Decision Support System for Managers
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Module - 09
Decision Support System for Distribution Network Design in a Supply Network
Lecture - 43
Flexibility and Total Cost of the Network

Hello and welcome to "Decision Support Systems for Managers"! We are into module 9 and lecture 3. In module 9, we are doing 'Decision Support System for Distribution Network design in a Supply Network'. And in week 3, in lecture 3 of this module, we are doing 'Flexibility and Total Cost of a Network'; ok.

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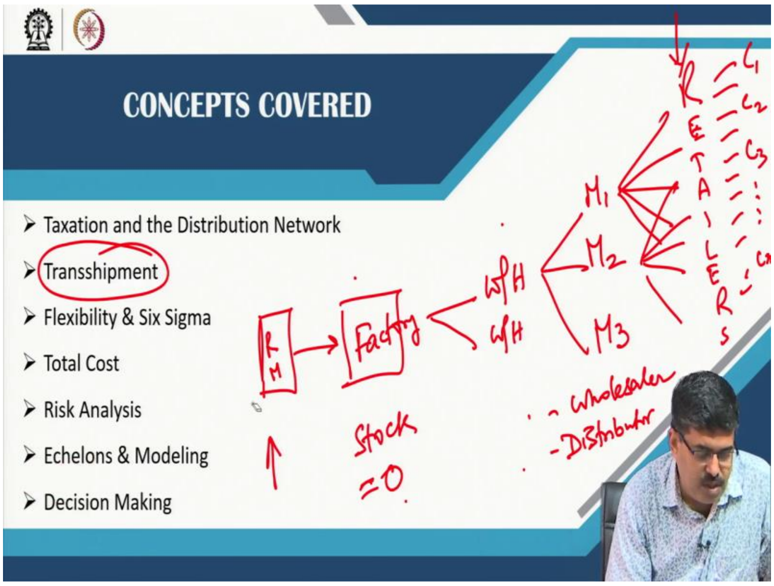

Now, in the first in the first lecture of this module what have we covered? We have basically covered the taxation and the distribution network. What have we learnt there? We have learnt that, any supply chain will be designed to reduce cost point number 1.

Now, to reduce cost we will have to also understand in which country the taxes are the lowest. And, then we will try to procure from those countries or we will try to set up a hub in those countries, just to take tax advantage.

Now, you will ask me the question that fine, if we take tax advantages ok, but then just to take tax advantage my transportation cost will rise. Yes, that also we will have to take care. That where there is a where even after taking tax advantage and offsetting for the extra transportation cost, my total cost is lower, I will set up my unit in that particular system.

I repeat, that where my I will take tax advantage, but to take tax advantage I will have to incur some extra transportation cost, where my tax advantage is greater than increase in transportation cost, I will set up my facility there. So, that was the first lecture of this module that is how to set up the distribution network.

The second lecture of this module was in trans-shipment and some glimpses of Six Sigma. Now, what is transshipment? Transshipment is basically just a recap that products are coming in from origin a b c and going to places destination x y z.

And, there will be a transshipment point in the middle, somewhere in the middle, where the products that are coming in from origin a b and c, they are mixed up small consignments are made, and then they go to destinations x y z. So, this is transshipment.

So, there I told you that, if you remember or if you look very carefully, warehouse is basically a transshipment point. And, at the end of the day what will happen in a transshipment center in a transshipment point, the inventory is 0, because what are we doing? We are just shifting the material from vehicle a to vehicle b and realigning the material.

So, at the end of the day the stock at the transshipment point is 0. Now, if you look carefully that is what we told in the previous class if you look very carefully, warehouse is a transshipment center. So, and then we learnt the equations for transshipment; ok.

Today, we will so the first step of supply chain design, first learning outcome is tax advantage, we should design keeping in mind the tax advantage. Second learning is say every node in the supply chain is a transshipment point; ok.

You look at it second learning what I said every node in the supply chain is a transshipment point; ok. What do we mean by that? Here is the here is the raw material from then it is coming to the factory from there it is going to warehouse. From warehouse it is going to market, this market is basically wholesaler, distributor; ok. And, from market it is going to retailers and from retailers it is going to consumers; ok.

So, if you see this is the supply chain model. Now, what do you want to say in this what are we saying, we are looking at transshipment; ok. Every node in the supply chain, other than this origin and this retailer point, every node in the supply chain is a transshipment center.

And, transshipment center what is stock? Stock is 0 at the end of the day. So, if you see, does factory keep stock? Factory produces sends it to warehouse, warehouse stores sends it to market, market means basically retailers, ok. So, at the in between the factory and the warehouse and the market wholesaler distributor each one at the end of the day wants to have 0, 0 stock because then they know that the products are moving out moving out means revenue.

So, every node in the supply chain, other than the origin and the destination point is a transshipment point that is the second learning. First tax second is transshipment; ok. Then we look at something called, then we look at something called flexibility and Six Sigma; ok. So, let us consider someone this ‘flexibility’ and ‘six sigma’ today; ok.

