Modelling and Analytics for Supply Chain Management
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Lecture 55
Risk Analytics in Supply Network Design

Hello and welcome to Modelling and Analytics for Supply Chain Management, we are into week 11 and the first portion of week 11 and today we will discuss Risk Analytics in Supply Network Design. Now, we all of us will appreciate the importance and the relevance of risks, risk is there in every sphere of business activity, be it marketing, be it finance, be it your operations, be it HR, everywhere there is a risk.

Now supply chain is no exception to such a riskiness. Now, assume that there is a production facility in South East Asia and suddenly there is an earthquake, what will happen, your entire production line will stop, your entire production line will stop and that will impact the availability of the final product in the market worldwide that is in the global market.

So, if there is any supply chain disruption, the impact is felt not only locally, but because all businesses now manufacture in one cluster and then sell the products globally. So, your riskiness in one cluster will hamper the marketing and availability of the product all over the world. So riskiness of the supply chain is something which you cannot ignore and so any modelling in supply chain has to build in the riskiness part of it.

That is for any activity, we will have to analyze and understand and try to measure what is the riskiness of this proposition. Like, for example, you might have or you might like to build a supply line that comes in from the upper part of Asia or even the western side of Asia via Afghanistan to India. I am just quoting that Afghanistan part I am trying to concentrate.

So, you want to build a supply line via Afghanistan to India. Theoretically it is fine because the geographical distance, if you cut short, if you cut through Afghanistan then the geographical distance will be minimized. So, when your geographical distance is minimized, if one unit of distance, if you convert to one unit of cost, that means your cost is also getting minimized.

Less distance, less transportation cost. But then, is it safe? What is the riskiness of moving products through your, moving products through your supply chain by a country or through a

country called Afghanistan. There will be very, very high risk. So, you see, understanding the riskiness is very, very important. This is one aspect.

Second aspect as we were telling in the, right at the beginning, there is a earthquake, tsunami happened. Fukushima power plant disaster happened, so all these has a bearing on supply chain. When tsunami happened, your entire supply line that encompassed Japan, portions of India, etc, all were stopped. There is a great storm that happened in India in West Bengal some years back, about a decade back called Aila. Heavy rains along with heavy storm that lashed the Sundarban areas, the largest mangrove forest in the world and entire habitation was very, very much disturbed.

It took year, not days, not months. It took years for the situation to become normal. What happened? The Sundarban basin, or the Sundarban delta not the basin. The Sundarban, the mangrove area is known to supply the best quality honey and that honey is required or is used by domestic users as well as by the pharmaceutical companies for manufacturing medicines.

The Sundarban area is known to supply fish for entire West Bengal, portions of Bangladesh, North-eastern part of India. So, entire fish supply chain was disrupted and disrupted for the time being but it took years to become normal because the human habitation was totally disrupted during the Aila.

So, what we want to say is riskiness in supply chain can happen from many angles. One is the country as such, the country domain, the political situation in a country, the second is natural disaster. If, if you are aware, some years back, many of you might have been very young then, but there was a massive earthquake in Taiwan and your Ericsson, was procuring all their chips from a plant in Taiwan.

What happened? That plant got damaged and your entire chips that was being supplied to Ericsson, entire supply link was totally destroyed and Ericsson never ever got up from that huge setback and after some years anyway, the Sony Ericsson, that brand died down in India.

So, you see, if you supply chain gets disrupted, it creates a tremendous problem. Now, if you, if, if you go back again if you see the 1971 war between India and Pakistan, what India did? India

basically blocked the port area of Pakistan, the Karachi port and other areas of Pakistan, what does it mean?

Your food supply is blocked. So, the nation has to surrender. So, this is what we want to say, that if your supply link gets blocked, if your supply chain gets disrupted, then, it is very, very difficult to come back to normalcy and most of the businesses who have suffered a supply chain shock or a supply chain disruption, many of them could not come back to normalcy and have died down.

So today, we, our job is to somewhat give a quantitative or a number to that supply chain risk. For example, if you are trying to build up a supply chain from Europe to India, what is the riskiness of the different routes possible in that supply chain? Let us say, from Germany you are trying to send some product to India.

