Modelling and Analytics for Supply Chain Management
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Lecture 56
Risk Analytics in Supply Network Design (Contd.)

Hello and welcome to Modelling and Analytics for Supply Chain Management. Today, we are into the second part of week 11. We were doing Risk Analytics and Supply Network Design and in the previous lecture, we gave you an introduction and the relevance of risks in supply chain and we also told you that quantifying such and quantifying such risk is very-very important and the second thing that we told you is that, if risks.

Because of risks a supply chain is disrupted. We showed you some numbers and we told you that a supply chain is disrupted for more than 10 days, then in all probability, you will be out of business. Even if you are not out of business, you will, your business will be hit severely. So, this is what we ended up in the previous lecture. Today, we will continue with this and we will try to numerically estimate the riskiness of a supply chain.

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So, we basically ended up here in the previous week. The types of risk. Financial, strategic, hazardous and operational risk and I gave you some brief about, some examples on what, examples of these types of risks. What happens if a supplier in a very different country does not pay you, then your supply chain is in shortage of funds, so that is your financial risk.

Because of mathematical models, you built up a warehouse somewhere in a country where there is snowfall for three or four months in a year. So, for those four months, there is no product movement. This is strategic risk. You have taken a wrong decision. Hazardous risks,

chemicals and if you remember, we in one example we have told about one such hazardous, one such incident that happened in India also, the Bhopal Gas Tragedy.

Very recently, in Japan we have seen what has happened with the Fukushima Daiichi Power Plant. So, these are examples of hazardous risk and operational risk, as we mentioned that as we move on doing the day to day activities, whatever risks are come in is operational risk. A product has to move very fast, it has to reach by Saturday mid night, latest.

But what happened, because of certain issues, certain problems, etc, maybe the vehicle was not able to move to a lot of traffic jam etc. The product has reached instead of Saturday, on Sunday. But Sunday is a full day holiday, so you do not get delivery of the product. So, you have to wait till Monday. So that is an operational risk because you never expect that to happen.

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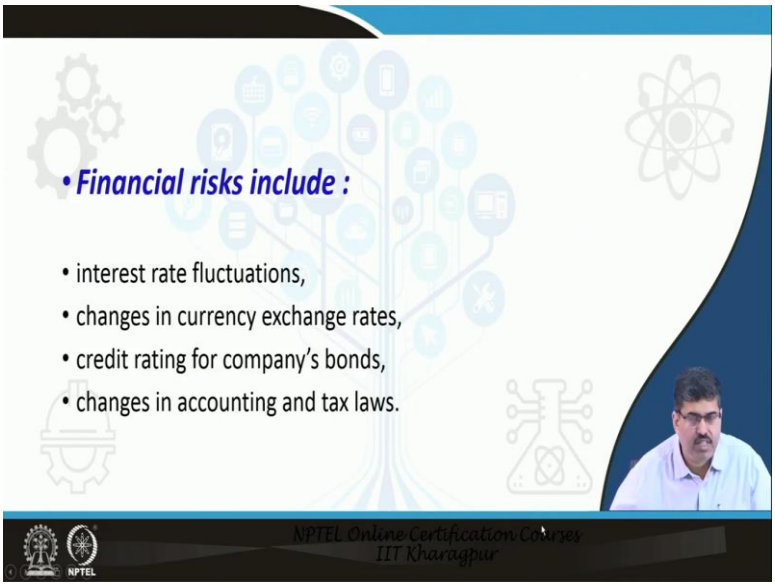

So, let us go into first financial risks. These are examples of financial risks. Interest rate fluctuation. Lot of risk. Even the smallest amount of interest rate fluctuation and when you are dealing with crores of rupees, it is huge risk. Changes in currency exchange rate. Great risk. That is why, slightest foreign exchange rate changes business community gets very-very panicked. Credit rating for company's bonds, again if that suffers then there is a problem.

Changes in accounting and taxation laws, very-very risky. So, that is why every year people are very eagerly waiting for the budget. Not consumers because consumers anyway pays and gets the product. So, even if there is an issues, they will have to pay. So, not that much consumers, but business community keeps on looking at the financial budget to understand

changes in accounting and tax laws. Those are examples of financial risks. We will explain how to quantify them later.

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What are the strategic risks? New competitors. Great risk, great risk. Remember new competitors are coming with something called quote-unquote, learning from previous incidents. Learning from previous incidents. So, when they are coming prepared with learning from previous incidents, very likely that they will commit lesser number of mistakes and so, what will other, they were very smooth and cost effective supply chain.

So, strategic risks, new competitors, very, very risky for your organisation, very risky. New competitors means, you have to really take stock of the situation and do something about it. Frame new strategies, new policies, new tactics, whatever. Negative press coverage, very very challenging, very, very risky. There was a debate in India, two debates, two debates that shook the nation, really. Number one, I think about 12-13 years back, 13-14 years back, pesticide in Coke and Pepsi, pesticide really shook the nation.