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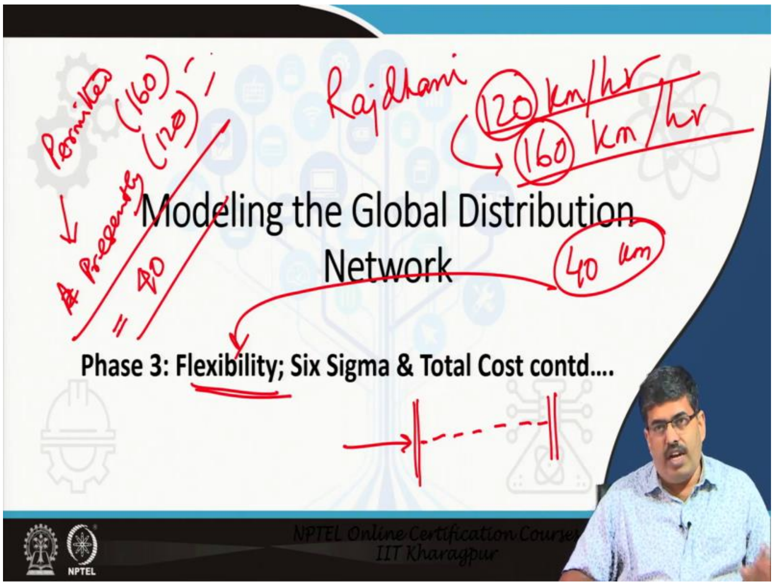

Today, we will do modeling flexibility Six Sigma and total cost. Now, Six Sigma we have covered in the previous lecture to a great extent.

Now, because flexibility and Six Sigma go together that is why we wanted to write this caption, but Six Sigma we have covered in the previous lecture ok. What is six just to see, what is basically flexibility, what is flexibility?

Flexibility basically means, that what is my excess capacity that in supply chain terms as flexibility. What is my excess capacity? Ok. For example, see we remember 1 day, in week 2, we told you about the example of Rajdhani express; ok.

Now, this Rajdhani runs at 120 kilometers per hour. If Rajdhani is late it has been given a permission to run at 160 kilometer per hour ok. So, this 160 minus 120, this 40 kilometer per hour is Rajdhani's flexibility; ok.

That is Rajdhani's flexibility. That is what we mean by flexibility. That means, you can move up to that extent not more than that ok, clear. Now, you will ask me that what is the lower side of flexibility, Rajdhani can increase it is speed by 40 kilometers.

Fine, it runs at 120, can move up to 160 so 40 kilometers fine. What is the lower end? What is the lowest speed of Rajdhani? Well here, there is as such no lowest speed, because if Rajdhani speed is coming down slow, another train which is here that train gets affected ok. The speed of this next train gets affected.

So, how much is the lower end of flexibility that will depend on the situation. What is in front, what is in store, for Rajdhani, why is the rajdhani not able to move fast? So, all these factors are there; ok.

So, flexibility basically means. So, now, you see 160 maximum speed, you are running at 120. So, if you look at it flexibility basically means what you are permitted, here you are permitted 160, what you are presently, what you are presently doing, presently you are doing 120. So, what is it flexibility is equal to 40, 160 minus 120, that is what is flexibility; ok.

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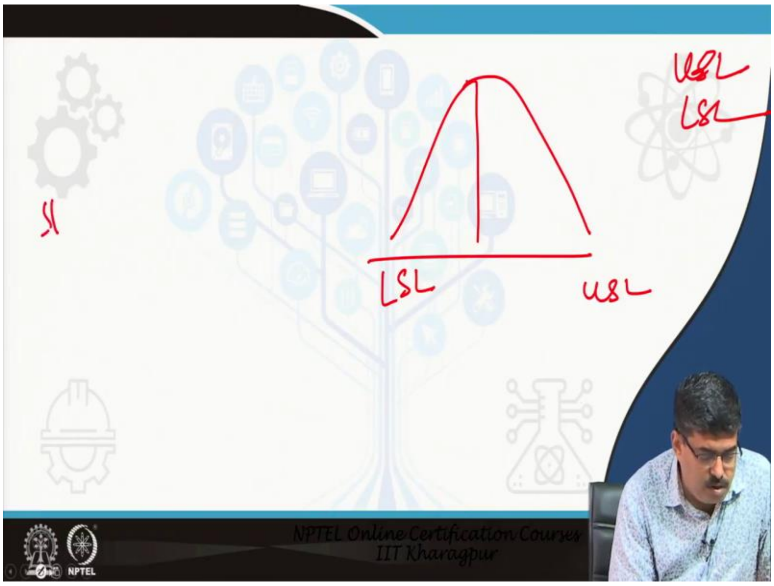

Now, Six Sigma what it is doing? In Six Sigma what are we doing? Six Sigma we are saying flexibility is fine, please let us have some sort of a upper specification limit and some sort of a lower specification limit, this is what is all about Six Sigma; clear.

