Decision Support System for Managers
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Module – 09
Decision Support System for Distribution Network Design in a Supply Network.
Lecture – 05
Echelons in the Network

Hello and welcome to "Decision Support Systems for Managers"! We are into module 9 and lecture 5 of module 9. In module 9, we are covering 'Decision Support System for Distribution Network Design in a Supply Network' and today is the final lecture of this module that is 'Echelons in the Network'; ok.

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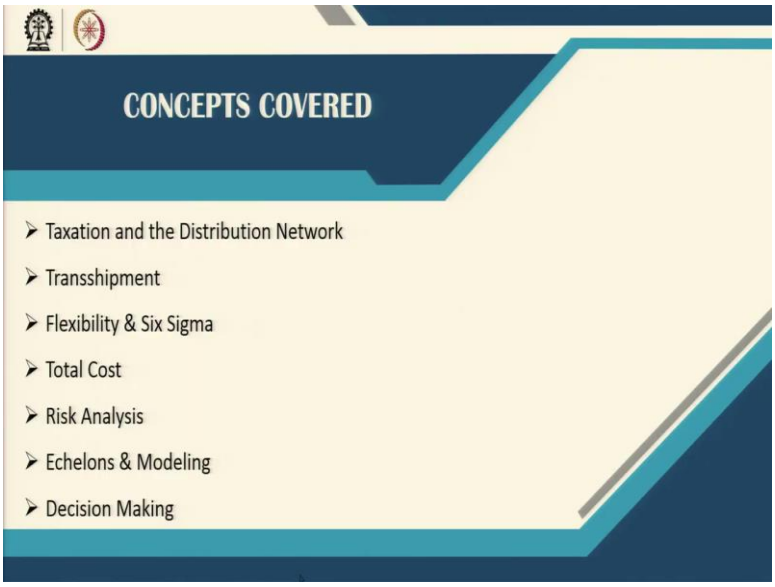

What have we covered till now? The first stage was how to design the, how to take advantage of supply chain design, rather how to design a supply chain taking tax advantage. That was the first part. Second thing that we learnt is what the role of transshipment in a supply chain design is and we learned that even warehouse is a transshipment center.

The third part that we learned was flexibility and Six Sigma. Now, in flexibility and Six Sigma what did we learn? We said that there should be some amount of flexibility in the supply chain network.

Because, without flexibility tomorrow if there is a sudden increase in demand or sudden decrease in demand if, we are moving with a fixed capacity, then this the supply chain will not be able to accommodate this sudden increase in demand or reduction in demand. Either way the company will make a loss a notional loss; ok.

Then, next we learnt what the total cost of supply chain is; there also we learned the equation that is cost from one stage to the next, next to the subsequent one, this is the total cost of the supply chain network; ok. Then, we learned risk analysis; ok. This risk analysis we learned how to value or how to measure risks in a supply chain, and at each stage of the supply chain how to measure risks; ok.

Today we will do echelons and modeling, and decision-making in supply network; right; ok.

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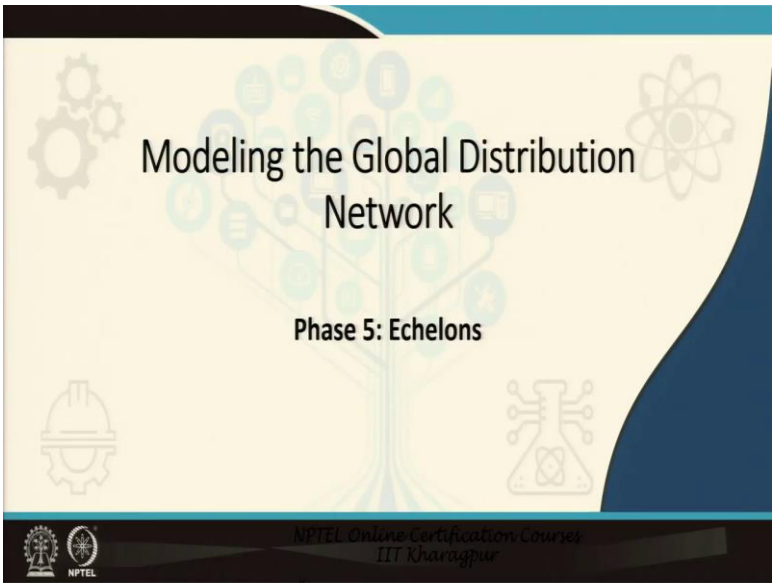