People stopped buying, people stopped buying and people stopped buying. Pesticide in Coke that is what they used to call, some were say Pepsi etc etc. Whatever, but what is important is pesticide in aerated drinks. It shook the nation. Took lot of time, for the businesses to recover from this issue and the second thing that has really the negative, the negative press coverage, that has really, I mean created, lot of problems in, in our this thing is your chemicals in Maggi.

Chemicals much, much, much above the permitted level in Maggi. Over the last two decades, 20 years, food habit in India, particularly in urban and semi urban areas have changed drastically. Whenever you are hungry, this is the food that people take, this is the food that is very less costly and this is the food that can be cooked in shortest possible time.

But now, the nation wakes up to understand that the food that we were consuming for so long, morning day evening, whenever you are hungry, you are just within 5-6 minutes, Maggi was prepared, that has much, much alarming level of plus chemicals. Much above the permitted level. Pesticide was Coke and Coke and Pepsi, this was chemicals, much above the permitted level. You know Maggi was out of the market totally. The product was severely hit. Supply chains just got choked with products. It was not moving. So, negative press coverage.

Customer demand changes the traditional breakfasts have gone. What has replaced the urban and semi urban breakfast table? Corn flakes. So, milk and corn flakes, are the new mantra for the morning breakfast. Bread, new mantra for morning breakfast. Slice bread takes lot of time, you have to heat it, then put the butter or the jam. That takes lot of time. So, now bun bread or the pita bread has taken up its place. So, customer demand is changing. But you have not geared your supply chain for that change. So, that will hamper your risk that will hamper your supply chain, it's a strategic risk.

Erosion of brand loyalty. Over time, brand loyalty is gone. What will happen to your supply chain? Will products move, will products move in your supply chain? No, your products will nor move. They will be choked again. Poor customer relations that also creates negative publicity. So, these are strategic risks.

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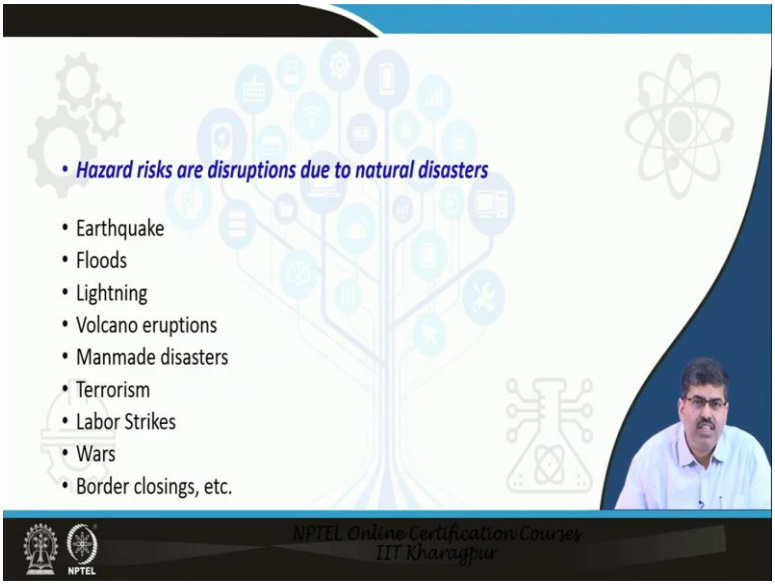

Hazard risks, we have mentioned. Earthquake, flood, nothing to, lightning, volcano eruptions, in US, two three cities cannot be served by supply chain because there is a volcano. Manmade disasters, terrorism, labour strike, wars, border closings, border means the geographical boundaries between two nations. The border closing, geographical manmade, whatever. Hazard risks are disruptions due to natural disasters.

Now, there is something to know from here also, related to supply chain. This manmade disaster, this this flood, earthquake. A Walmart store in US, they did some data crunching, immediately after the earthquake and flood. I think floods and they found out that immediately after flood, people were buying more onions and more potatoes. So, that data, now they were ready with. So, whenever there was a forecast that there will be flood or there will be heavy rain and heavy rain is the first or the precursive to flood.

So, whenever they got a forecast, that there will be heavy rainfall for the next five days or heavy rainfall for the next ten days. So, what happened, they immediately stock their store with huge onions quantity and huge potato quantity. Because that was the leaning from the previous flood. So, that they can gain. So, supply chain has to gear up for that also.

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Operational risks, supplier problems, IT systems failure, computer virus, product recall happened with Toyota also. Product recall, logistics failures. So, these are examples of these four types of risks. Financial, strategic, hazardous, operational.

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Now, we have something called risk assessment. So, now we are quantifying the risks. Risk mapping subjective and risk prioritization. Step one, step two. What is step one?

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Risk mapping. Risk mapping is the subjective process where the risks are broadly classified based on risk appearance and risk impact. Risk appearance and risk impact. What do you mean by this?