So, every now look at it in that end, every supply chain at every stage has to have a specified USL and LSL. Every supply chain at every stage has to specify USL and LSL. Otherwise, you cannot design and plan a supply chain; ok.

Clear; what do you mean by that? Say your product is coming out, say your product is starting point; ok; your.

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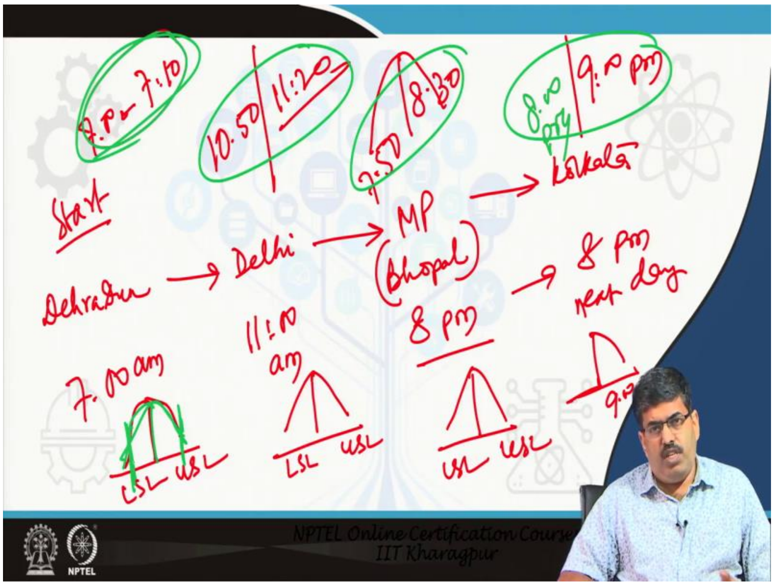

Your product is, starting point is, let us say Dehradun; ok; clear. Now, from Dehradun, it will come to Delhi. From Delhi, it will go to Madhya Pradesh, Bhopal; ok. From Bhopal it will come to Kolkata; ok. Now, your Delhi, it has to start at 7 in the morning; ok. Delhi it has to reach at 11 am; Madhya Pradesh it has to reach, let us keep it the same day 8 pm; ok.

And, Kolkata it will reach 8 pm next day; ok. So, this is the so, this is the pattern; ok. Not every place we have to keep a upper specification limit and lower specification limit; ok. Here again upper and lower; that means, what is the upper specification limit here? Maximum by 7:10 it should leave Dehradun.

Lower specification limit may be 7 or maybe 6:50, Delhi maximum 11:20 it should move ok. It should reach Delhi definitely by 10:50 or before that it cannot reach actually ok, because road condition speed Bhopal 8 pm.

We are saying ok, you move by 8:30; ok, 8:30 is your this thing; ok. And, it should reach here by 7:50, because we have to finish off some work. So, Kolkata 8 pm we say anyway by 9 also if it reaches, by 9 if it reaches it is fine 9 pm; ok; and if it reaches before 8, very-very good; ok.

So, you see at every stage we are specifying a range, upper specification limit and a lower specification limit. Every place we are specifying a range ok. And, that range if you notice very carefully is this upper and the lower, this gap or this range is the USL minus LSL; ok.

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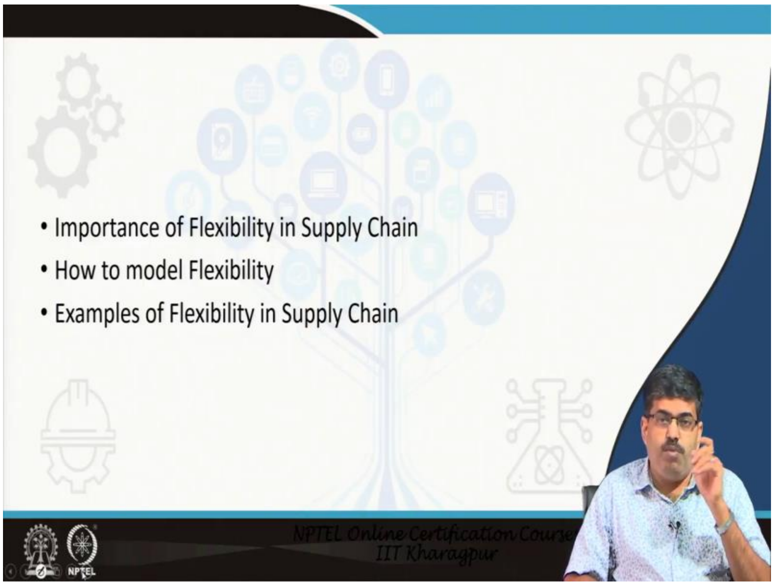

So, this is basically your flexibility Six Sigma everything; ok. See importance of flexibility in the supply chain. Why is flexibility important? Because, you cannot plan such a huge network in with such precision vehicle is moving, it is like, you are moving from Howrah station and you will go to Bhopal, you have not got any ticket in the direct train.

