.

The contribution margin, I said that functional products have low contribution margin or profit margin and we can, you know, estimate that the contribution margin for functional products can vary between 5 percent to 20 percent, whereas for innovative products, the contribution margin is high and it ranges from 20 percent to 60 percent.

Product variety is very low in case of functional products may max, at the max, there can be 10 to 20 variants per category for functional products whereas in an innovative products, the variety of products is pretty high, a hundreds of variants per category exists, margin and since you see what is happening that functional products have stable and predictable demand. Hence, if we are going in for forecasting the demand for functional products, the error will be, average value of error will be very low, maybe to the tune of say 10%.

Whereas innovative products, the demand pattern is not stable and highly unpredictable and hence the forecast error is very high, 40 per… maybe even 100 percent error effect. So, in this

case, the planning becomes a very complex one. Then average stock out rate is very low in case of functional products, it is 1 percent to 2 percent, whereas in case of innovative products, the stock out rate is to the tune of 10 to 40 percent.

And we have already mentioned that since the demand is stable, in case of a functional products, hardly there is any markdown at end of any season. And for innovative products for particularly for fashion garments, this kind of apparels and all, we have noticed that this forced markdown at the end of the season can vary between 10 percent to 25 percent.

The lead time required for made to order products, okay, it has to be very short because innovative products, if we are not able to supply the product at the time of, the at the time when customer needs them, then you know, it is of no meaning, no use, so the lead time required for made-to-order products in case of innovative products varies between one day to six weeks.

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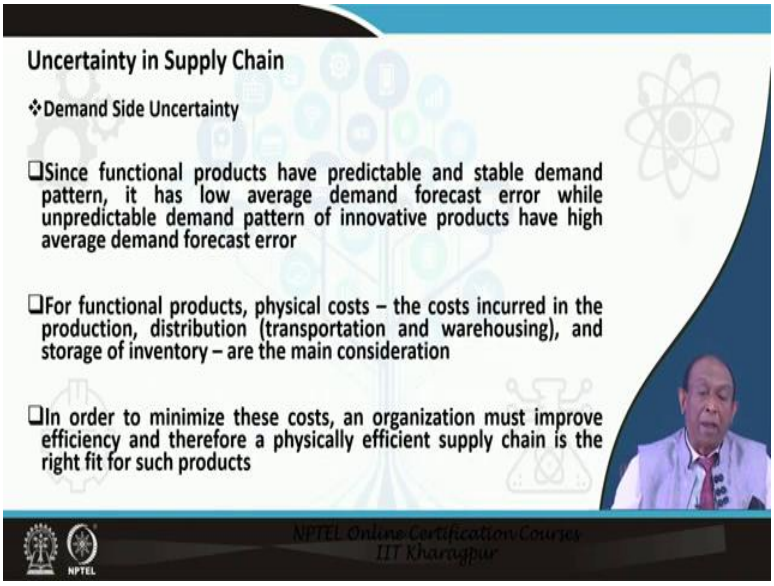

Again, coming back to demand side uncertainty, since functional products have predictable and stable demand pattern, we have already said that the demand forecast error is very low, average demand forecast error while unpredictable demand pattern of innovative products have made them prone to high average demand forecast error. So this is one aspect.

For functional products the physical costs, that is the cost that we incurred in the production, distribution, distribution means the total cost incurs the transportation and warehousing costs and storage of inventory, these are the main cost components that need to be considered. Again, once I depict a for functional products, the physical cost that is the total cost of production, distribution and storage of inventory are the main things that need to be considered and in order to minimize these costs an organization must improve efficiency and therefore a physically efficient supply chain is the right fit for such products. By efficiency here primarily we are emphasizing on minimization of cost.

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For innovative products, market mediation cost dominate and this market mediation cost arise from demand uncertainty and subsequent mismatch of supply with demand. Market mediation cost basically include the cost of disposing of excess inventory, lost sales and lost customer goodwill due to shortage or stock-out.

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Now, in order to reduce this market mediation cost an organization must improve its responsiveness to fluctuations in demand and hence a market responsive supply chain is appropriate for innovative products. So, what is this responsive? The primary goal of a responsive supply chain used to quickly react to changes in demand. So, short production lead times and flexibility are valuable capabilities with respect to a responsive supply chain.