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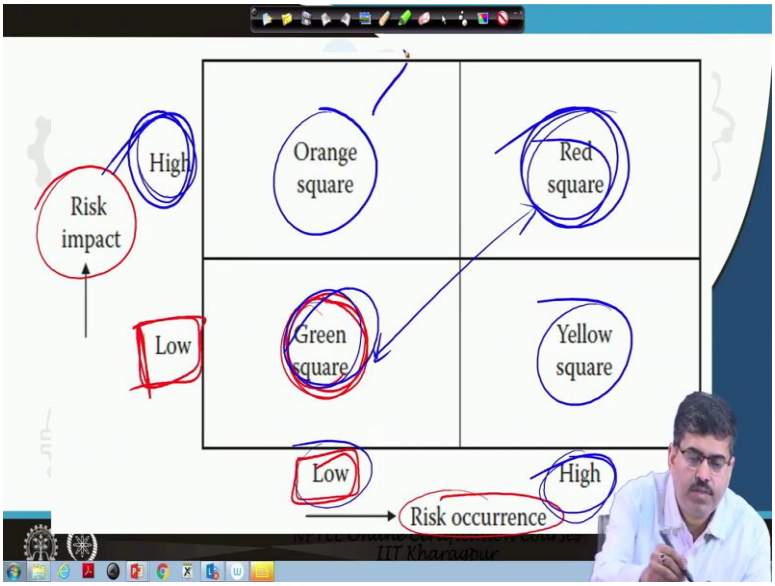

This. So, let us see, what is this? Now, what we see it, based on two criteria, risk occurrence and risk impact or this is another way, some people call it as probability of occurrence and risk impact. Now, when the probability of occurrence of the risk is low, probability of occurrence is low and the impact of the risk, how it will attack and damage or hamper your supply chain.

When the impact is also low, so risk will also not occur, very less probability, impact is also less. So, what will happen, your supply chain is basically not to worry. It is a green square, it is a, it is a green one. It is a green one. When risk occurrence is very, very high, probability of occurrence is very high and the severity of that risk is also very high, what do we have, we have a red square, red is always dangerous, so red and green.

Red, just like a train, red signal and the green signal. In road also, red signal-green signal, so similarly. So, when your risk occurrence is high and when your risk impact of the risk is also very high here in red square. So, be very, very careful. Now, when your risk occurrence is high, probability of occurrence is very high, but the impact of the risk is very low, then its somewhere yellow. When your risk occurrence is low but the impact is high, a little more so orange.

So, this is basically the first nomenclature. This is the first nomenclature. The first categorized the risks according to their occurrence and impact. According to their occurrence and impact.

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So, this was what? We mentioned risk mapping. Map the risk based on risk occurrence and risk impact.

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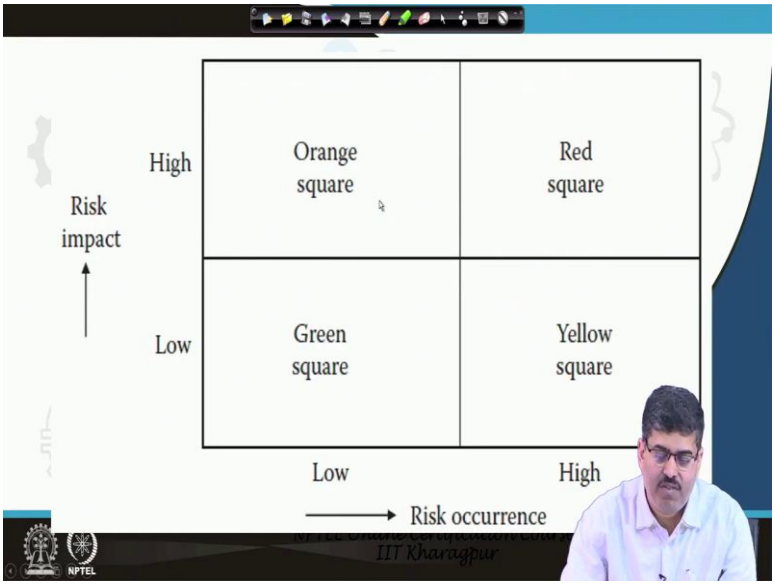

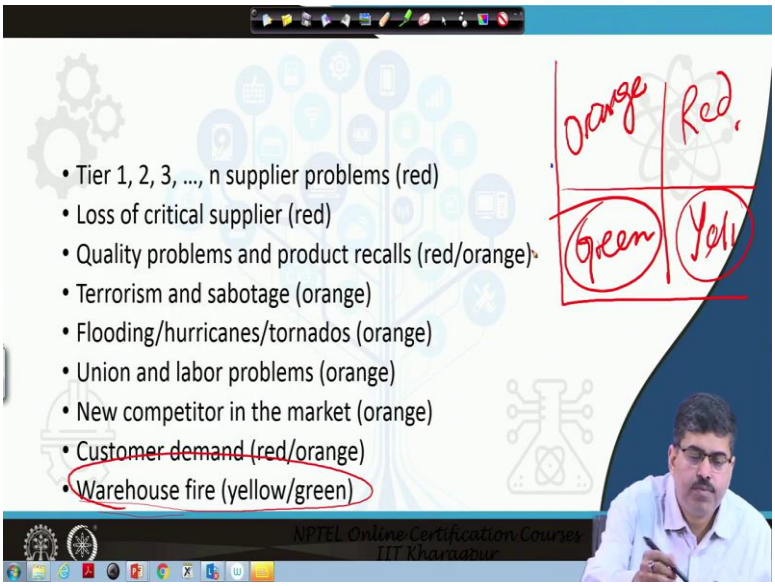

Now here are some examples. Tier one, two, three supplier problems, red. I will just draw it once. Red, green, yellow, orange. I will draw it here at this corner. Red, green, yellow, orange. So, tier one, two, three suppliers is red. Any risk, it will fall under red category. Loss of critical supplier, dangerous- red. Let us take a green. Warehouse fire, last one, let us take warehouse fire, it is yellow or green.