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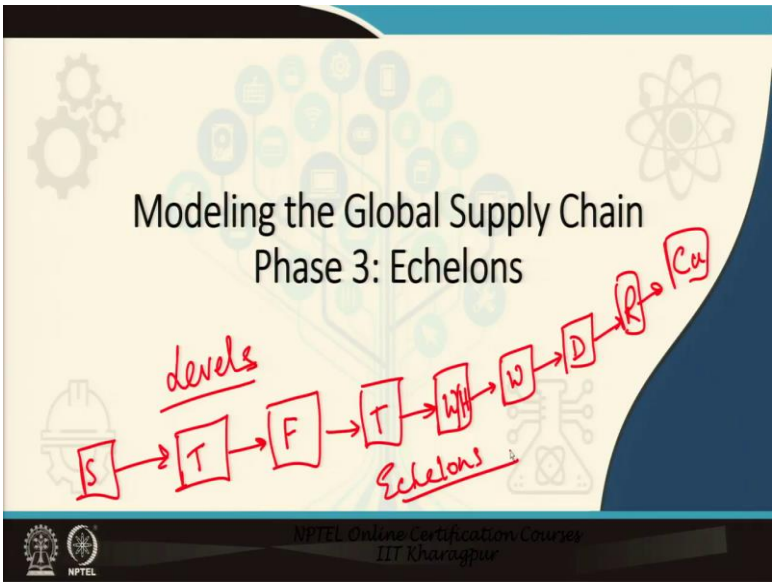

So, phase 5: Echelon. Now, the first question is basically what is a echelon or what is an echelon, ok. Now, basically you will find many meanings and many thing, many ways to interpret echelons in many books; ok.

But, to us echelon means basically level; ok. That is here the supplier, from supplier to the goods are given to the transporter. This transporter transports my goods to the, yeah, my supplier, transports my goods to the factory; ok. My supplier transports my goods to the factory. From the factory, again it is given to the transporter.

This transporter transports the goods to the warehouse ok. Warehouse and from the warehouse it goes to the wholesaler or the distributor; distributor, retailer and this from the retailer it goes to the end customer ok. So, if you see that, these are the levels, these are the levels, ok, through which the supply chain moves.

And so, these are called the echelons in a supply chain, these are called the echelons; ok. So, this is what echelons in a supply chain refer to; ok.

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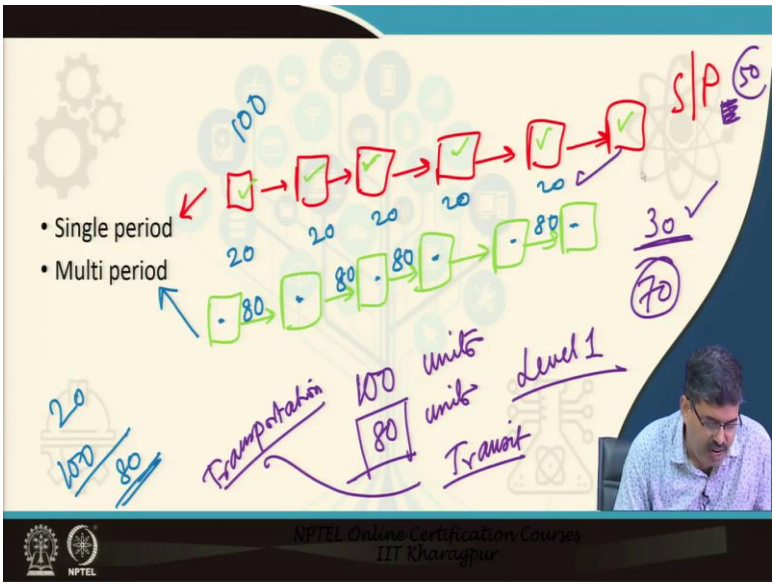

Now, if you see that this the diagram that we drew this diagram ok, this diagram that we drew was ok, this diagram that we drew was a single period echelon, single period design ok. What will happen is that at the end of the first period, let us say first period. What will happen, at the end of period 1, there will be some learning's, there will be some learning's from the experiences in period 1 ok and, based on that we will modify the distribution network of period 2.

