Modelling and Analytics for Supply Chain Management
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Lecture 44
VIKOR and ISM Methods (Contd.)

Hello and welcome to Modelling and Analytics for Supply Chain Management.

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We are into week 9 lecture 44 and our topic today is ISM methods. Now in Modelling and Analytics one important factor is in real world we do not need deal with only one variable, we deal with multiple number of variables. What is a variable, which varies and which is the key to our decision making. The factors, which vary and is the key to our decision-making.

So in reality in multi-criteria decision-making, that is what we are doing now, multi-criteria means there are many criteria which we consider before taking a decision, there are many criteria which we consider before taking any decision. Many is multi, so multi-criteria decision making models so that is the objective.

Now in multi-criteria decision making models, as you have learned already, that there are many methods. You have learned AHP method. When is AHP method used? Again I repeat, I am better than him, she is better than him, so in this way when we have some hierarchy then we can use Analytic hierarchy process.

Other method is TOPSIS, which you can use for shifting of employees from one department to other, also for supply selection, etc. The third method that we learned in the previous class

was VIKOR. Now, in VIKOR what we learned is sometimes in real world it is not exactly only one variable or we cannot pin point sometimes. So there are other factors that come into play, then we use VIKOR method.

And then we touched upon what is ISM method. ISM method is sometimes, there is a relationship, there is a one-way relationship between two variables, two-way relationship between two variables and sometimes there is no relationship between two variables. So that is the time when we use ISM method to find out what is important for our organization and how to take a decision and we started off with ISM method in the previous class.

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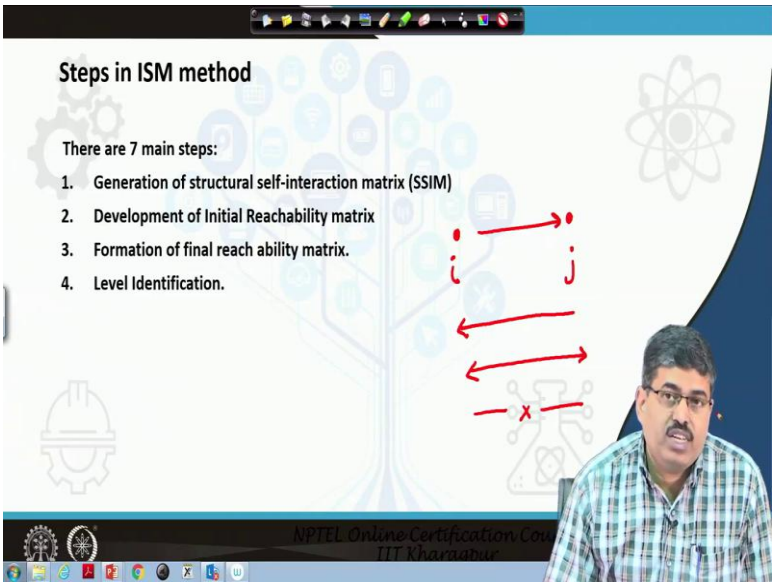

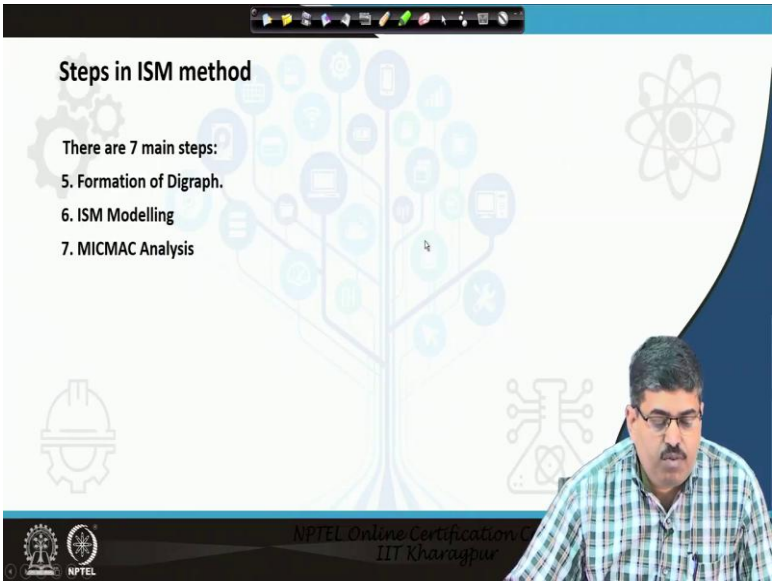

Today we will continue and take you through the entire process of ISM methodology. So this is what we have already seen. DEMATEL is one as we have mentioned, though we have not

covered it in this course as such but there are many MCDM techniques. Now, I think here we will, ISM method there are 7 steps in ISM method. Now here, let me just again repeat what, where we ended in the previous class. Now our objective is to find out the MCDM techniques.