That is the probability may be high or low. But the impact to the risk is low. Why? Why is impact to the risk low? Actually, impact to the risk low, because it is something, it can be controlled. Number one, insurance is there, number two and then, you say that but production, supply line is hampered, yes. But there are finished products from other places which I can use. So, these are examples of risk.

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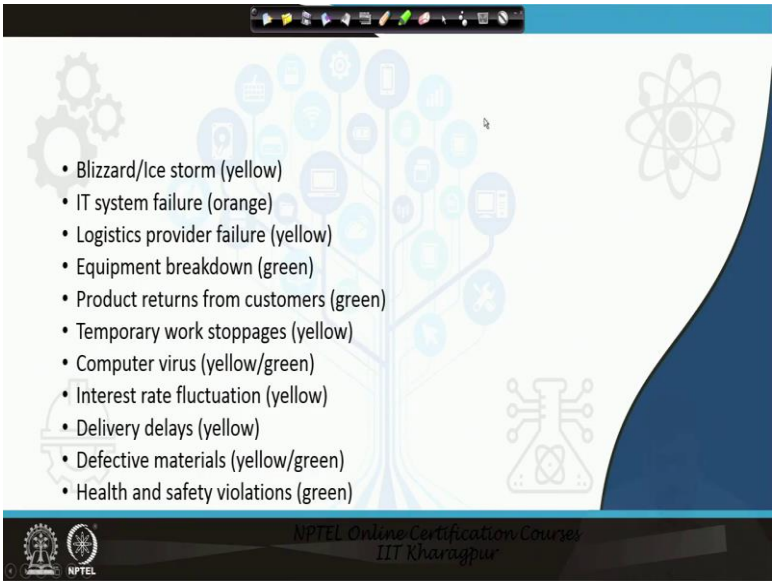

Ice storm yellow. IT failure orange. These are all examples, that I have given, computer virus is yellow, defective material is yellow. These are examples of this.

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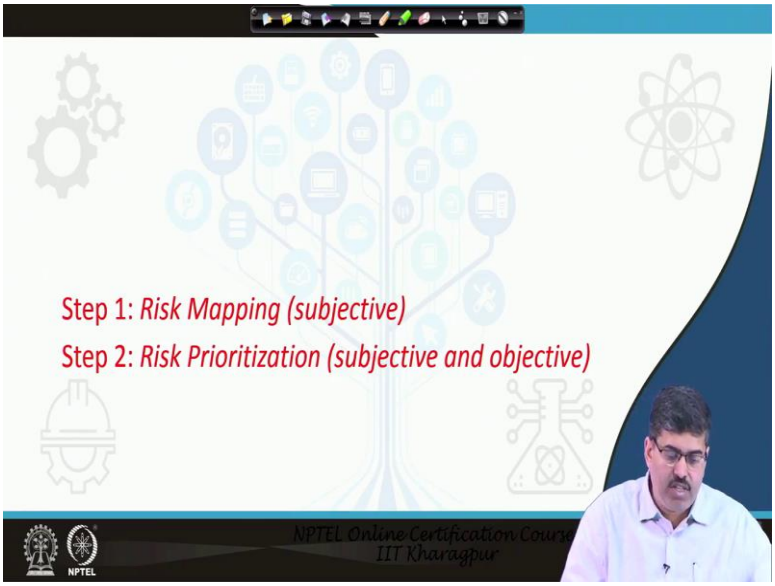

So, the first one was risk mapping, so let us go back, first step was risk mapping, whether it is in a red or a green or a yellow or orange, second one is risk prioritization, risk prioritization.

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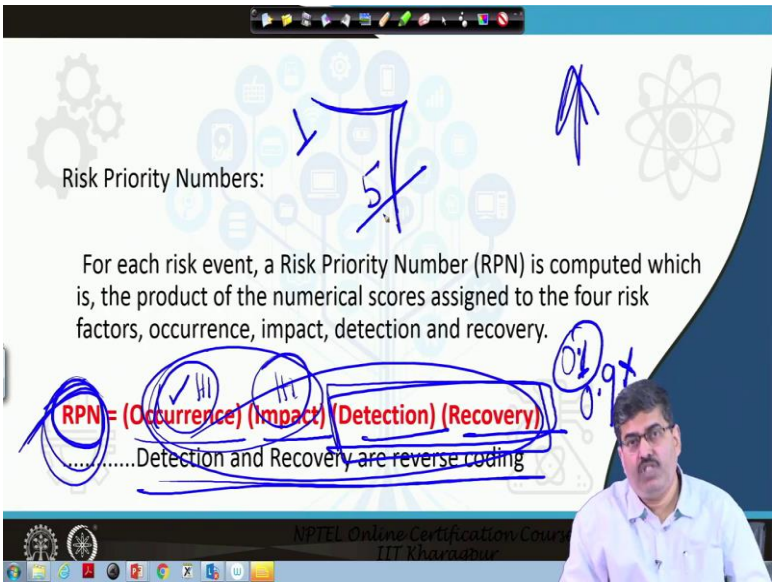