So, you will get down at Nagpur by may be Bombay mail via Nagpur, you will get down at Nagpur and after 2 and half hours you will get a Duronto for Bhopal. It goes to Delhi, but it will you pass via Bhopal so, after 2 and half hours ok. Assume that your train from Howrah to Nagpur, that is Mumbai Bombay mail via Nagpur.

Assume that train is delayed by 1 and half hours or 2 hours or 2 hours 30 minutes. What will happen you will not be able to catch the Duronto if it is on time?

So, this type of things have will happen every day, everywhere. So, that is the reason why your supply chain, why it should be flexible. You should have a minimum 3 4 hours gap between getting 2 trains. So, that is the reason, why they design supply chain with some amount of flexibility. So, that is the importance of flexibility in supply chain.

How to model flexibility very simple ok. I just showed you 40 kilometers is the flexibility of 40 kmph is the flexibility of Rajdhani. Examples of flexibility very important, where do you see flexibility within our setup. See, flexibility most importantly it is; it is a method of work; it is a model of working of all the automobile companies; ok.

One of the important dimensions of flexibility is let us take Maruti. Whatever Maruti is saying, they will order that is shared with the suppliers, but Maruti has a right, Maruti or Suzuki whatever you say, but Maruti has a right to change the order quantity, change the order quantity at the last moment, increase it or decrease it.

If Maruti increases the order quantity, it will also check-up whether your machines are able to supply will be able to supply. So, what Maruti will do; Maruti will ask you whether they want a, they want your machine capacity.

If, they see that yes you can, then only they will give you that sudden order change. Otherwise, they will give it to another supplier; ok. Their sudden increase in quantity that they will give you only when they know your machine capacity. So, that is an example of flexibility; ok; I gave you the example of Rajdhani; ok; clear.

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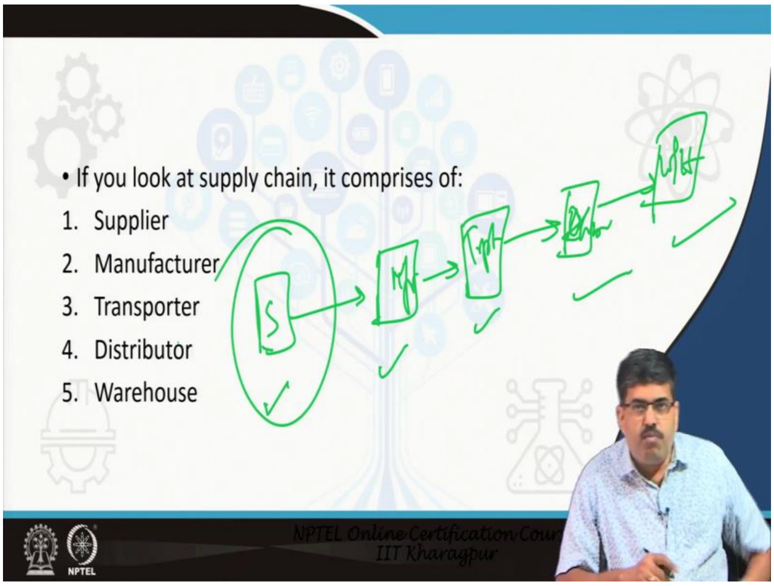

If you look at supply chain, it comprises of supplier, manufacturer, transporter, distributor warehouse.

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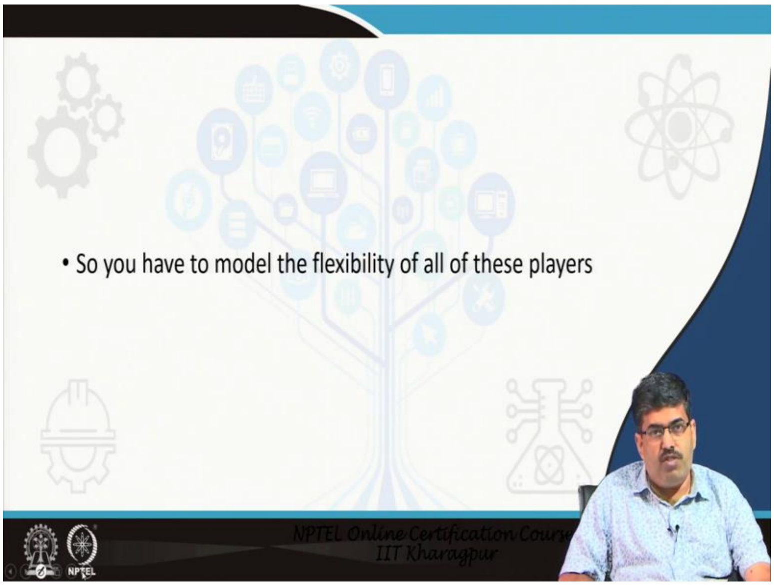

So, you have to model the flexibility of all these players; ok. Otherwise your supply chain, so, total flexibility we will not get.