Number 1, you see what happens in real world is there is a relationship of this with this. This is i and this is j, so there is this relationship. Similarly there can be this relationship also, a reverse. There can be a two-way relationship between i and j and there can be no relationship between i and j. So there are different factors, different variables, so between variable i and variable j there can be one-way, unidirectional, bidirectional and no relationship at all.

So ISM method helps to take a decision when such a situation exist. So this is the starting point of ISM method. There are seven main steps in ISM methods. First is generation of structural self-interaction matrix, then is Initial Reachability matrix, formation of final reach ability matrix, level identification, then we come to Digraph, modelling and MICMAC Analysis.

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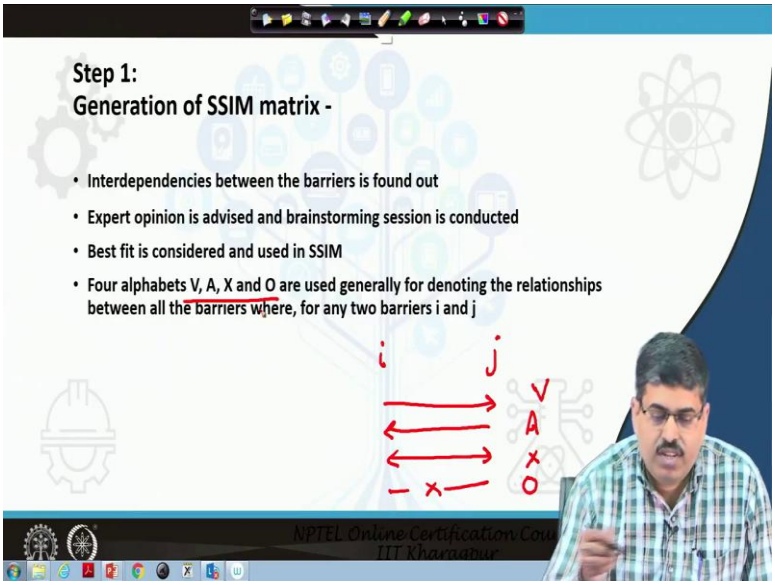

Now, what do you mean by this? Now, just see this last line okay, that is V, A, X and O, four alphabet are used for ISM Analysis. No need to worry, this is very simple okay, V, A, X and O. Now as we, remember what we mentioned i and j are two variables right. When I and j, there is i is leading to j we say it is, we denote it as by V. When j is leading to I, it is A. When it is both then is X and when it is not at all related it is O.

So these are the four alphabets that are used. This is the starting point of an ISM method. V, A, X and O, V, A leads to B, A, B leads to A, X both ways and O means zero, basically that is there is no relation. So this is the starting point of ISM method.

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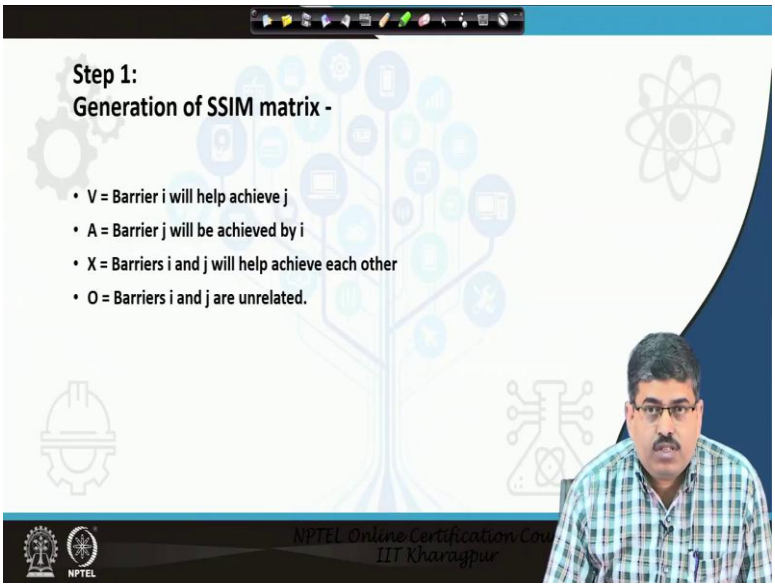

This is what we just now mentioned. i will help achieve j, V; j will be achieved by I, A; i and j will help achieve each other, X and O is the barriers i and j are unrelated, that is there is no relation, that cross mark that we had given.