Now what is risk prioritization? You creates something called a risk priority number. That is there in the red. It is there in the red, create something called as risk priority number. That is RPN. Risk priority number that is RPN. It is occurrence, impact, detection, recovery. Occurrence into impact multiplied occurrence, multiplied by impact multiplied by detection multiplied by recovery.

Detection and recovery, this is important, detection and recovery are reverse coding. Detection and recovery are reverse coding. So, occurrence into impact. So, get a risk number, very easy. Probability of occurrence is there say what will happen? Let us state this formula.

Occurrence, probability of occurrence is high, its impact is also high. So, what will happen? My risk priority number will increase. So, whichever. So what is the conclusion?

Whichever root, whichever system, whichever time, there is a risk. Because of the occurrence and the impact, these two because of these two, occurrence and impact, because of these two, occurrence and impact, there is priority number will be very high. This priority number is very high. So, you know how this is calculated.

Detection and recovery, if you have an early detection, if you have an early detection, then the detection score should be 0.2 or 0.1, because that will reduce your risk. If you can detect something very early, that will reduce your risk. So, detection score 0.1 is better. Otherwise what we could have said, 0.9 is better. No, 0.1 is better. 0.1 is better. So, then may risk priority number will come down.

So, occurrence that is why it is reverse coding and recovery again, if I put a very high score, what happens, high chance of recovery my risk priority number increases. So, I have to get a reverse coding, recovery, detection and reverse coding. So risk priority number. This will be somewhat subjective, each one has their own judgement. But you should take care that if somebody has given occurrence a score of one out of five, you should not give a five out of five. Both has to be examined, both has to be examined to see which score is ideal score.

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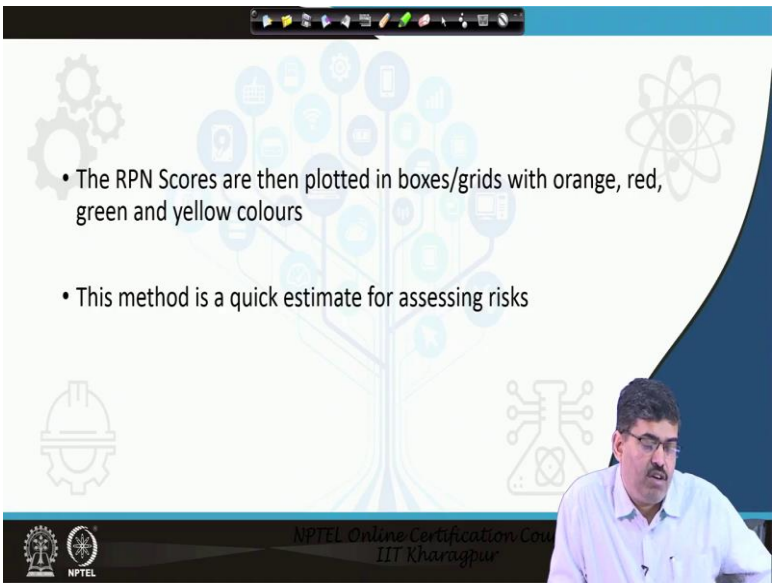
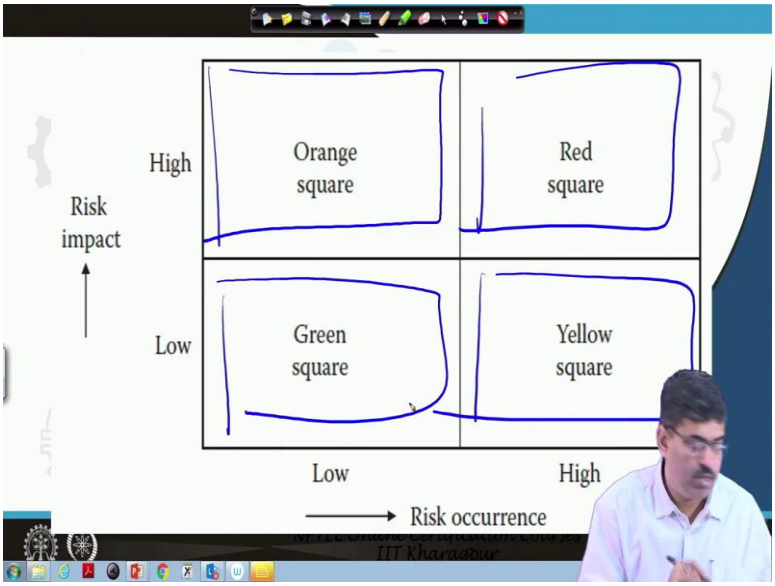


QUANTIFYING THE RISKS: MODELS



Risk Priority Numbers:

For each risk event, a Risk Priority Number (RPN) is computed which is, the product of the numerical scores assigned to the four risk factors, occurrence, impact, detection and recovery.