It can come via multiple modes of transport by route 1, it can come via multiple modes of transport by route 2, it can come via multiple modes of transport using route 3. So, now we need to understand what is the riskiness profile of each of these routes and then the supply chain will finally be built. The corporate headquarters will take a decision which route to use.

But that does not mean, now here is a caution, which we will again come back later on. Let us say, there are 3 possible routes and you decide that route 1 is the cheapest, least risky, etc, etc. But that does not mean that you shut off route 2 and route 3 altogether.

There is some little quantity of product movement using route 2 and route 3 also, just to ensure that incase route 1 gets jammed or there is a problem with route 1, the most economical and the least risky route, then at least you have not closed down your route 2 and route 3. There is a line, so you can pump your products using them.So, this is the way basically we, we do the riskiness profile mapping in supply chain. We will deal with it now.

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So, we will try to understand in this week the types of risks, then we will map the riskiness profile of the country, we will map the riskiness profile of possible international routes and then, we will design the route plan based on riskiness profile. So, let us move to the first one, that is the types of risks.

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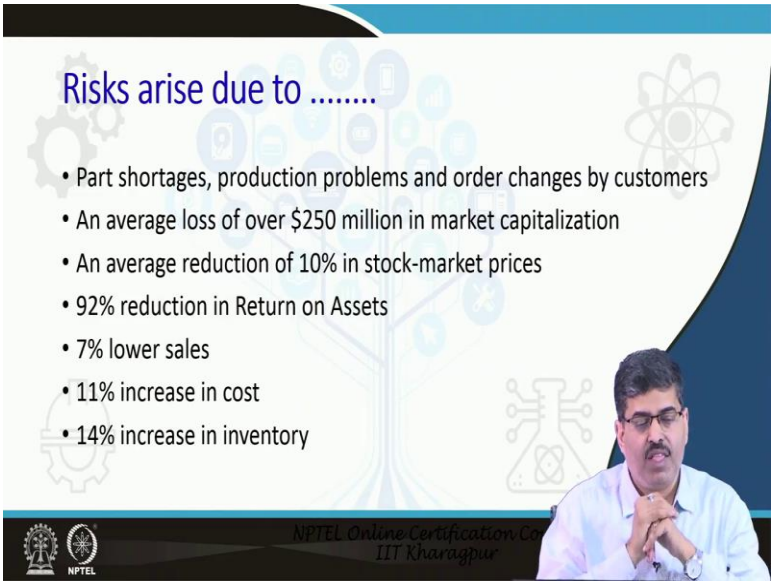

Now, if you see the, this is what I was talking about, risks in, just give you a brief introduction about risk. Risks arise due to different reasons, first one is part shortage, production problems

and other changes made by the customers in the last minute. Repeat, risks arise because of part shortage, production problems and other changes made by the customer in the last minute.

Let us take the example of part shortage, there is a company in India, which you have heard about, they are very well known for manufacturing floor tiles and tiles for bathrooms, etc, that is HR Johnson, which we commonly call as Johnson tiles. Now, Johnson tiles, say you are building a house, you have purchased a particular design, color, etc, particular size, design, color of a tile for your bathroom and for your living room.

You purchased it today and the construction work is going on, the people are putting the tiles on the floor and after one month, once the work is almost over, then suddenly you realize that, that particular color, design and size of tiles, you need one more box or one more packet of such tiles. So, you go back to the dealer and what will the dealer say? That no, that packet design, color is no more available. Then you are gone, you say, why, I just purchased it one month back, why is it not there, etc, etc. The dealer raises his or her hands and he says that no, sorry, it is not there. So, dealer surrenders he raises his hand.

But then, the issue is your problem is not solved, your room is half done, your bathroom is half done, you need one or two more packets of tiles which is not available. That is part shortage. Now you will ask my why? Why is Johnson not manufacturing? See, when production happens, it happens in a continuous, continuous manner. So, when that particular and Johnson, they do not rotate, they do not continue the design for long, for the fear of imitation. So, every 7 days, they will change the design, change the color and a new product, new design will come.