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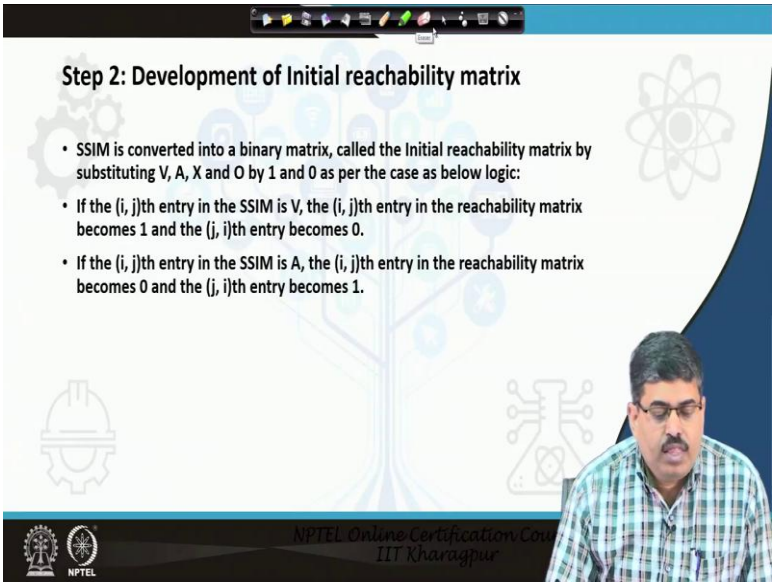

Then we come up with the Initial Reachability matrix. This we have mentioned it here, you will not understand now that much, when we do a problem then you will understand. So we

will straight away go to the problem to understand this okay, but what we are doing in the problem that is given in all these slides, okay. So let us go straight to the problem.

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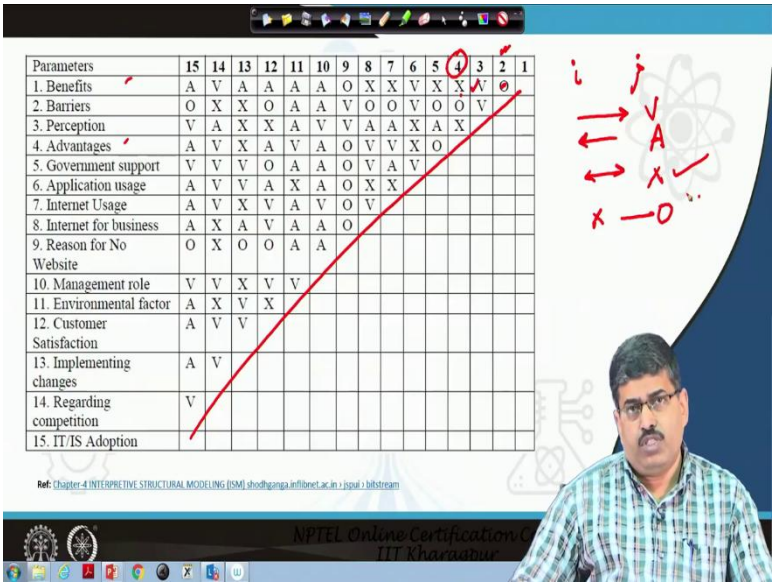

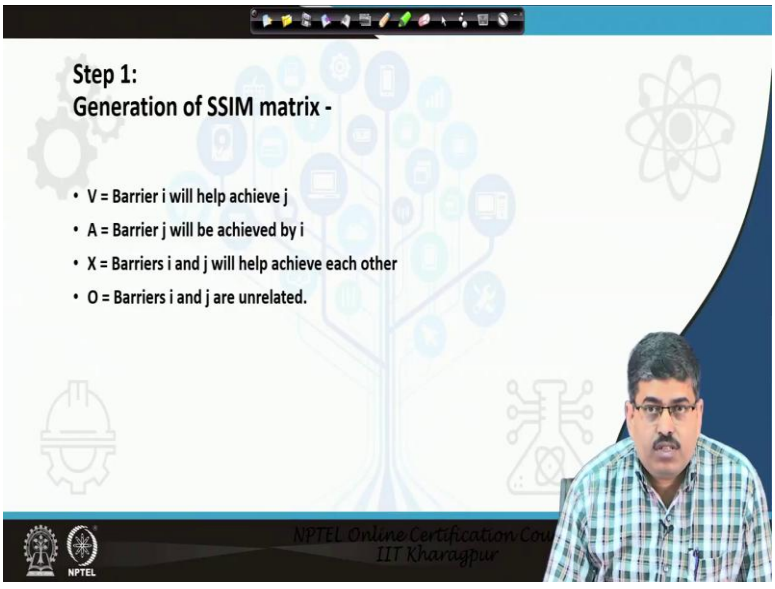

So this is the problem that we have taken. The reference to this problem is given at the bottom, so you can refer to the original paper also. Due acknowledgments to the original paper and the reference is given, you can just go through it. And it is very simply written also, that is why we chose this paper as the reference paper so that you can read it later and understand without any difficulty.

