Modelling and Analytics for Supply Chain Management
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Week 5 Lecture 23
Strategic Performance Improvement

Hello and welcome to modelling and analytics for supply chain management. We are into week 5 of strategic performance improvement. This week we discuss about how to measure performance and how to improve upon performance in supply chain. Now, all along, that means up to week 4, you have learned about supply chain drivers, introduction to supply chain modelling, supplier selection models, transportation models.

Now see we have mentioned earlier that supply chain is basically a cost centre. Supply Chain as such, your chain does not give you any income, any revenue. So it is not a revenue centre. Any centre or rather let me put it, for those of you who are not from a management background or a management discipline, this word revenue centre, profit centre, let us spent one minute on this.

See any activity is called as a centre. Any activity is called as a centre. So supply chain activity, activity of supply chain is also some sort of a centre. Manufacturing plant is a centre. So any activity is a centre. Now, does manufacturing give you income, give you revenue? Yes. Because you can manufacture, then you sell and then you earn revenue. So manufacturing activity is a revenue centre, it gives you revenue.

Now marketing activity. Is marketing a revenue centre or a cost centre or a profit centre? The marketing activity is a mixture of a revenue centre and a profit centre. Because your manufacturing department has manufactured the product, the production department has manufactured the product. The production department is responsible for the generating the revenue.

So production department is also some sort of a revenue centre. It helps to earn revenue. Similarly, your marketing department is entrusted with selling the product. Now selling the product means selling price minus cost price is equal to profit. So marketing department is a profit centre, because it is entrusted with selling the product. Selling price minus cost price is equal to profit. So marketing department is a profit centre.

Your manufacturing department, some people say it is a cost centre because it incurs costs, but some people say this cost is necessary to earn revenue, so it is a revenue centre. But what

is supply chain? Supply chain is purely a cost centre. It, supply chain by itself does not earn any revenue, it does not generate any revenue, it spends. It spends money on transportation, it spends money on warehousing, it spends money on risks, it spends money on returns. So supply chain is a cost centre.

Now, whenever you have a cost centre, here comes your strategic performance measurement. Wherever you have a cost centre there, there is lot of focus on reducing cost, lot of focus on reducing cost. You will see later on when we do coordination in supply chain, that supply chain coordination only speaks of how you can reduce cost and yet, raise the products on time at the correct place, correct price etcetera, etcetera.

So let us come back. Supply chain is a cost centre. Now when it is a cost centre there is tremendous focus on reducing cost and supply chain managers are always under tremendous pressure to reduce manpower, bring in machines, do the same quantity of work with lesser and lesser amount of resources. So supply chain performance measurement is a very very difficult task.

Difficult in the sense that performance measurement is not difficult, but it is a very very sensitive issue. For example, let us try to visualize this, your factory is in Himachal Pradesh. Now, from Himachal Pradesh, you are sending the products to Delhi, Mumbai, Kolkata and Madras, 4 metropolitan cities - Delhi, Mumbai, Kolkata and Madras. Now suddenly it might come up that this product is not doing that much well in Delhi and Chennai.

So the two extremes, that is Delhi, Mumbai, Kolkata Madras, the two extremes the product is not doing well. Mumbai and Kolkata, they are doing well. So naturally, the head office will tell that the supply chain of Mumbai and Kolkata is better than Delhi and Madras, but is it so? It may not be so. Maybe the nature of the product is such that in Delhi people do not use the product. Maybe the nature of the product is such that in Chennai people do not use that particular product or use less.

So it is not a problem of the supply chain. It is a problem with the or it is an issue with the basic nature of the product or basic marketing. But everywhere it is a trend that being supply chain being a core area of operations now, that performance of the supply chain is risked or is questioned. So you have to be very clear about how a performance of the supply chain is to be measured.