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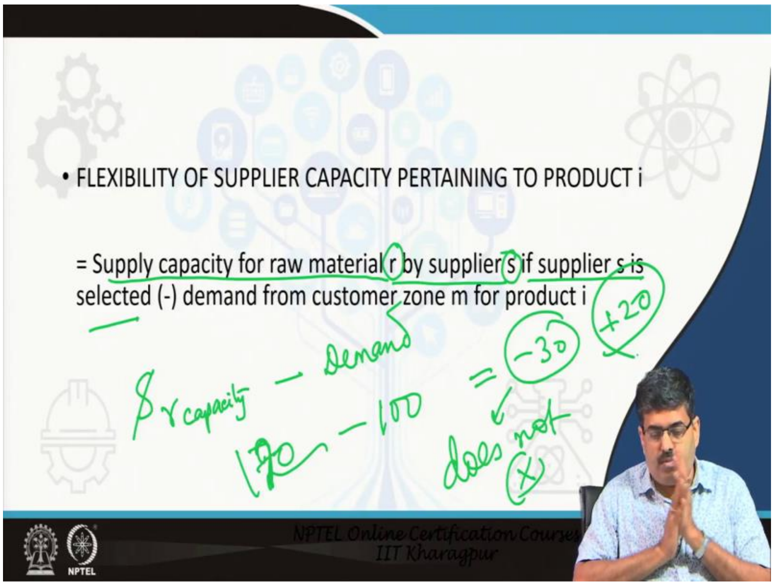

Now, so, let us see. What did we say just let us have a brief recap, supplier, manufacturer, transporter, distributor, warehouse; ok; supplier, manufacturer, transport, distributor, warehouse; ok.

So, this is supply chain. So, you need flexibility here, here, here, here, here. Why do you need flexibility with supplier as we just give you the example of Maruti. We can change the order quantity.

Flexibility of supplier capacity pertaining to product I; ok. Supply capacity for raw material are by supplier s if supplier s is selected minus demand from customer zone m for product I; ok.

What do you mean by that? Supply I am erasing and just doing it again. Supply capacity supply capacity for raw material r by supplier s, if supplier s is selected; that means, supplier s with a raw material r. So, supply capacity of raw material r, supply capacity of raw material r, for this particular supplier minus the demand. See my demand is 100 my capacity is 70.

So, 70 minus 100 is minus 30. So, this supplier does not have any flexibility ok. My capacity is 120, my capacity is 120.

So, what will be now my this thing plus 20. So, that is my excess capacity, that is my flexibility. So, tomorrow if any other city wants my product, I can immediately give it to them; ok; that is supplier.

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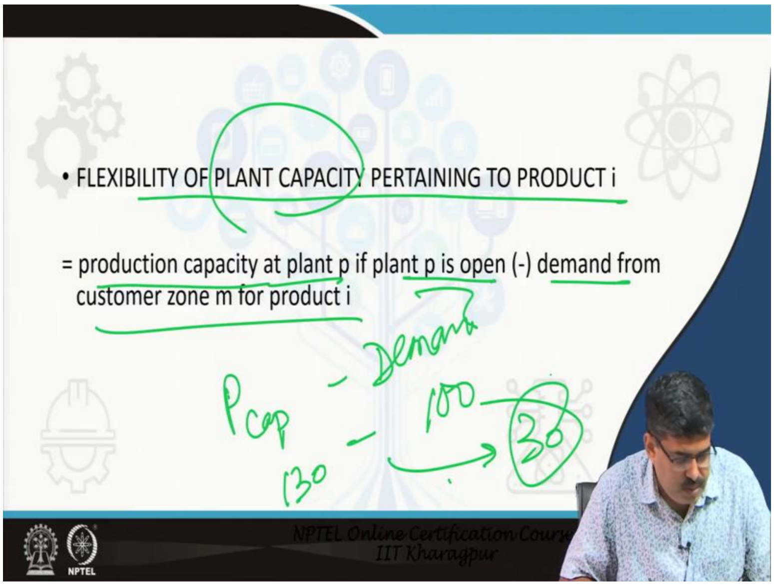

Then from supply it is coming to plant, plant flexibility of plant, flexibility of plant, production capacity at plant, if plant o p is open minus demand from customers.

So, my production capacity, production capacity minus demand; in the previous example we heard, we saw that production capacity was 100 sorry my demand was 100. So, if my production capacity is 130 t units is the flexibility; ok.

Now, there is a problem. If, this flexibility is too much, that is to say unused capacity is too much, then what will happen, that will send a signal that I can increase my production number 1 and number 2 lot of unutilized capacity means less more cost; ok.