Now see, at the left hand side there are different parameters benefit, barrier, perception, advantage, government support, internet usage, internet for business, reasons for no website.

This is, some company is trying to understand the relationship of IT related things okay, so they have listed fifteen factors that are related to IT.

Benefit of Information Technology, barriers, what is the perception of people, what are the advantages, how is the government support towards IT usage and adoption, application of usage, internet, what is the internet usage, reasons for no website, okay. This way you have given fifteen variables, okay.

And here, on the top you are seeing one, two, three, four, five, six, and seven, eight and up to fifteen, so these are the fifteen variables and these are the fifteen things, okay. Now the question is see, benefits 1 is benefit, how is it related to benefit? Basically there is no such, 1 and 1 they are anyway not related. Now let us just go back once again and write down the V, A, X and O, right. Just see this slide, V, A, X and O. So let us go back to this problem once again and then you will see what is V, A, X and O.

So when I is leading, so i and j are two variables, okay. When i is leading to j, it is V; when j is leading to i; when both are leading to X and when they are not leading to each other it is O right. So just remember this okay, i, j. Okay, so benefits and barriers are they related basically? No, right? So you see it is O here. Benefits is 1, this is 2, right? What is 2? Barriers, so benefits and barriers are they related? No, not really so it is O. Now, benefits and 3. 3 is perception. Yes, benefits leads to that perception that it will work or I will adopt it. Benefits lead to the perception that I will adopt it, okay, so it is V.

Now let us take an X. Benefits leads to advantages, okay, this is 4. Benefits lead to advantages, yes and advantages also is related to benefits, so it is a bidirectional one, X is. So in this way you can frame this entire matrix. Just keep on thinking about it and draw these relationships, okay. Once you are done with this what do we do? Next step is wherever there is an O that it is a zero because there is no relationship. Wherever there is A, V, X it is one okay.

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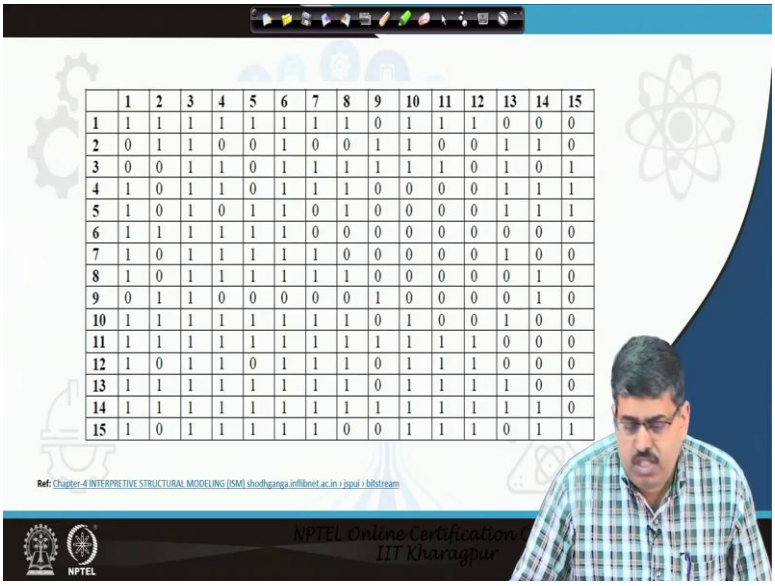

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	1	1	1	1	1	1	1	1	0	1	1	1	0	0	0
2	0	1	1	0	0	1	0	0	1	1	0	0	1	1	0
3	0	0	1	1	0	1	1	1	1	1	1	0	1	0	1
4	1	0	1	1	0	1	1	1	0	0	0	0	1	1	1
5	1	0	1	0	1	1	0	1	0	0	0	0	1	1	1
6	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
7	1	0	1	1	1	1	1	0	0	0	0	0	1	0	0
8	1	0	1	1	1	1	1	1	0	0	0	0	0	1	0
9	0	1	1	0	0	0	0	0	1	0	0	0	0	1	0
10	1	1	1	1	1	1	1	1	0	1	0	0	1	0	0
11	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
12	1	0	1	1	0	1	1	1	0	1	1	1	0	0	0
13	1	1	1	1	1	1	1	1	0	1	1	1	1	0	0
14	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
15	1	0	1	1	1	1	1	0	0	1	1	1	0	1	1

So the same thing if you see, this we have modeled it out right. Wherever there was an O it is a zero, wherever there is A, V, X it is one, right. So this is what we have modeled right. Now once you are done with this, just replace the A, V and X with one nothing else.