Why shall we take as supply chain managers, why shall we take the onus of less functioning or I would say the ill functioning or I would say the non performing departments? We cannot take the onus and we should not take the onus of the other department's losses. So we have to be very clear on what we are measured against, how head office or headquarters is measuring our performance. Are we really responsible for those assets? Now, if you see, if you look at the traditional this thing of Supply Chain how will you measure normal? Normally how will you measure the performance of anything? Anything, performance of anything how will you measure?

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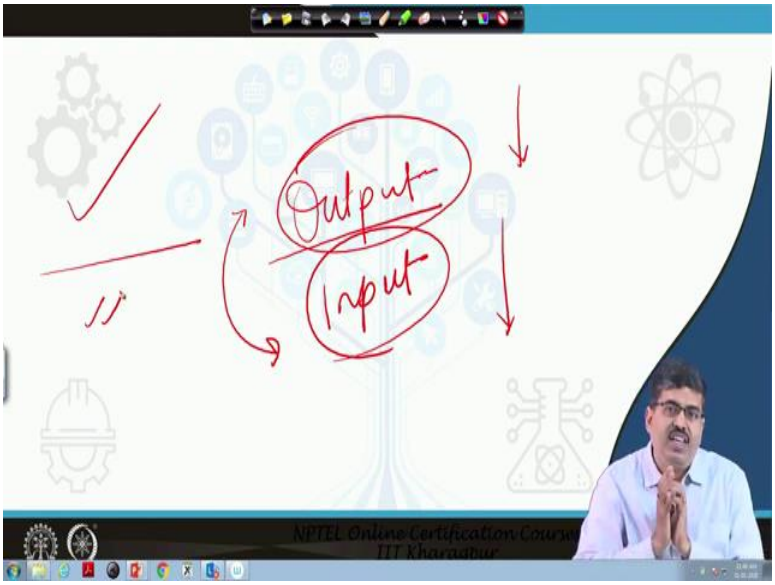

Performance of anything is measured by output divided by input, performance of anything is measured by output divided by input. Agreed? Performance of anything is measured by output divided by input. When output is less, we say that we have not put in enough inputs. For example, all of you are students and when you get little less marks, little poor marks, little less marks, so what is happened?

Your output has come down, your output has come down. Now, what will your parents say? You have not put in enough effort, you have not put in enough study hours. So what has happened? You have put in less inputs. That is what they will tell you. So output is always a function of input. This is the basic thing in every subject, in every discipline, .

In production system, let us take the manufacturing operations, more output means you have to put in more inputs. Agreed. So output input, that function you have to remember. So supply chain is no exception. Supply chain is no exception. In supply chain what will we do

to measure the performance? What is the output generated vis-a-vis, what are the inputs that are being given to generate that output? For example, let us take let us take another simple example to understand this, let us take a simple example to understand this.

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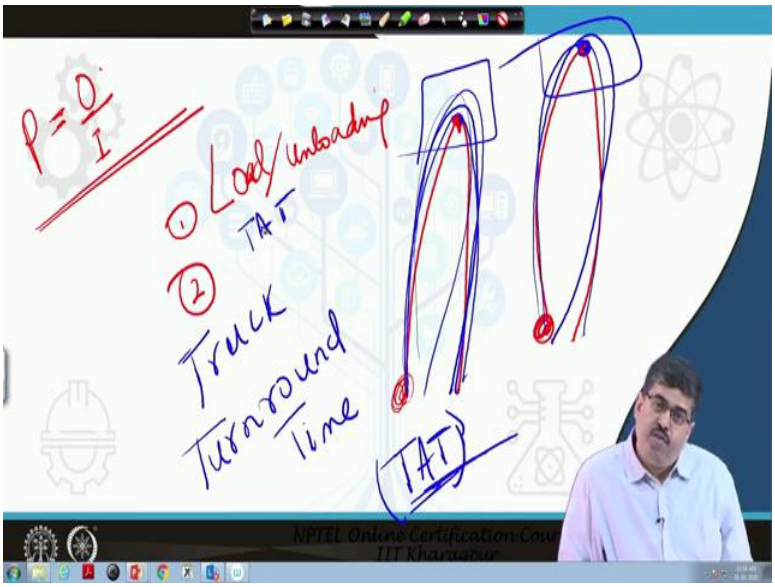