There will be some stock left over of period 1 at each of these levels ok, at each of these levels there will be some stock left over. These stock leftovers will have to be accounted for when we are designing the level 2, because level 2 if my demand is 100 and there is a stock left over of 20, then level 2 should actually carry 80 units of goods.

Whereas, level 1 carried how much; 100, but level 2 should actually produce 80 units rather carry 80 units and 20 units are anyway in stock. So, what is this is called as period 2 or multi period, ok. So, what is happening here? Look at it, look at the diagram very carefully ok, level 1 there was 100 units there is a stock left over of 20.

And, so the supply chain in level 2 is carrying how much units? It is carrying 80 units, ok. Assume that in every stage there is a stock left over of 20 units. So, level 2 is carrying 80 units. Now, what is the issue, what is the problem? The problem is when you design supply chain at level 1, you designed it for how many units? You designed it for 100 units.

In level 2, in level 2 your supply chain you are storing rather your supplier is supplying now how much? Your supplier is supplying 80 units ok. And, every stage there is a stock leftover of 20 units.

So, your supply chain design is now getting designed for 80 units for at least the first level, for at least the first level your supply chain is getting designed for 80 units. Then, what is happening is as we move ahead, as we move along, the supply chain, it is 80 plus the leftover stock ok. Now, the leftover stock has a cost so you want to get rid of it.

So, you are giving buy 1 get 1 free, getting the point. So, this is this is the problem in supply chain design, single period, multi period. Moment it is multi period all the stock leftovers of the previous system now comes into picture. And, because your supply chain is now carrying less goods, you are having lesser number of goods in transit.

So, your transportation planning earlier you transported 100 goods, your transportation now is only 80. So, the transporters who were very happy to do business with you in year 1, because you are carrying 100 huge products and you are requiring 100 trucks, now you are requiring only 80 trucks.

So, the transporters are bit sad, not unhappy. They have enough business, but they are a bit sad ok, that you are not able to give them 100 units worth of business. So, all these problems will happen in supply chain. Third year; third cycle again there is a leftover of 30 units, for some reason or the other product has got stuck up. So, how much is your supply chain carrying now? 70 units; ok.

Some people will say no it is not carrying 70, it is carrying only 50, because 30 plus 20 is equal to 100 minus 50 is equal to 50, you are only carrying; ok. So, you are only carrying 50. So, that is a problem. So, lot of these debates will continue; ok. So, we have to design a supply chain in a manner which is single period, multi-period; at the same time, my cost is minimum; everything is according to my way of understanding and wellbeing; ok.

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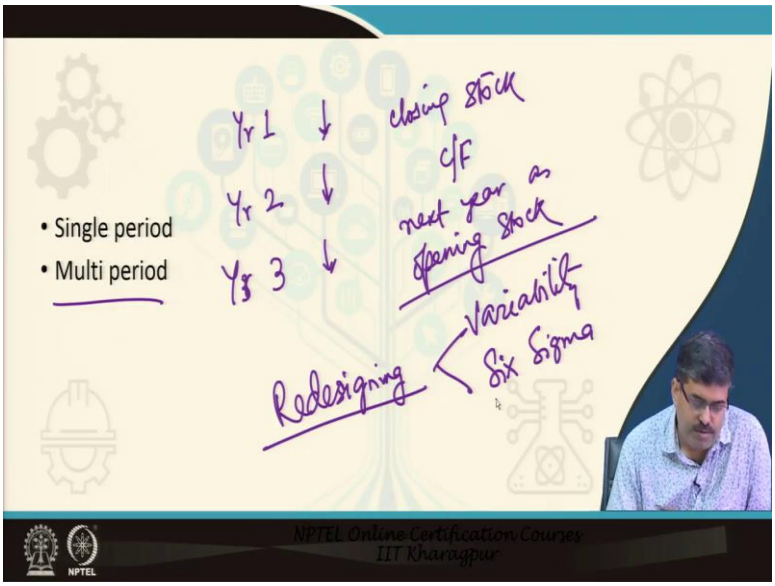