See basically, this is very important, you know, the flexibility and short production lead time, these are two very important parameters of a responsive supply chain. So, what happens that in many responsive supply chains in order to be flexible, they keep excess capacity, okay. And sometimes there is some more inventory on hand to quickly react to customer's demand.

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Now, when we talk about responsive supply chain, sometimes the question is what are the indicators for supply chain responsiveness? Because normally we by responsive supply chain people basically mean that in order the delivery lead time has to be very short. But besides this delivery lead time, okay, there are other indicators of responsiveness.

For example, if we are talking about, you know, supply chain responsiveness, one thing is that they should respond to wide ranges of the quantities that are demanded. Now this range must be very high. Okay. And we have already mentioned that the delivery lead time should be short. Then the supply chain must be able to handle a large variety of products. Okay. It should be able to build highly innovative products and it should also be able to meet a high level of customer service. These are the characteristics or the indicators of responsiveness.

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Supply Side uncertainty – Now, if we talk about supply side uncertainty, supply processes maybe categorized into stable supply processes and evolving supply processes. If we talk about a stable supply process, a stable supply process is one who had the manufacturing process and the underlying technology are mature and the supply base is well established.

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And evolving supply process is one where the manufacturing process and the underlying technology are still under development and they are changing rapidly. So, in this case the supply base has to be limited with respect to both size and experience.

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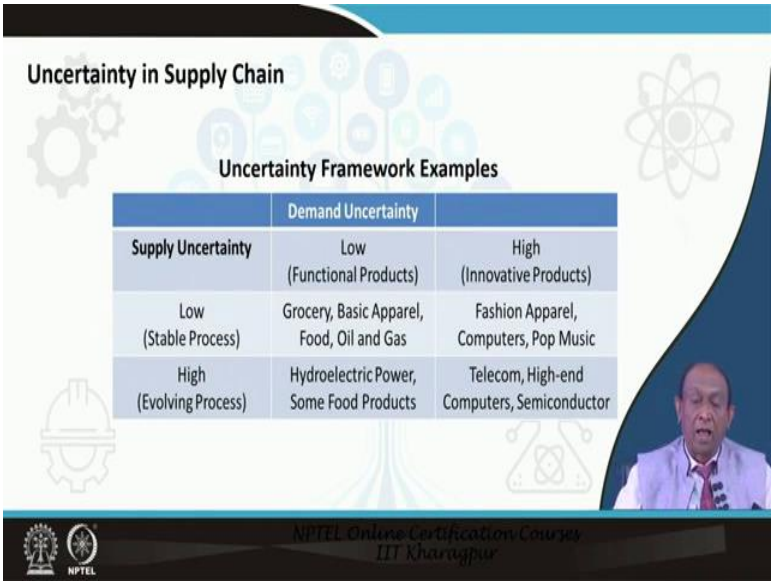

Now if we look at the uncertainty framework, okay, then we find that the functional products, okay. Basically fall into a situation where the demand uncertainty is low and supply uncertainty is also low. For example, grocery, basic apparel, food, oil and gas. But in case of innovative products, okay, we see that the demand uncertainty is also very high and supply uncertainty can be low also.

So, for example, in case of fashion apparel, computers, pop music and in case of you see telecom, high-end computers, semiconductors, you see the both, the supply uncertainty is high as well as the demand uncertainty is high. So, a separate kind of strategy has to be devised and deployed for such kind of products.

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Now coming back again, this, we were talking about efficient supply chains. In case of efficient supply chains, the emphasis is on minimization of cost. So, if we look at the structure of the efficient supply chain or the strategies that are deployed in case of efficient supply chain, we see that the production centers, they are typically located in a low cost location or close to the supply base.

Whereas in this case, the products, sometimes are often outsourced to the most efficient or specialized supplier. Transportation in this case is by low cost means, since the demand pattern is stable. The inventory that is carried in the pipeline has low demand uncertainty and therefore very low risk of obsolescence. So, we can use transportation by low cost means for example, by sea route.