RPN = (Occurrence) (Impact) (Detection) (Recovery)

.....Detection and Recovery are reverse coding

The RPN scores are then plotted in boxes grids with orange, red, green and yellow colours. This method is a quick estimate for assessing risks. Now, quantifying the risks. There are different models to quantify. The first, what did we do? This risk priority number is basic so.

As a first step, to calculating risk, we show this grid and then we put the different products across different grids. We put different products in different grids and so first is we put different products in different grids? Then what we do, we put different products in different grids, then what we do? We generate an RPN number, risk priority number.

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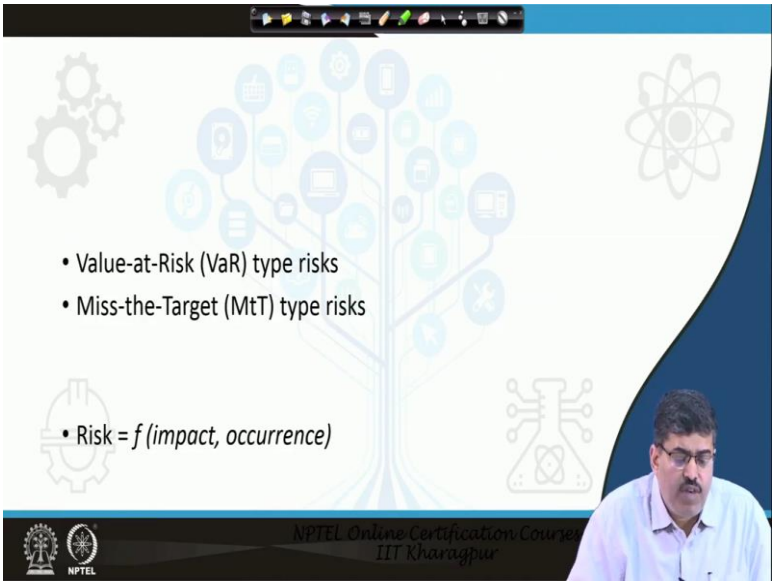

So, quantifying the risks, there are other models but we will say risk priority number that is a very very decent model very easy model to do. There are other models, value at risk, miss the target and here risk is a function of impact and occurrence.

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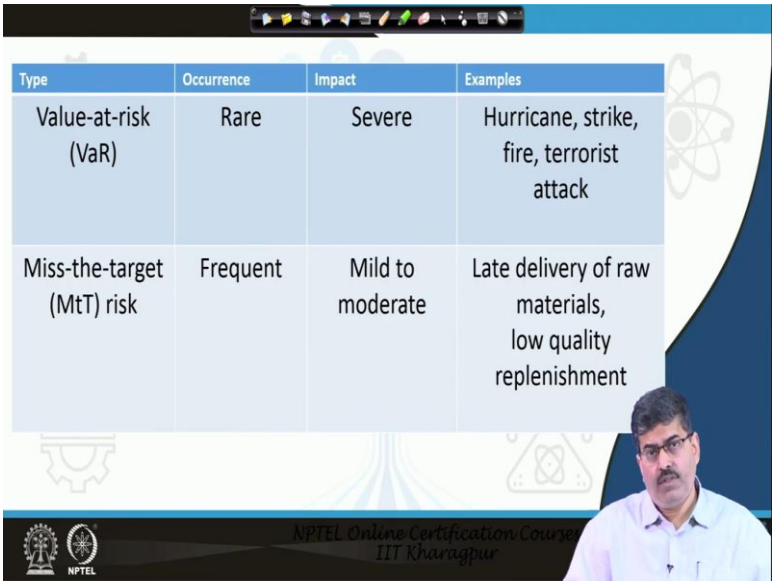

Again, we have a nomenclature, you can just have a look at it.

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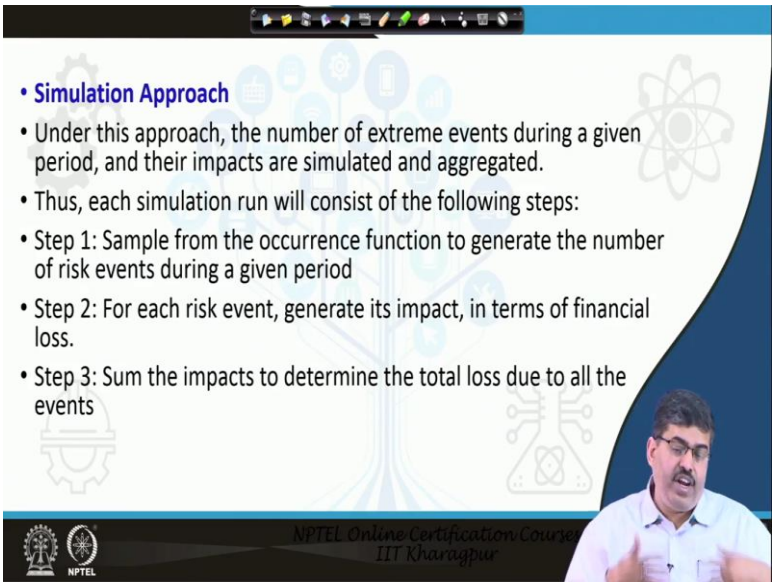