So, this is, what is your single period and multi period; ok So, multi period is basically year 1, year 2, year 3, in that way it moves; ok. And, the closing stock is carried over is carried forward to the next year as opening stock ok, opening stock.

So, this is basically the multi period model. Now, in multi period model another thing is happening. At every stage we are, we are redesigning. Every stage we are redesigning and the redesigning is based on variability, which is aligned to a Six Sigma; ok.

Every stage redesigning variability Six Sigma, this is what is happening getting the point; ok. So, that is the issue with single period and multi period models; ok. Now, my next issue is in the single period and multi period model something else is happening; see; look at the complexities.

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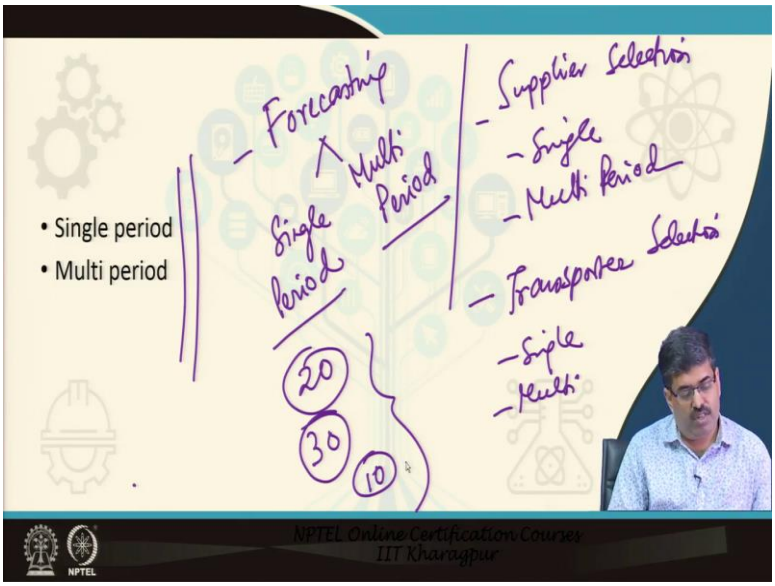

We said that we will deal with the echelons and levels. What are the complexities? The forecasting, single period, multi period, ok. Forecasting single period, multi period, supplier selection, you selected a supplier you guaranteed him a supply of 100 units, but next year it is only 80, third year it is only 70.

So, supply selection; single period and multi period, we have already discussed about transporter selection; again single, multi; ok. So, many problems are happening in single period and multi period systems; ok. These are issues; right; anyway fine.

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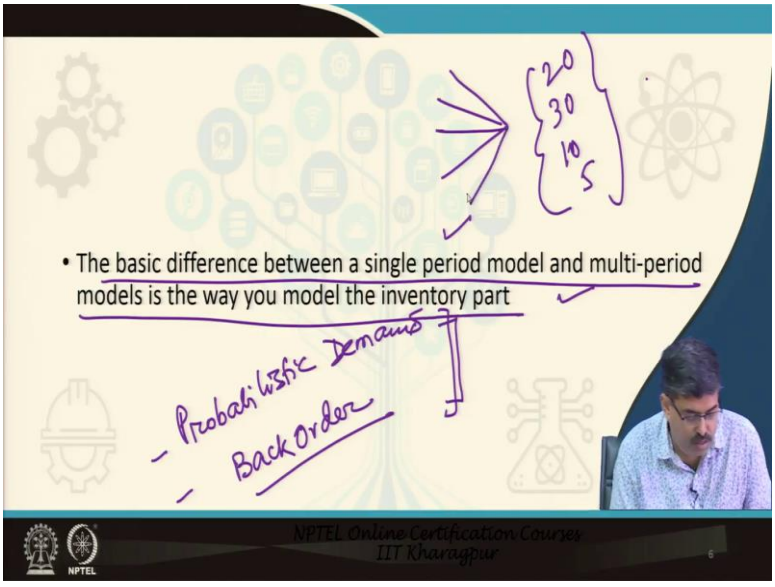