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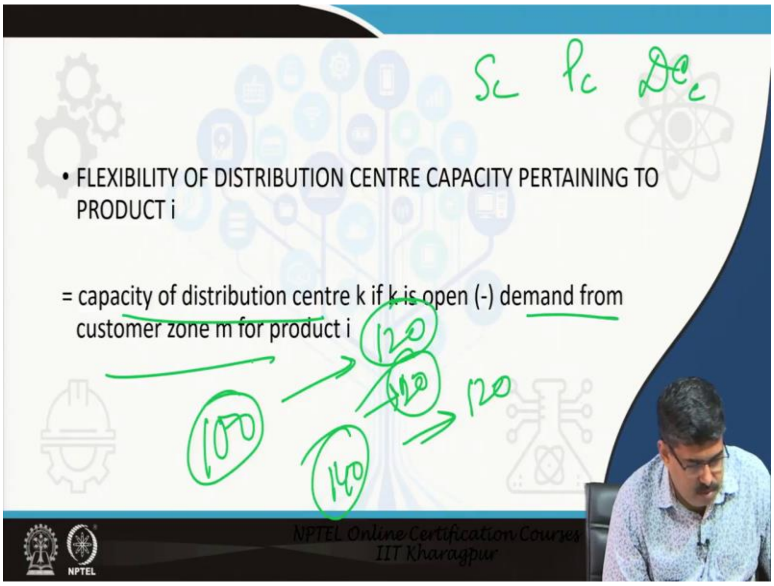

So, this is what? Flexibility of distribution center capacity. So, first we said supplier capacity, then we said production capacity. Now, we are saying the distribution center capacity; that means, the distribution center can hold 100 and the demand is 120.

So, demand is 120 it can hold 100. Now, flexibility demand is 120 it can hold 140. So, what is the flexibility? How much more can you accommodate? 20; ok; that is what is mentioned capacity minus demand from the market; ok.

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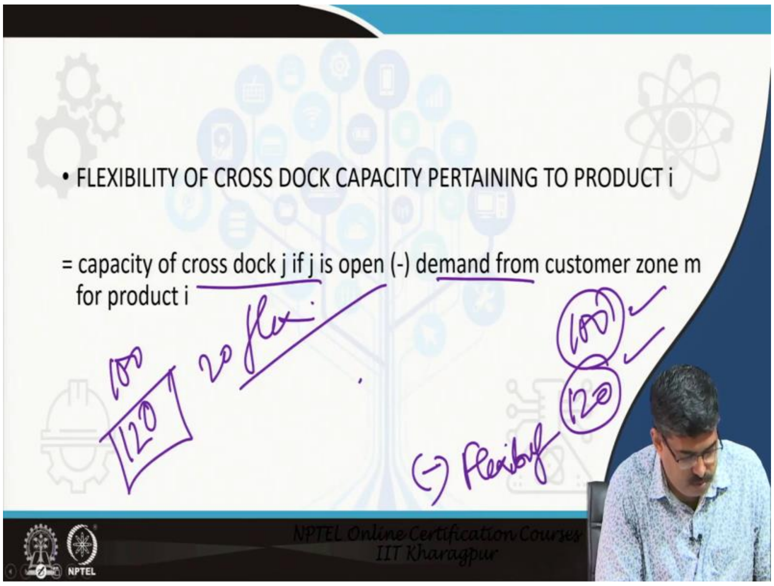

Flexibility of cross dock, apart from the distribution center you have this cross docking, cross docking means vehicle from this side comes here, vehicle from this side also comes here. Similarly, vehicle from this side comes here and vehicles from vehicles from this side come here; ok.

So, what we do? We just load unload and then this vehicle will take half of maybe assume 50 percent. Now, 50 percent of this product and 50 percent of this product, this vehicle will take 50 percent 50 percent and then both will go back to their destinations; ok.

So, capacity of this cross dock facility minus demand, see if my cross dock facility is 100, my demand is 120, what is happening I am going with a negative flexibility; ok.

Cross dock capacity is 100 my demand is 120. Conversely my demand is 100 my cross dock facility is 120. So, 20 units is flexible; clear; ok.

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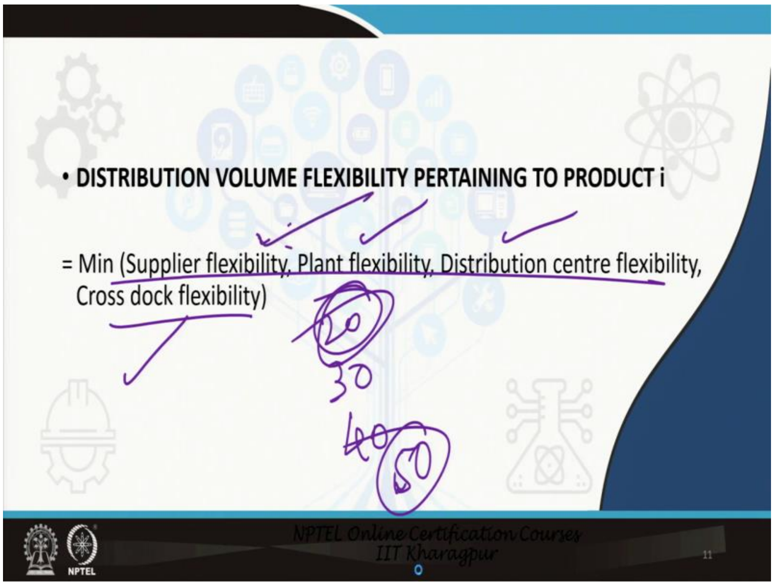

Distributed; distribution volume flexibility. So, what is this then? Whatever you got flexibility in the first case assume 20, flexibility second case 30, fourth place is 40.