So, they do not repeat the old design. So, you will not get the tiles which you require for the incomplete portion of your building because the design is not getting repeated. In a sense, it is a part shortage. This is one aspect from the customer's side of the supply chain. In the manufacturing side also, certain spare parts, if not available, the machine stops functioning. Say your production gets hampered. So, that is your part shortage and production problems.

The third one, order changes by the customer. This is very, very common for industrial products, very, very common. One is order change, second is delivery schedule change. For example, a

railway bridge is getting built over a river, across, it is with, connect from one city to another and the bridge will go across a river.

So, it has certain dates, phase 1, phase 2, phase 3. Now, based on that, this railway construction company has asked the cranes and the forklifts and the pillars and the pliers, etc to be brought in so the construction can start and there is a delay. Suddenly the note goes from the construction company that no, do not send the tippers and the dumpers, do not send the cranes now, you send it after 15 days. So, what has happened? You have initiated the supply chain, but it gets stuck up.

Somewhere down the line, it is stuck up, your trucks are held in mid-way. So, everything, your entire supply chain gets disrupted. This is also a disruption, now, then the order changes, you order 500 pieces of a very costly product, suddenly you say no, send me 400. Because of business relations, nobody can charge a penalty. So, send me 400, what has happened? At the back end manufacturing work for 500 units have started. At the back end 500 units construction has started. But you suddenly say 400. So, these are the problems, risks associated with supply chain.

It has been estimated that, an average loss of over 250 million dollars in market cap happens because of this and an average reduction of 10 percent in the stock market prices, 92 percent reduction in return on assets, 7 percent lower sales, definitely lower sales because the product is not available, 11 percent increase in cost and 14 percent increase in inventory.

Definitely, if I go and I need 5 boxes of tiles and the shop has only 4 boxes, what do I do? I do not buy, I come back. So, what happens to those 4 boxes? They keep on remaining, keep on staying in the, as inventory. So, a 14 percent increase in physical inventory happens because of these issues in supply chain.

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According to this particular organization Crisis Management International, it is a very well-known and reputed organization, companies that had, this is what I was talking about. Companies that had prolonged supply chain disruption of 10 days or more had the following impact, do not think of months, just days. Companies that had prolonged supply chain disruptions of 10 days or more had the following impact, 73 percent closed. Imagine, just because 10 day supply chain disruption, 73 percent of your companies are closed down that is the impact of supply chain disruption.

That is why I say, you know, Ericsson, as we were giving examples, if the mobile is not in the market, customers will immediately switch and when the customers switch to a competitor brand, it is very, very difficult to bring back this customers, bring back these customers from that particular brand back to your brand, it is very difficult.

So, what happens at the end of the day? You die. So, your business dies. So, this is what happens, 73 percent closed because you could not supply things on time. Take the classic example, see why do you close? This is, this is something that will, you keep on thinking are, just because 10 days I did not have inventory, why shall I close, but that is very true.

Imagine a simple, simple thing, it is hot summer and you go to a particular, you are out for work, feeling very thirsty. So, what do you do, go to a nearest small shop and say give me Thumbs Up.

This person says, sir Thumbs Up is not available. Then you say, give me a Coca-Cola, he says a Coca-Cola is not available. Now Thumbs Up is a Coca-Cola brand. So, basically, what I want to say is both are not available.

So what do you do? You say, what is available, what black color drink is available? He says, Pepsi hai. Pepsi is there. Now, you might be a bit surprised or you might argue Pepsi and Coca-Cola are competitors. So, by logic and by business you choose both these brands are not available in the same store.

If Pepsi is there, Coke brands will not be there, if Coke is there, Pepsi brands will not be there. But it is not always the case for very, very small shops, they do keep all types of things. So, what do you do? You say give me a black color drink, this person says Pepsi hai, Pepsi is there, you buy Pepsi and you come back.

What does it mean? That it is a lost sale for Coke. That is what I want to say, 73 percent closed, first point or had significant long term impact. Why 73 percent closed? Because you are not able to supply on time. Because Coke bottles were not there, customers switched to Pepsi. Customers will not keep on searching for Coke bottles from one shop to the other.