So, basic difference, so, what did we notice here. Basic difference what was happening your inventory was building up unsold goods 20, 30, next cycle it may be only 10 ok. So, look at the fluctuations. Again if next cycle your inventory is only 10, again you will have to start redesigning your supply chain, renegotiating, finding out the transporter, looking at the optimal model everything is changed.

So, single period model, rather than single period model multi period model is always better, then you can understand the dynamics of supply chain. So, as I said the basic difference between a single and a multi period model is the way you model the inventory part that is why in your inventory though it is not exactly of this subject.

I am telling that is why in inventory you have probabilistic demand pattern you consider. Because, you do not know how the demand will behave, you can only give you some probability; ok. This is the probability of demand behaving like this; this is the probability of demand behaving like that so, probabilistic demand; ok. That is why in inventory you part because you do not know how much will be the inventory left?

So, but you want to keep your supply chain smooth, you do not want it to get fluctuated every year a lot of problems will happen. So, that is why you have something called back order in the automobile industry, we just mentioned 1 day right that is why we have something called back order.

So, that you will there will be orders that will be piled material, will be supplied later on; ok; so, this is called as the back order. So, this is the basic difference between a single period model and a multi period model that this is the demand pattern; ok; probabilistic demand and back order; ok.

These problems will happen right, with inventory. And, we learnt that inventory is the main problem 20 units, 20 units, 30 units, next can be 10 then can be 5. So, look at this this is your inventory. So, demand is also fluctuating. So, how do you plan your supplier selection, your transporter selection, route planning, market forecasting? How do you do all these things? So, lot of problems; ok.

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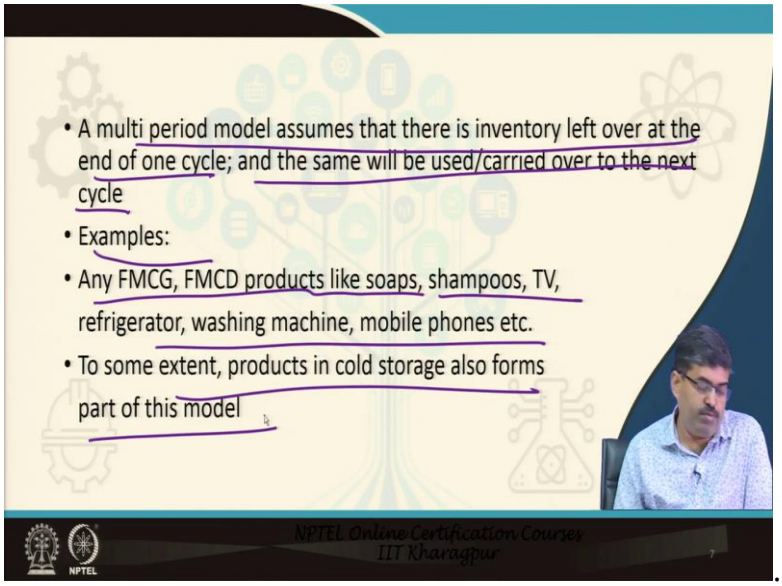

A multi period model assumes that there is inventory left over at the end of one cycle; and the same will be used or carried over to the next cycle. Exactly, what we mentioned. Examples, any FMCG, FMCD products like soap, shampoo, TV, refrigerator, washing machine, mobile phone. To some extent products in cold storage also forms part of a multi period model that keep on getting stored; ok. We will model the single period model first; ok.

How to model? Let us take; ok; let us take the drawing here; then, we will take it in the next slide; ok.