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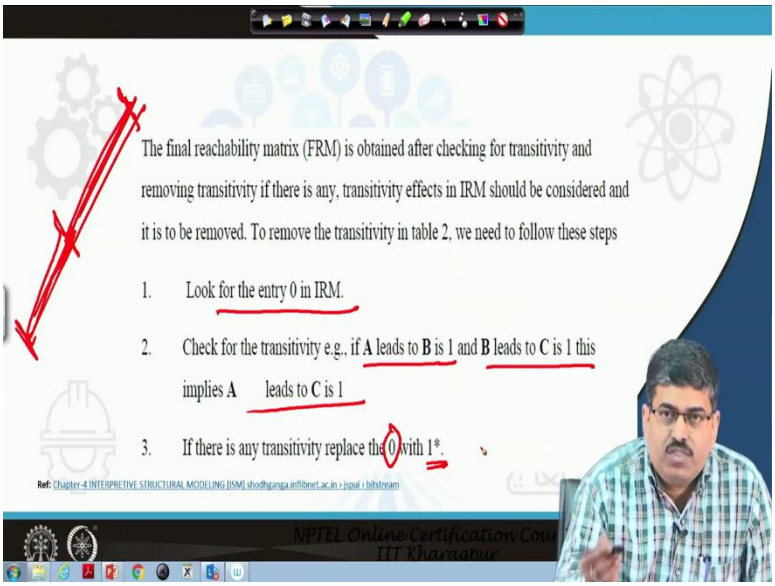

Once we have modeled this we now come to final reachability matrix, which we call as checking for transitivity okay. How to do this? Look for an entry zero in the matrix. Wherever you have got zeros, just the previous slide, wherever you had zeroes look for the entry zero in the IRM, initial reachability matrix. Check for the transitivity, that is if A leads to B is 1 and if B leads to C is 1 this implies A leads to C is 1.

If there is any transitivity then replace the zero with one. Wherever there was a zero if A leads B, B leads to C that is, if there is a transition this leads to this, this leads to this, if this leads to this, this leads to this. That is if there is any transitivity then if that zero cell is leading to a transitivity type of relationship, this lead to this and this leads to that then that zero has to be replaced with one. That's it.

So now with that zero replacement one, so if there is a transitivity, the transitivity also comes from repeated discussions. If there is a zero, if you have replaced it with one the matrix that we have just obtained in the earlier phase, that is in the earlier slide, the zero and one matrix that we had, all the transitivity sets, all the cells of the zero will now be replaced by one. So you will get a new matrix with now, maybe some more ones than the earlier slide.

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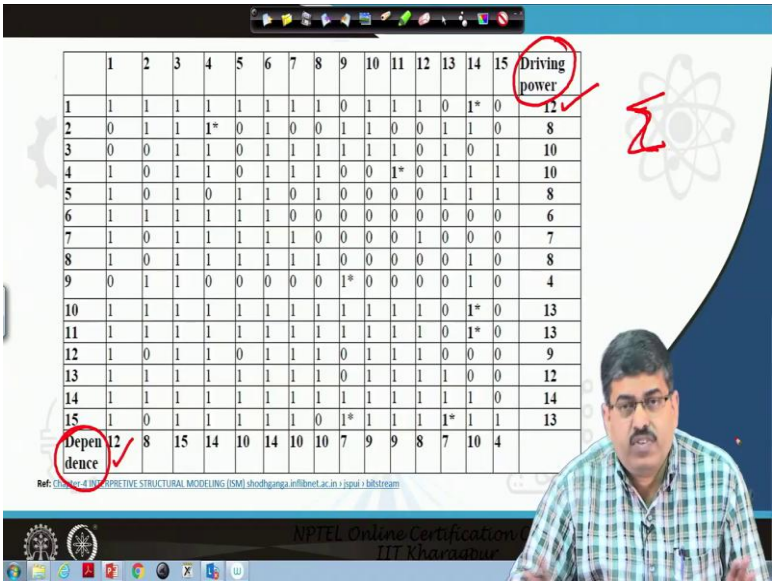

So this is the after transforming the transitivity matrices this is the new matrix. Now, what you do? Count all the ones row wise. Add it, twelve. Count all the columns okay, add it so this row summation is actually called the Driving power and this column summation is called as Dependence right. Driving Power and Dependence. In one previous slide you had the formula with summation sign and all, then I said that no need to get worried about those formulas it is very, very simple.