So, which is your flexibility minimum of these you know, because you cannot say 50 is a flexibility because you are limited here ok. So, minimize minimum of this supplier plant, distribution center and cross-dock; ok; minimize supplier, plant distribution and cross-dock that is your flexibility.

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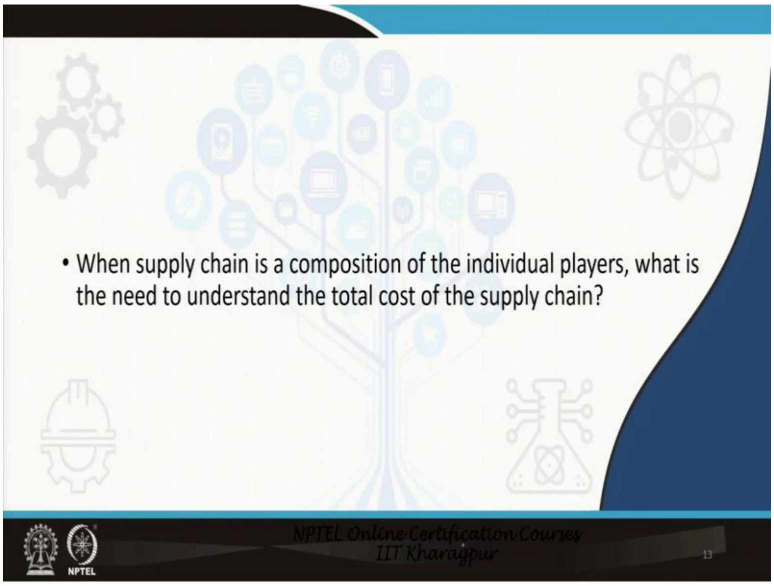

What is total cost? When supply chain is a composition of individual players, what is the need to understand the total cost? Yes, it is important; very important.

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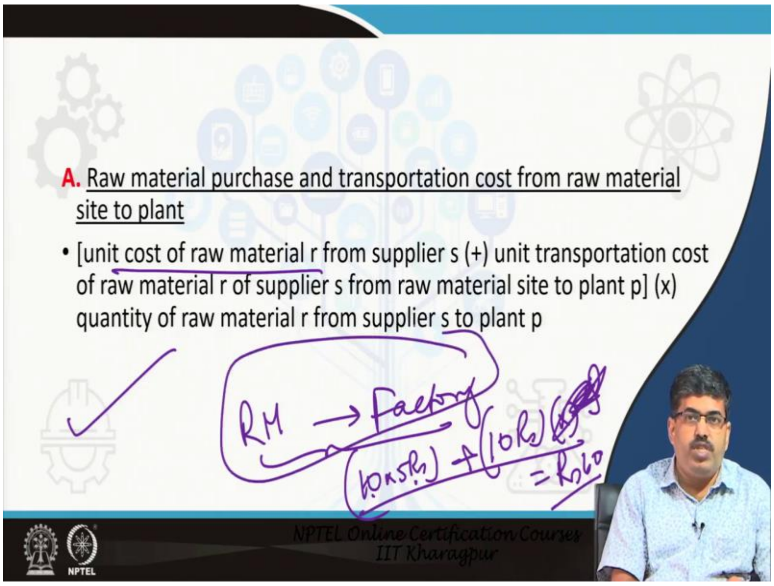

Because ultimately at the end of the day that is what is profit is composed of; right.

So, raw material purchase and transportation cost from raw material site to plant so, raw material to factory so, cost for this. How much raw material is being is coming 10 units. So, unit cost of raw material into 5 rupees. So, 50 rupees plus transportation cost 10 rupees, multiplied by quantity yeah. So, we have already multiplied by quantity; ok.

So, 10 rupees 10 pieces are coming 5 rupees. So, 50 plus transportation cost 10 rupees 60. So, 60 is the from raw material to factory rupees 60.