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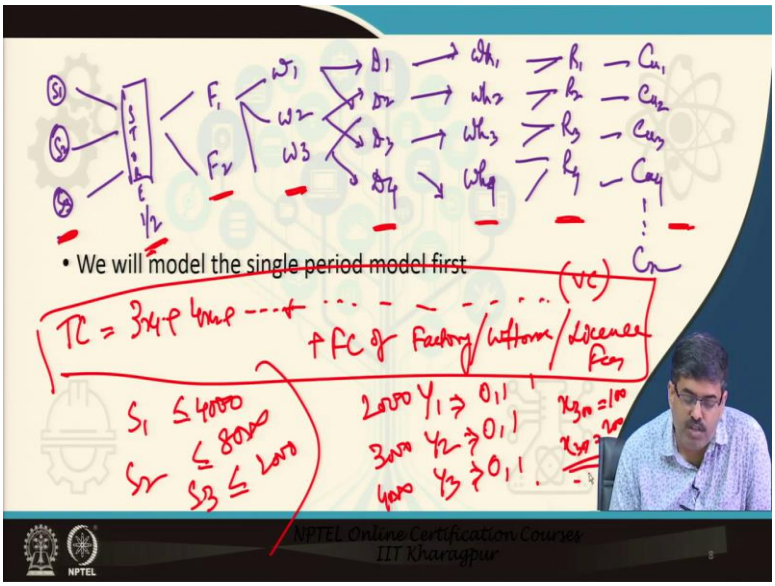

We will model the single period inventory model first; ok. What is there? Supplier 1 2 3 store, stores may also be 1 2, factory warehouse 1, warehouse 2, warehouse 3. So, warehouse it goes to; ok.

So, this is the model, that is from supplier, to store, to factory, then to warehouse distributor ok, let us use a different ink from supplier, oh sorry from supplier to store, that is a raw materials have been stored for some time, then to factory, then the finished goods is sent to warehouse, distributor, wholesaler, retailer, customer; right.

How to model this? Supply selection models after selecting the supplier, you select 3 suppliers. So, from supplier they are going to store, then to factory. So, first is total cost is equal to how much quantity is going from which supplier? We do not know; right; ok. So, some cost 3 x 1 plus 4 x 2 plus dot ok, then this entire costing; ok.

Clear plus these are all the variable cost, plus fixed cost of factory, warehouse, license fees etcetera. So, this is my total cost model. What are the constraints? S 1 can supply let us say only up to 4000, S 2 can supply only up to 8000, and S 3 can supply only up to 2000, supply constraint.

What is the warehouse constraint? Ok. Each warehouse can support, let us say 2000 is the fixed cost y 1, 3000 y 2, y 3 ok. What are these y 1, y 2, y 3? These are basically 0 1, that is warehouse 1 is open warehouse 2 is sorry warehouse 1 is either open or close; ok.

So, this is these are the basic cost constraints, demand we know, demand is not a problem let us say x 300 is equal to 100, x 301 is equal to 200, in this way continue.

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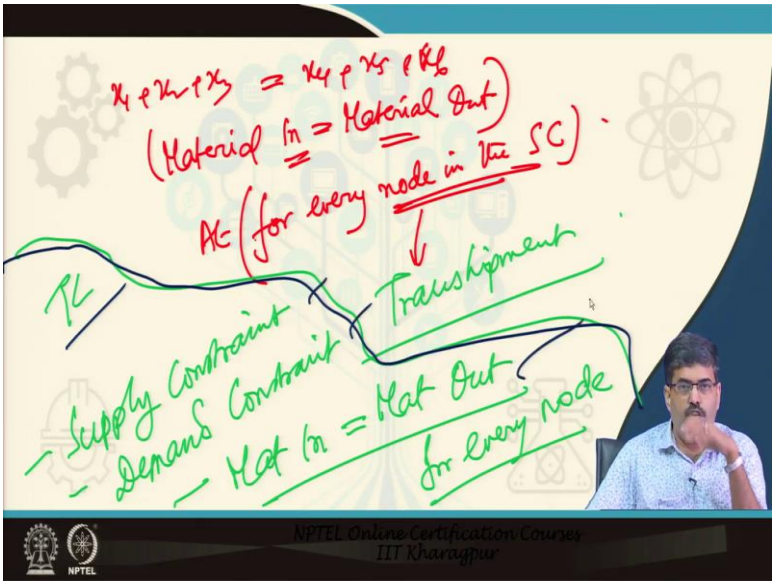