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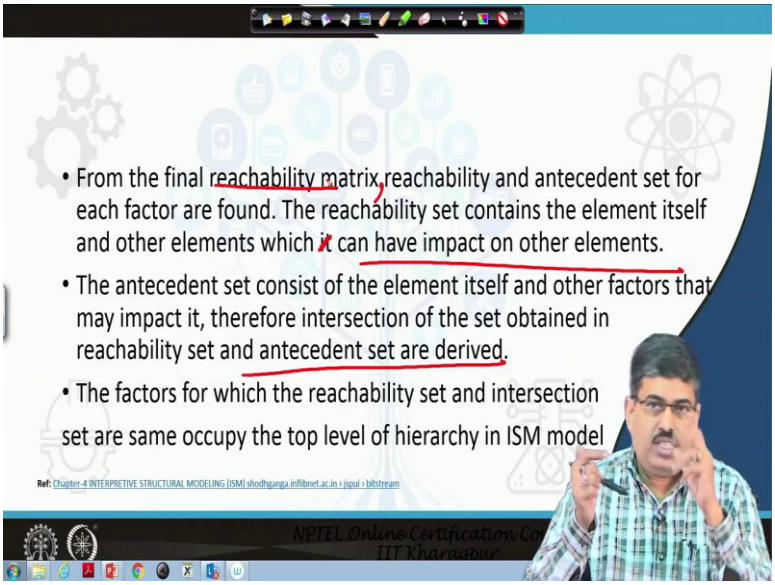

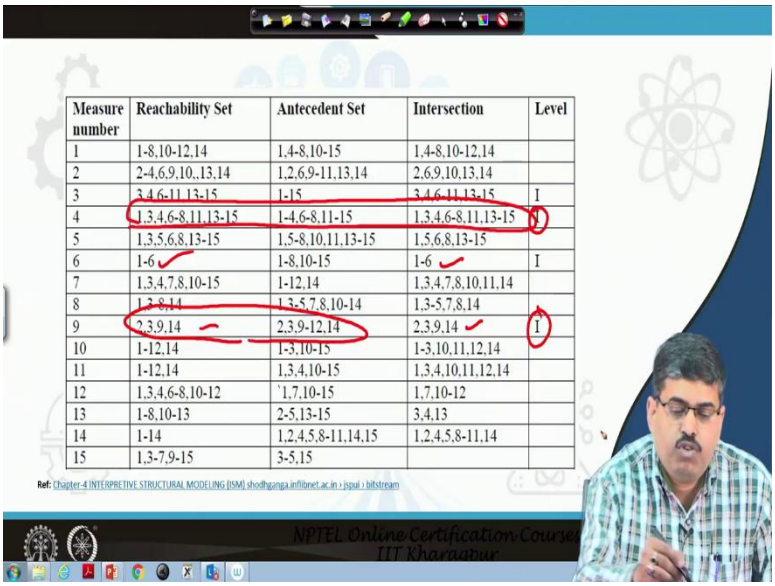

Once you are done with this, from the final reachability matrix, reachability and antecedent sets for each factor are found. Just look at the slides very, very carefully. From the final reachability matrix, reachability and antecedent sets are found. From the final reachability matrix, reachability and antecedent set of each factor are found. The reachability set contains the element itself and other elements which it can have impact on other elements. Sorry, the reachability set contains the element itself and other elements which can have impact on other elements, okay.

The antecedent set consists of element itself and other factors that may impact it, therefore intersection of the set obtained in reachability set and antecedent sets are derived. Okay.

Antecedent sets consists of element itself and other factors that may impact it. One is, it may impact the others that is the reachability, antecedent is before it may get impacted. The factors which may impact others, and second one is the factor which gets impacted by others, okay, and the common ones is to be noted. Let us see how it is done.

Yes, so 1 is impacting 8, 10 is impacting 12, 14. 1,4 is impacting 8, 10 is impacting 14, antecedent sets. So what is the interaction? 1 okay, 4-8, 10-12 and 14. 2-4, 6, 9, 10, 13, 14, this is the antecedent set, so what is the interaction set? Basically you need to come up with the common ones that is there in the interaction, right. So in this way you get the interaction sets right. Now, what is the level? The level is basically wherever there is only, wherever this 3, 4, 6, 11, 13, 15 okay. 1, 6, okay.

Now the factors for which the reachability set and interaction set are same, occupy the top level of hierarchy in the ISM model. The factors for which the reachability set and interaction set are same, occupy the top level of hierarchy in the ISM model okay. So this, the factors for which they are same occupy the top level, okay. So if you see, this interaction set, this interaction set, this interaction set and this interaction set okay clear, they are there in the level one of the hierarchy. So these are the first factors. In this way you keep on doing the iterations and you will get different levels for it.