Even though lead time is high the products, the pipeline inventory will not get obsolete. Entities that means the players in the supply chain, they must share demand and production information so that the costs can be lowered throughout the supply chain. So these are the typical characteristics associated with an efficient supply chain. Once again I repeat, the production centers are typically located near a low cost location or they are located, near the, supply base.

That's why you will find that many, you know, companies that operate in US and UK, they have their supply base located in Asia, particularly in China, India, Bangladesh and things like that.

Products are often outsourced to the most efficient or specialized supply. This is very, very important.

The outsourced service provider must be, must have certain specialized capability in delivering those goods. Transportation is by low cost means maybe by sea route. And the pipeline inventory is of no consequence because the, you know, since that demand is stable, there is no risk of obsolescence and players in the chain must share their demand and production information.

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So, these are the characteristics of efficient supply chains. So again, I have again I repeat, when products have both low demand uncertainty and low supply uncertainty, the basis for competition is by efficiency. So this is very important because today I said the competition is between one supply chain against another.

And in an efficient supply chain. In order to minimize cost, we have to eliminate non-value-added activities and focus on getting the best capacity utilization in production and distribution. And hence, you see value stream mapping takes a very important role in finding out or identifying the non-value-added activities. And in order to minimize cost, funds, they utilize advances in information technology to link all the activities to increase the efficiency. That means lower down the cost.

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So, these cost efficiency maybe achieved in two major ways, one is through productivity improvement and the other through effective logistics and distribution.

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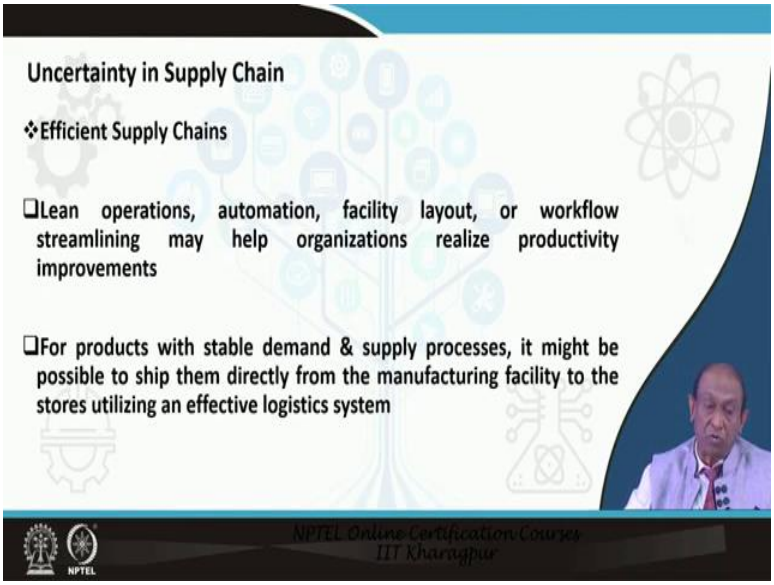

So, you know, if we look at our management concepts, then we will find that in efficient supply chains there is deployment of lean operations, automation, facility layout or workflow streamlining and these are helping organizations realizing productivity improvements.

For products with stable demand and supply processes, okay, it might be possible to ship them directly from this product, from the manufacturing facility to the stores utilizing and effective logistics shipment sometimes referred to as drop shipment when you know the materials are dispatched from the manufacturing location directly to the customers.