So, product, non-availability of product even for one hour means quite a lot of publicity, good or bad, for your organization. Negative publicity. Now 43 percent never recover sufficiently to resume business, they were there only on name, they were just there and of those that never recovered, only 29 percent were still operating in the next 2 years that means others have closed down. So, you see that is the importance of supply chain risks, looking at supply chain risks. The, what are the major causes?

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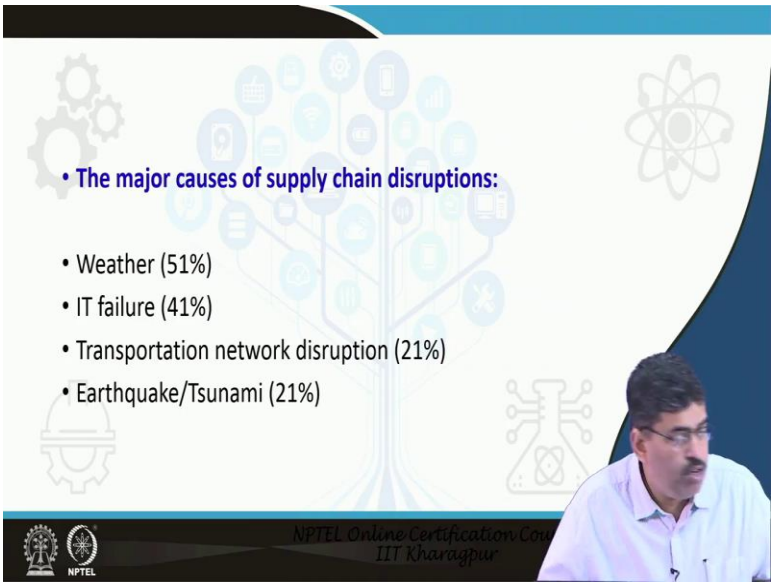

Weather, 51 percent disruption, we just gave you the example of Tsunami. We just gave you the example of the Ailas of the Sundarbans. It is estimated that a huge amount of wildlife habitat were gone because of the Aila of the storm and there was no estimate, nobody could do it. Because the Sundarbans, the mangrove area has a 3 rung thing.

The forest department officials also go only up to the first circle, the first rung or the first ring, second and third ring, nobody goes, it is dense. So, what happened there, how much damage, no, no idea and those were not the days of drone that you will get to have an aerial view. So, it was gone, so weather plays an havoc.

Earthquake plays an havoc. IT failure is another one, 41 percent closed because of IT failure. Imagine you buying from Amazon, certain things and a very different product comes to your home, once, accepted, second time it happens, you get irritated, annoyed, third time it happens, you get very angry and decide never to buy from Amazon and you keep on posting the same, in the Amazon portal. For every product, at the bottom you write, worst delivery. So, what I want to say is IT failure is a great problem, great risk in supply chain.

Wrong size put in your packet, wrong color, put it in your packet, wrong item as a whole, put it in your packet, wrong destination sent. So, what, IT failure is a great, great, great risk in supply

chain. Transportation network disruption, definitely, these are very common particularly in the developing world and some other countries in South-east, in this part of the world.

Any problem, the transportation network gets disturbed because sometimes there are agitations where then people stop the, I mean the transportation system for some time till there is action and they get and it is solved. So what, the network transportation network disruptions is one issue. In Bangladesh, rainy season that, is one example, the second example, in Bangladesh rainy season, most of your transportation and network distributions get totally destroyed.

Because most of the rivers are flooded and when they are flooded all the rail lines are gone, flooded all the roads are under water. So, basically your supply chain is very, very much at risk because of natural disasters. Nature and the transportation is very, very much in question and the last one we have already discussed, earthquake and tsunami, 21 percent. So, these are the major causes of supply chain disruption.