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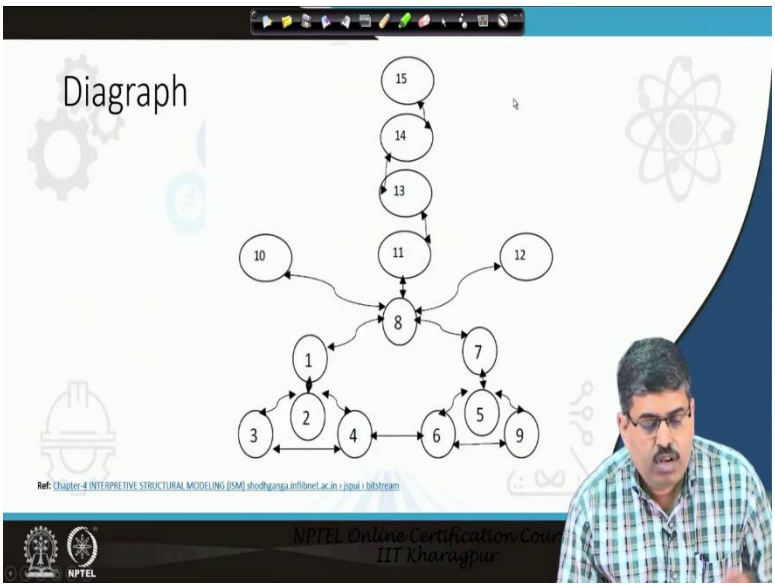

And this is, if you move on this is the diagraph that you will derive based on those iterations. Based on those iterations this diagraph you will derive.

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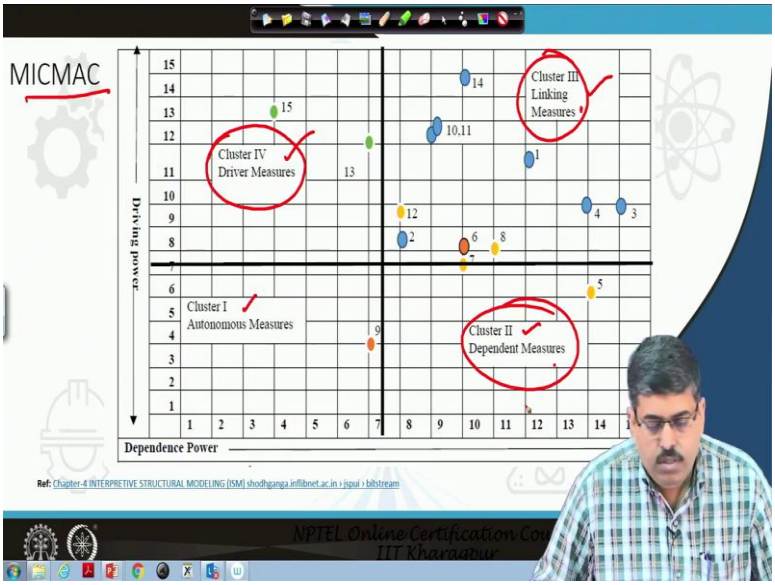

Based on that we have something called as a MICMAC. What is this MICMAC? Once you plot this on a four quadrant diagram you get cluster one, cluster two, and cluster three and cluster four. Cluster one is autonomous measures, cluster two dependent measures, cluster three linking measures and cluster four driver measures. So, autonomous, dependent, linking and drivers. So which is more important? What are the drivers to it? What are the dependent measures? Autonomous, they do not bother you that much and linking measures okay.

So if you see, so basically what a company needs to worry about is these three quadrants one, two and three. And if you can model this relationship very well then your decision making will be very, very helpful. You have to model this in a very, very useful manner, linking them up and that will lead to a very effective decision making.