We can do a simulation approach to find out the risk. We can measure political. Macro, social, market social input risk.

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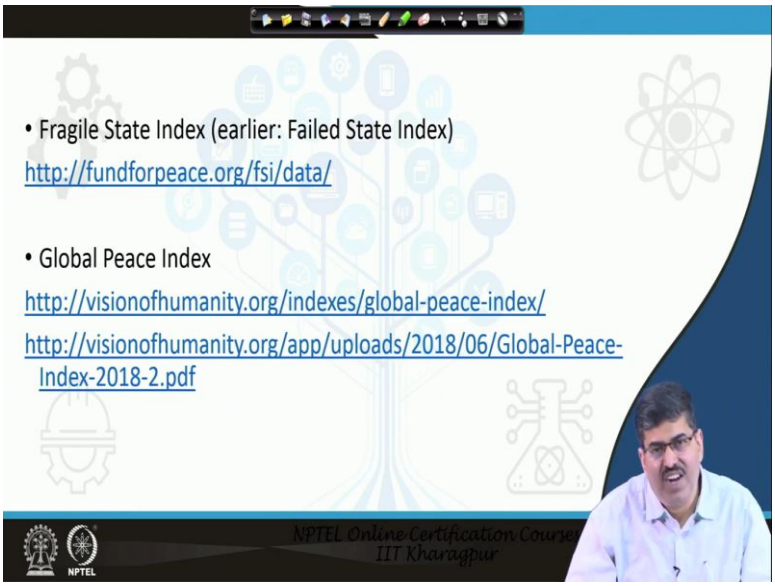

Now there is a website, if you do not want to calculate risk, you want to just know the risk in this profile of a country. Country risk analysis. There is a website called fragile state index, earlier it was called as failed state index. Which tells you that basically the risk data. Global peace index again gives you the data, on risks.

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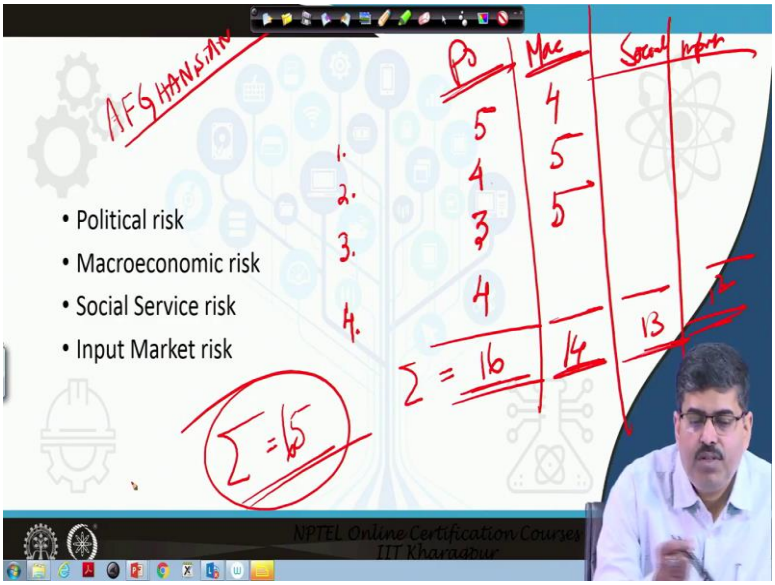

Now, we will do a short exercise on this quantifying the risk. Political risks, let us say we are doing for Afghanistan. Let us say, we are doing for Afghanistan, political risk. Higher the value, higher the risk. Higher the value, higher the risk. Stable political system, one, I am not writing here because I am dictating anyway. Stable political system. What score will you give Afghanistan is it stable? No, give 1. Then, then type of the system, democracy, autocracy, theocracy, somewhere in between so 2.

It should be reverse coding, we are using the, we are using the direct coding. Just give me a second. We are giving a direct coding, where high number means high risk. High number means high risk. So, political stability of the government. No, government is not stable. Type, how, so the riskiness is 5, stability of the government, no. So, riskiness is 5. Next is the democracy, democracy is the most used form all over the world.

So, is it a democracy? Again, pseudo, so what is the risk? High risk. Then, at the rules of the country, changing with every change in government. We are not sure, but still that persist, so risk is 3. So, type of system etc, etc, does the, does the policies of the government change with every change in government? Yes, 4. So, if you see, the summation of the political risks is 16. If my summation is correct. So, this is your political.