What is important is, what is important is that at every node let us say x 1 plus x 2 plus x 3 is equal to x 4 plus x 5 plus x 6, material in is equal to material out this is true for every node in the supply chain ok. And, this for every node in the supply chain and that is what you call as transshipment, which we did earlier. So, this is the simple model ok, this is the simple model; right.

So, this is single model that is original supply. So, first is total cost then supply constraint, demand constraint, and then material in is equal to material out for every node, right. Supply constraint, demand constraint, this is the; this is basically the transshipment ok. So, this is my model; ok.

Total cost, supply constraint, demand constraint, material in is equal to material out for every node; here finish modeling the supply chain. Now, what is the; no problems; yeah. How to add out the single period model to multi period model? Material in was 40, material out should be 40 right at every node of the supply chain.

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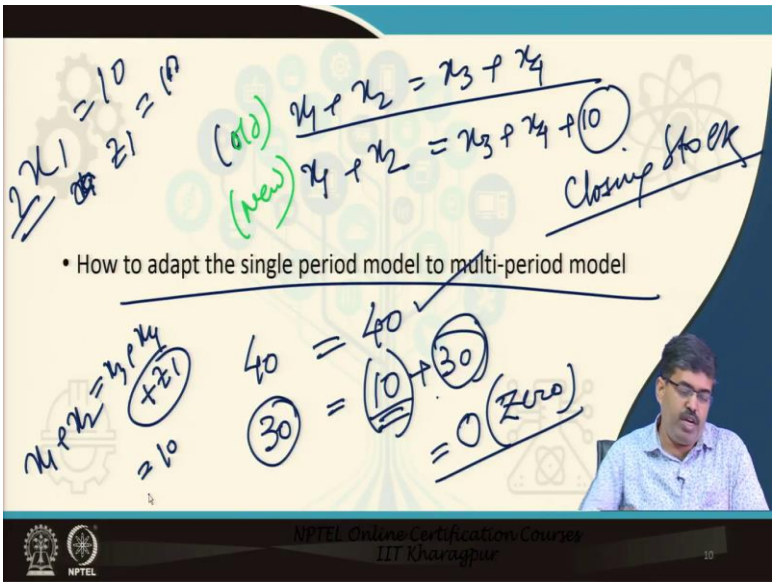

Here there was already an existing stock of 10; right. So, material out, so material in is now 30; ok. And, material out is actually 10 plus 30; right. There were some left over, 10 was left over. So, material in remains 30 material out remains 10 plus 30. Now your stock becomes 0; ok.

So, this is the only change, in the next model right. So, at the transshipment point what is happening? x 1 plus x 2 is equal to x 3 plus x 4. So, in the Trans this was material in x 1 plus x 2. What is the new model? Old model, ok. What is the new model? X 1 plus x 2 material in is equal to x 3 plus x 4 plus 10.

The 10 is what the 10 is my closing stock ok, the 10 is my closing stock. So, this is how the how to adopt the single period model to multi period model ok. So, there should be some provisioning for closing stock that 10. Now in some it is advisable that the 10 should not be an absolute number that you will put.

But, in the model it should be some variable ok, clear. If you put in some absolute number, then subsequent years you will have some modeling problems; clear. So, you just keep it as another variable right and here for this variable you put 10; ok.

So, do not put it like 2 x 1 is equal to 10, no this has no cause, just put x let us put this as z 1 is equal to 10. In in model you write x 1 plus x; x 1 plus x 2 is equal to x 3 plus x 4 plus z 1. And, the z 1 you put 10 clear, that is absolute for this particular model; ok.