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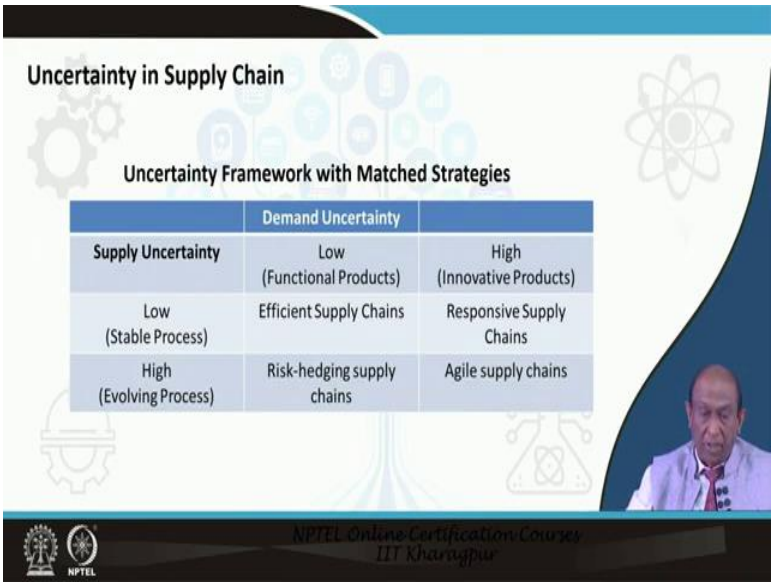

So again, if we look at the uncertainty framework with matched strategies, then we find that these type of supply chains can be classified into four categories. Okay. See if the demand uncertainty is low and the supply uncertainty is also low, the, you know, the right kind of fit is efficient supply chains.

Now, if the demand uncertainty is high, supply uncertainty is low then we basically talk about responsive supply chains. When the supply uncertainty is high and the demand uncertainty low, we have risk hedging supply chains and when both the demand uncertainty is high and the supply uncertainty is high, you know, we really refer to supply chains strategy involving agile supply chain.

And see agile supply chains basically now they are also catering to supply disruptions. They they can hedge against supply disruption as well as becoming customer responsive chain. So, you know, agile supply chains differ from responsive supply chains in the way that agile supply

chains are not only responsive but they also cater to the disruption in supply, okay, so they hedge against all these supply disruption also.

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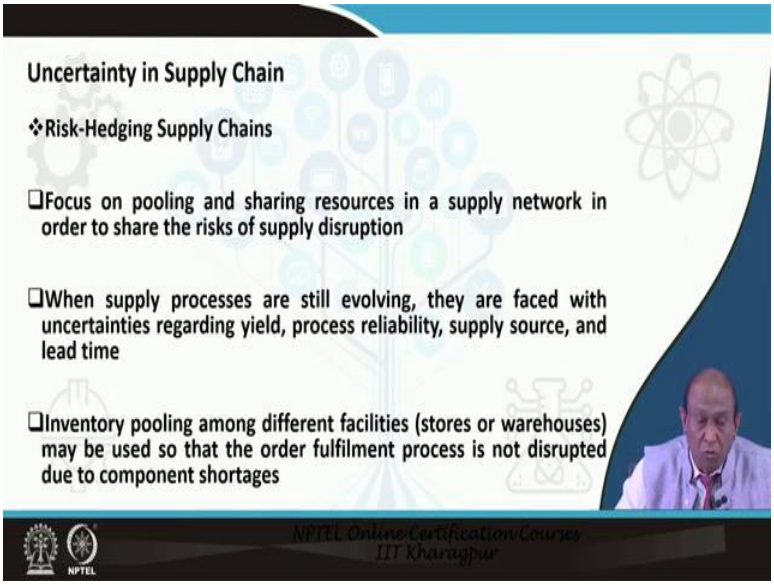

So, now if we look into the details of this, if we look at the risk hedging supply chains, which I already said that is mythically risk hedging supply chains are applicable when the demand uncertainty is low and the supply uncertainty is high, what are the characteristics of a risk hedging and supply chains?

They focus on pooling and sharing resources in a supply network in order to share the risk of supply disruption. When supply processes are still evolving, they are faced with uncertainties regarding yield, process reliability, supply source and lead time. And they, basically the strategy is that the inventory pulling among the different facilities that is a stores or warehouses can be deployed so that the order fulfillment process is not disrupted due to component shortages.

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If we look at this risk hedging supply chains, there is a need to develop multiple supply bases in order to have backup sources for their products. Now, although the cost of having multiple sources might be high, it reduces the risk of supply shortages, so that can be even more costly.

Supply shortages can be even more costly and hence we are basically resorting to having multiple supply sources. In this case, in case of risk hedging supply chains, another important issue is the deployment of internet. Internet is here used to transfer supply and demand management information and thereby increase the efficiency of risk pooling.