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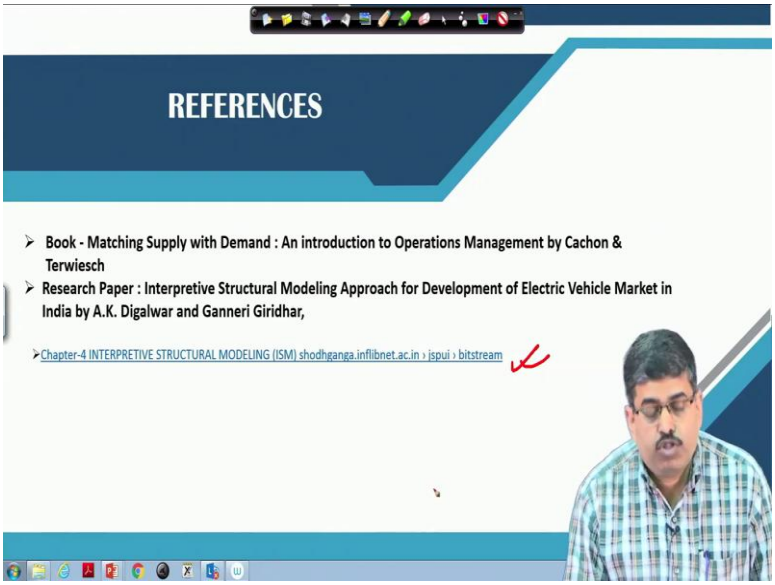

Now, there are different references given here, of which you can definitely refer to this particular paper which we have extensively used for this particular presentation. I duly acknowledge the sources from which this is taken.

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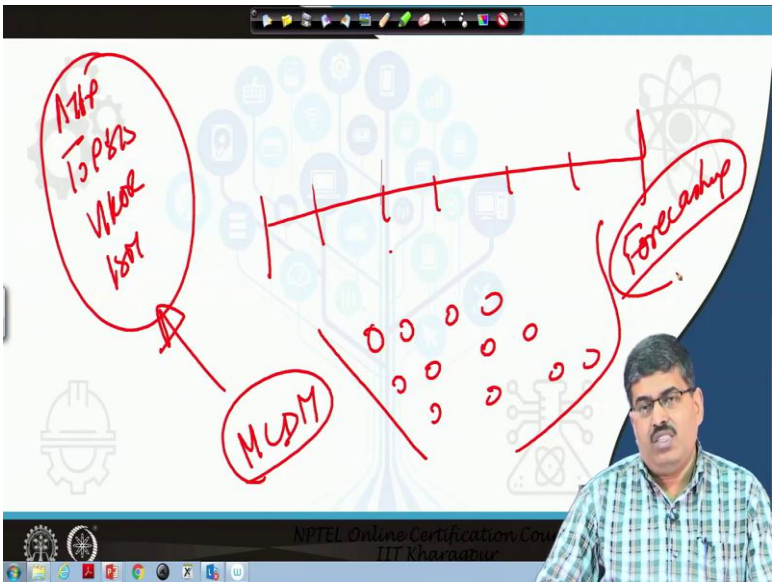

There is one thing that we need to understand okay. In the long list of presentations we have done AHP, we have done TOPSIS, we have done VIKOR and we have done ISM. Now, if you see, each of them has their own characteristics. Each one is used for a particular purpose right. Each one has their own characteristics, each one is used for particular purpose. But for

all of them one thing is all pervasive that is, there are many factors and you have to take a decision based on some objective criteria.

And if you also see all these four methods, it is some sort of a subjectivity, some sort of a subjective scores are given for all these methods, so it is not a purely mathematical one but it is a way to convert a qualitative system or a qualitative variable into a quantitative one. So this is one of the aspect of these MCDM techniques okay.

Now, what is the relevance of this is supply chain analytics? Supply chain, if you look at it in this sense as a chain with different levels, different blockades, everything each one it's operations, it's performance, everything is dependent on several factors. So you are dealing with something called multi-criteria decision making. That is why this multi criteria decision making tools and techniques you need to know, otherwise it is very difficult to model a supply chain situation. That is why we learned this.

Now, having said that, another thing is very important in supply chain that is forecasting. Now we have now, ideally forecasting is the first stage in supply chain. We purposefully did cover forecasting in the first stage because it is sometimes taken care of in different operations research modules but because it is a part of modelling, we indeed will take up forecasting and we will also tell you how to forecast, how the demand is forecasted based on different situations okay. And these forecasting modules we will take up in the next few lectures.

So overall, in a nutshell what I want to say is, overall we have done some MCDM techniques. These are not all. There are many more MCDM techniques available, okay. PROMETHEE, ELECTRE, TOPSIS we have done then DEMATEL. There are many, many MCDM techniques available. All are very easy to understand, very easy to operate, apply, etc. And there are lots of resources available, you can easily go through them. If you understand these three, four methods then knowing and understanding the other methods also become very easy.

So you go through each one of them and then have a grasp on what is MCDM techniques. See in supply chain, linear programming, integer programming, okay some cases non-linear optimization and these MCDM techniques. Say if you know all of them then your modelling becomes very, very easy. So this is something and next class onwards we will move ahead

and we will do forecasting techniques okay. With this, we will end today’s lecture. Thank you. Thank you very much.