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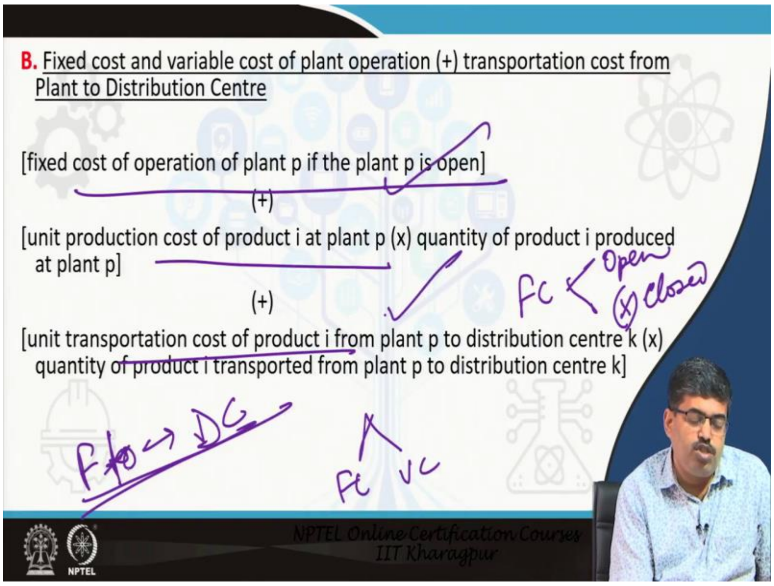

Next coming to plant. Plant has 2 cost, fixed cost and variable cost. Fixed cost comes when, fixed cost comes when plant is open fixed cost is 0, when plant is closed; ok.

So, fixed cost if plant is open multiplied by number of units produced plus transportation cost. This is from where, this is from factory to DC, distribution center from factory to distribution center fixed cost at the factory and variable cost of products move from factory to distribution center.

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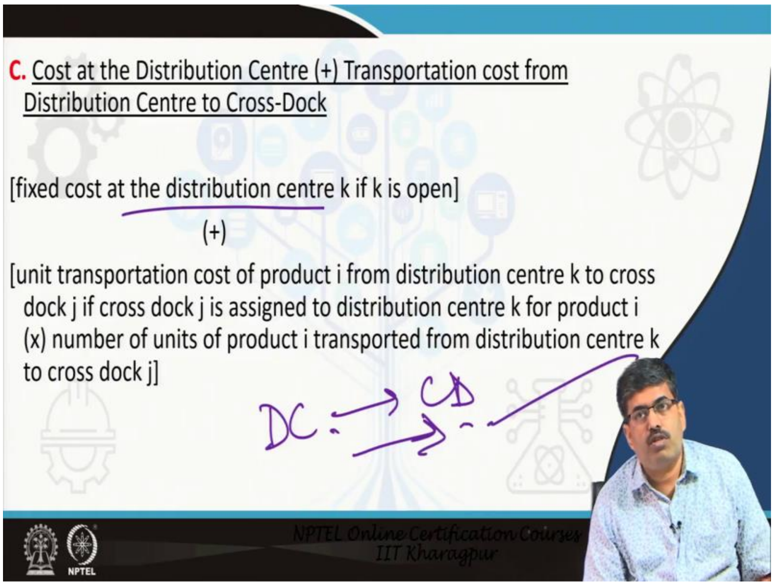

At the distribution center from DC to cross dock center same thing fixed cost at the distribution center plus transportation cost from DC to cross-dock; ok.

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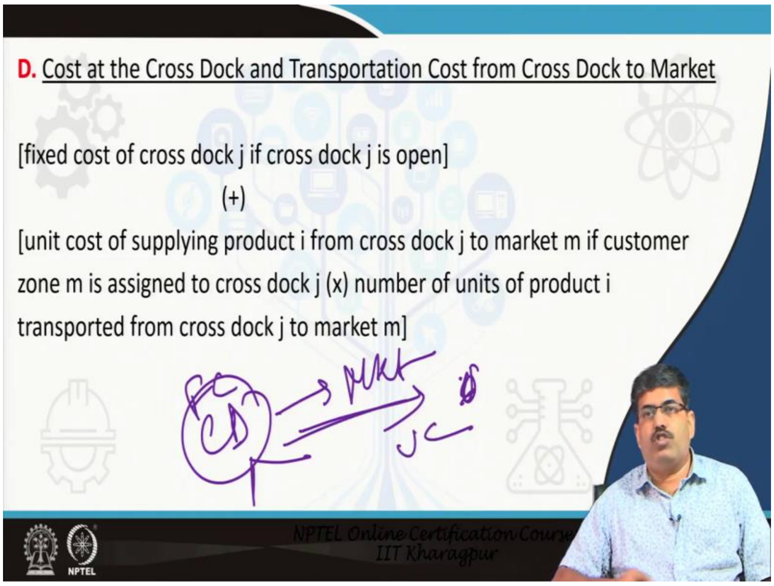

At the cross dock, cross dock to market; so, fixed cost at the cross dock and cost from, cost of moving the product from cross dock to market.

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So, fixed cost and variable cost of moving the product from cross dock to market; ok; so, this is your total cost of supply chain; ok.

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These are the references. So, we learnt about flexibility and cross-docking; ok; these are the references so.

Thank you very much!