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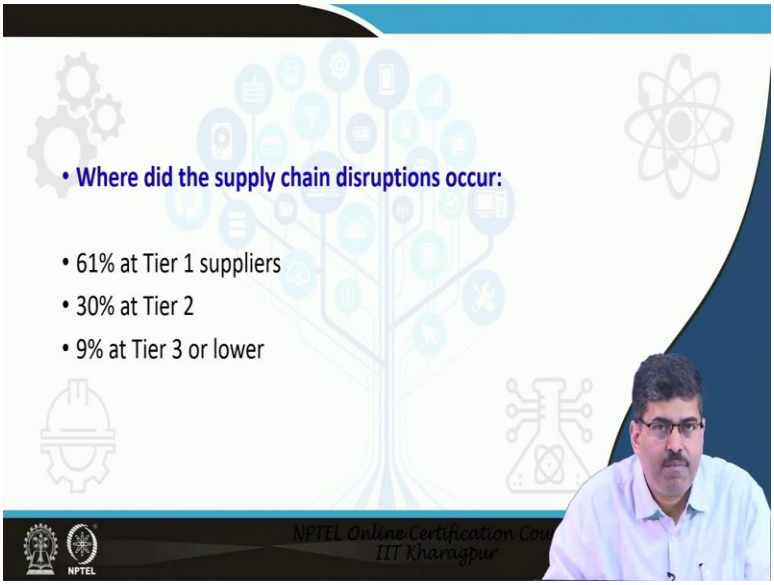

Where did the disruption occur? 61 percent in the Tier 1 supplier, 30 percent at Tier 2 and 9 percent at the Tier 3 or lower. So, you see 61 percent supply at disruption at Tier 1 and Tier 1 is the main one, it supplies to the factory. There if there is a disruption, then everything is gone. You can see there is a ripple effect continuing.

Now can you tell why 61 percent is in Tier 1 and only 9 percent at Tier 3? It could have been the other way around also. 9 percent at Tier 1 and 61 percent at Tier 3, because they are the people who is ultimately supplying to you, if you trace back, they are the suppliers. So, risk there means more risk should be there. 31 percent should be at Tier 3 and only 9 percent at Tier 1, they have been reversed, is it so?

Answer is no. See, we have, you have learnt it in supply chain that Tier 1 supplies the most important components to the factory. Tier 2 supplies the second most important components or Tier 2 can also be looked at supplying those components which are required by Tier 1. So, they are also very, very important.

Tier 3 are again smaller components which is supplied to Tier 2 to manufacture, assemble, fabricate and then send it to Tier 1. So, what I want to say is by the time you come down to Tier 3, your products become very, very simple and because the products are simple, they can be purchased in the local market at a decent price, at a lesser price.

So, even if there is a disruption for a particular supply chain, the Tier 3 does not have any problems because Tier 3 can easily procure them from the market. So this is, this is the supply chain disruptions are occurring here.

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Now, so as we have mentioning, we have to identify the risks. Risk identification, now there are actually 4 types of risks, financial, strategic, hazardous risk and operational risk, if you categorize, all the risk will come under these categories. Foreign exchange risk, you do not know the party in another country and vice versa, other party also does not know you. Both of you know them only by, both of you know them only by name and the country.

So the only way you can hedge against such risk is by having a bill of exchange. So, you go to your local bank, submit the documents and get the money. That company there in another county also does the same, goes to the local bank, submits the documents and remits the money. Otherwise you do not know each other.

So, but that is a risk, is a financial risk. Strategic risks, the long term, long term issues. Hazardous risks, hazard risks, I think we have spoken about the chemical supply chain, very, very hazardous. Where even if there is a leakage in the pipeline, system, lot of damage would be done to the human community, human race. So, hazard risks and, another risk is your operational risk, operational risk means the risk associated with day to day running of the business.

For example, train service getting disrupted. Now one, see, train service disruption will happen because of three things, one is nature made disruption. What is nature made disruption? These are operational risks, the last point. What is nature made disruptions? Nature made disruptions are fog in winter in the national capital of India, Delhi. Fog in winter, train, no train, the visibility is zero. So, no trains can move, so nature made operational risk.

Second is man-made operational risk, suddenly there is a labor strike or a worker strike, so vehicles are not moving. Third is the system generated operational risk. For example, your company uses medium sized trucks, the other company uses only small size trucks. So, there is a incompatibility issue, so the operational risk, that may have lot of damages to the product, lot of, some risk of theft, etc, etc.

So, operational risk. Now, this is, this lecture, we will stop the lecture here and in the next lecture session, we will start off with these and try to quantify them, so that you know how to measure such a, such risk and come up with a total riskiness score. So, we will stop here for today and we will continue with this in the next class, thank you.