Next is your macroeconomic. Macroeconomic risk is the, is the governments taxation policy is changing every time? Again, you do not know, but presumably yes. Is there enough credit getting generated in the economy? No. So that is a macroeconomic issue? Is the government able to have own funding for investment for infrastructure projects? No, it is always depended on other nations. So, in this way, maybe it may not be 4. So, 14 is the risks.

Then in similar way, social service risk is one and also in similar way input market risk is another. So, what you do is, you can get a 13, you can get a 12. So, your summation will become, summation will become, 30-40. So, let us say, your 65, this is your summation. So in this way, each country has a score, each country you can prepare a risk (())(24:53) score. This is a country example I showed you with Afghanistan. You can do such an exercise for within a country also, across regions, how will you design this supply chain network?

That will be based on supply chain risk and the word risk, be very careful, the word risk does not mean that somebody will destroy your supply chain. The word, word risk means these four things, political, macro, social, input market risk. It does not mean that somebody is destroying your supply chain by using some weapon. No, it is how your supply chain is getting vulnerable. That is what is political risk. So, this is how you measure some of these risks. This is how you measure some of these risks

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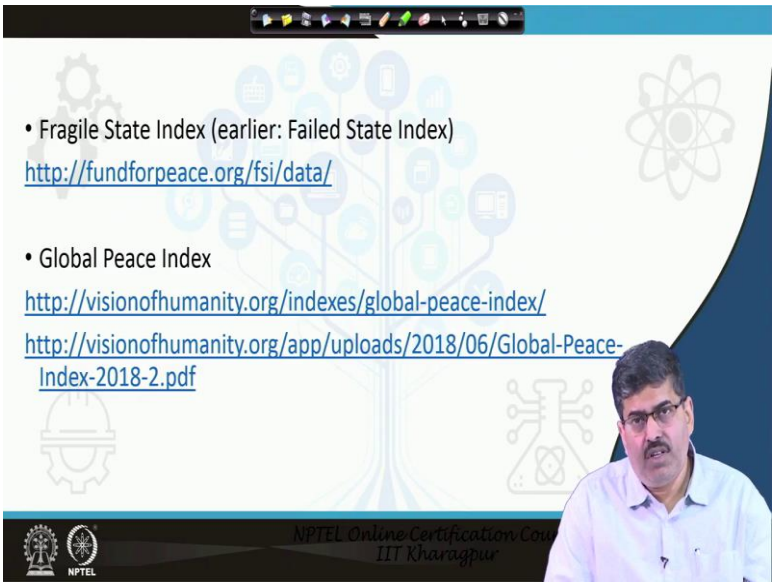

And we have mentioned that if you do not want to measure, there is a list available fragile state index but it is always better. There is also something called risk internationally which, all, the logistics internationally which also gives you the chart showing the rank of countries in terms of logistics business acumen. So, that also is a pseudo or a proxy to use risks.

So, I think we will end this particular week on risk analytics and supply chain by what we have done is we have given you a way by which you can measure the riskiness of a country. Similarly, what you can do, you can measure the riskiness of other countries, give a score and then compare it with this fragile state index and see, at least the ranking you can see. See whether you are giving score was correct or not. So, that you can do. So, you can fragile state

index. So, this is, so I think with this we will end this particular module or week on supply chain risk analytics.

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There is another one it is just, it is Global Competitiveness Index these are all ways by which you can do it. So, I think with this, we will end the particular module. This just, just go through them, and (())(27:12) risk etc,etc

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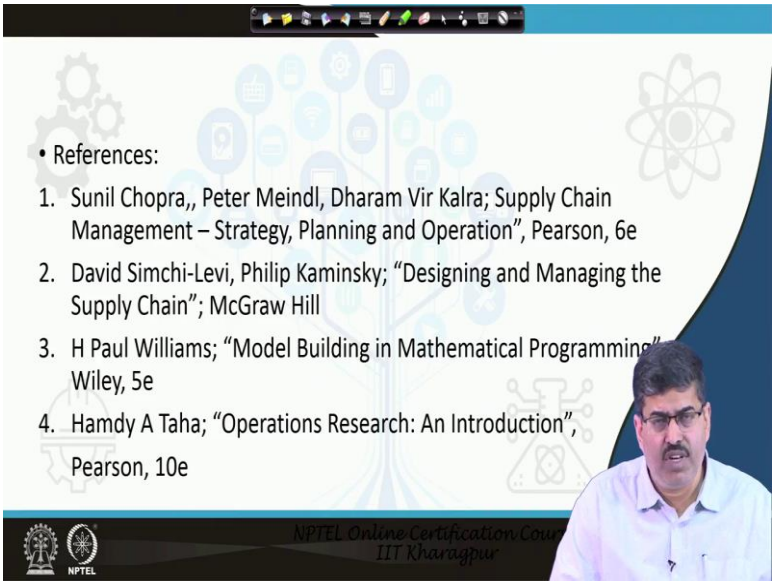

And go through the references and I think we will end this module on risk analytics in supply chain management. Thank you.