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Another example of risk hedging supply chain is the use of this internet in e-marketplaces such as, you know, we all know about the Covisint that was established by the big three car manufacturers in the United States and later on joined by Nissan and Renault. Through this public e-marketplace the companies can locate many supply sources which reduces the risk of supply shortages as well as lead times for the company.

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Again, coming back to responsive supply chains here unlike efficient supply chains here, the facilities in the chains are typically located close to the customer base so that the delivery lead time can be shortened. In here excess capacity or flexible capacity is built-in so that the production volume and the mix can be changed quickly.

Supply of raw material is ensured by investing in adequate amount of inventory and yet the focus is on reducing various components of lead time such as in product design, product launch and replenishment. Once again, in responsive supply chain facilities are typically located close to the customer.

They are in excess capacity to attain flexibility so that production volume and mix can be changed quickly. Supply of raw material is ensured by investing or keeping adequate amount of inventory. So, the focus here is on reducing various components of lead time, such as in product design, product launching, and replenishment.

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This responsive supply chain if, when you look at the, you know, strategies that are most appropriate for responsive supply chain, they need suitable strategies for cases when demand is highly unpredictable with a short selling season, which could result in excess inventory, which in turn might be very costly for, you know, innovative product, the kind of strategies that are

deployed in such case. For example, if you look at, take the example of Zara. The, you know, their fashion season normally starts from say September till February.

Now, the season that lasts for a very small period of time. And, depending on the trend of the colors or the fashion garments that will be vogue, that particular season, they resort to certain strategy is called a read reactive strategy and we will be walking out some of the problems, deploying analytic techniques to how to really cater for this kind of fashionable garments which are being sold over a season lasting over a small period of time.

In addition to accurate forecasting and inventory planning. We know certain strategy concept including say a postponement or build-to-order strategies are also deployed in case of such kind of supply chains. Now, you might ask me that what is this postponement strategy. This postponement strategy basically refers to, you know, delayed differentiation, that means if you look at the value chain, okay, the differentiation among the different variants of the final product is made quite late in the chain.

For example, you know, if you go to a particular, paint shop, okay. Now, previously what used to happen that there, you know, in olden days we used to have some six or seven different colors and with the pens packed in tins, we did not have much choice. We used to, you had to choose from all those seven or eight colors and they used to carry heavy inventory of those few colors only.

But today if you go to a paint dealership a way that it is for asian paints or for anybody, you know, if you go there and ask that you know, I want to buy paint, they will show you a catalog. Okay. And then you can choose the color of your choice based on this indication on the catalog and they will prepare the paint because they will carry the base paint.

And they will put in these (())(26:11) inside those base paint quite at the last moment. So, this delayed differentiation basically helps them to you know, carry less amount of inventory and you know, be responsive towards the customer's demand. We will talk more about it at a later point in time.

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So, these responsive supply chain strategies are highly used in fashion industries. Companies such as Benetton, Sport Obermeyer and Zara use these concepts to cope with this fashion gamble. For example, if you look at Benetton (())(26:49), you know, previously they used to have colored fabrics and then they used to knit them.

Today, knitting is first done and then, you know, the dying is taking place depending on the preference of the colors from the customer. So, Benetton used this idea of postponement by redesigning its sweater manufacturing process from dying first to knitting second and then to knit first and then dye second, thereby postponing the color decision until more information about the demand for colors arrived.

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And then last and you know, which is most important, we will talk about agile supply chains. See these agile supply chains, they are not only the, they possess the characteristics of responsive supply chains, but they are also flexible to customers changing and diverse needs. This is very important. The, you know, customer's needs may be changing, there may be diverse need. So, agile supply chains should be able to meet those kinds of demand as well as they should be able to take care of supply shortages and disruptions.

They have got special ability or strategies rebuilt to hedge against the risks of supply shortage and disruption. And another thing is very important in case of agile supply chains is they basically pool inventories or other capacity resources to achieve the objectives of being responsive, as well as being able to guard against disruption in supply disruption, supply disruption, and supply shortages. So thank you all, for today, we will meet tomorrow or with a module three of this particular first week and since then goodbye. Thank you.