So, this is that. So, that is the only difference between single period and multi period models; so, this is the single period to multi-period model.

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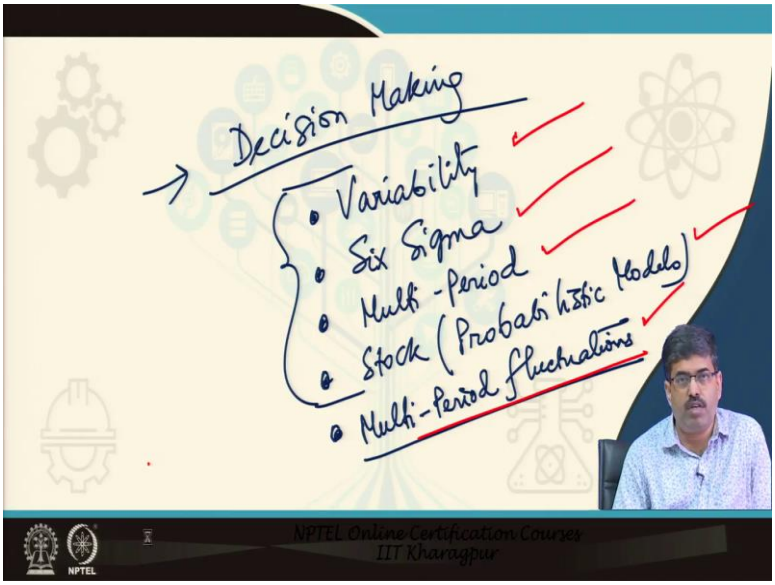

Now, there was another; issue, another aspect called decision making. This is the last part in this supply chain design ok. Decision making this is very important. What have you learnt with decision making? Keep in mind the keep in mind the variability ok, keep in mind the variability. Then, what do you do in decision making? Keep in mind your Six Sigma, keep in mind that it is a multi-period, keep in mind that stock some probabilistic models; ok.

Based on this and keep in mind that multi period fluctuations. So, these are things that you have to be very-very careful of when you are doing decision-making; ok. So, variability, Six Sigma, take care there it is a multi-period model; also keep take care of the stock and also look at the multi period fluctuations; ok. That should be enough when you are taking a decision on supply chain; ok; supply chain designing.

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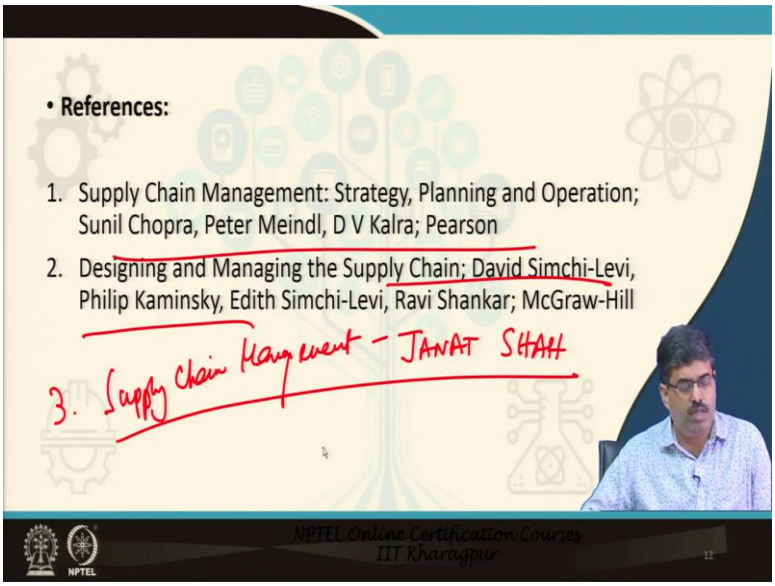

Now, these are the references; ok. You can add up one more, supply chain management by Janat Shah; this is also a very-very good reference for you; ok. So, with this we will end this module and what I would suggest is you try to solve this model using numbers, using data, and see how it is behaving; ok. In that way you will learn some things hands-on so.

Thank you very much!