Say you are looking at performance. So what did we say? Performance is equal to output by input. Let us write this here at the top corner so that we do not forget. Performance is equal to output by input. Now say, you are measuring the performance of your warehouse which is essentially a tremendously a cost centre. That is why there is so much of concentration reducing the warehouse space, because it costs a lot of money.

Now, performance of warehouse. What is my formula? Output by input, that is performance. More output with lesser input means I am doing good. So what is the output of a warehouse? What is the output of a warehouse? If you see very, very carefully, output of a warehouse are many. Output of a warehouse are many. What is the basic function? Let us see what is the output of a warehouse.

Then you can understand this measuring of performance. What is the output of a warehouse? Output of a warehouse is how much of load it is loading and how much it is unloading. So how much of load or how much of materials it is loading, how much of materials it is loading and how much of material it is unloading. Output is how much it is loading; how much it is unloading. Output of a warehouse is also measured in terms of how much time a truck is waiting at the gates to unload or load the consignment.

That is, a truck enters your warehouse, it goes for loading, it loads the product and it comes out of the warehouse. Similarly, a truck enters the warehouse, goes for unloading, unloads and comes out. So basically this movement, this movement, is it is turning around right, this movement, it is turning around to the original gate. So that is why it is called as, it is called as turnaround time. It is called us turnaround time.

And since it is vehicle, so what do we call it as? Since it is vehicle we call it as truck turnaround time. So in short form we simply call it as TAT. If you go to any industry that deals with supply chain, you will not even hear truck turnaround time, you will not even hear TAT. What you will say? TAT has reduced, TAT has increased. So initially you feel you wonder what is TAT, TAT is nothing but truck turnaround time.

Now, as a manager what would you like? Will you like the TAT or the truck turnaround time to increase or reduce? As a manager what will you like? Will you like the truck turnaround time to reduce or increase? Increase or reduce? Reduce, increase, increase, reduce, What? See if you notice very carefully you want to reduce the truck turnaround time. You want to reduce the turnaround time. Why?

Because the more the truck spends time inside the warehouse, its productivity is reducing because it is not, see a truck, a performance or the revenue generation of the truck, revenue is not generated, let me rephrase it, revenue is not generated by a truck by standing. Revenue is generated by a truck by rolling. That means, I am repeating. Revenue is not generated by a truck by standing.

Revenue is generated by rolling. Rolling means the wheels are rolling. That means what? The truck is moving. If you do not move, if you do not carry goods, then it does not give you revenue. If you stand at one place it does not fetch you income. So truck turn around time basically you are moving. You are moving. If you see the diagram here, what are you doing? You are moving. Moving with the load, emptying it, coming out. Moving, empty, pick up the load, come out.

So basically what you want to do is this turn around has to be very, very quick. You always want to be on the road. You do not want to stand here for loading unloading. So what is your objective? So what is your another performance? Your another performance measured is what is my truck turnaround time. Your another performance measured is what is my truck turnaround time, TAT.

So if you see carefully, we now have give me a second to erase it performance measurement two output measures. We have said performance is equal to output by input. We have seen on top, top left hand corner, performance is equal to output by input. Now, this output by input we have just got two output measures. What are these output measures? Loading unloading time and the truck around time or the TAT.

Now, the next question is assume that these two are my output measures. What are my input measures? What are my input measures? My input measures are, what are my input measures? What do you need in a warehouse? In a warehouse you need labour. In a warehouse you need capital in the sense that you need a lot of these equipments. So in the warehouse you need labour, in the warehouse you need equipments right or capital.

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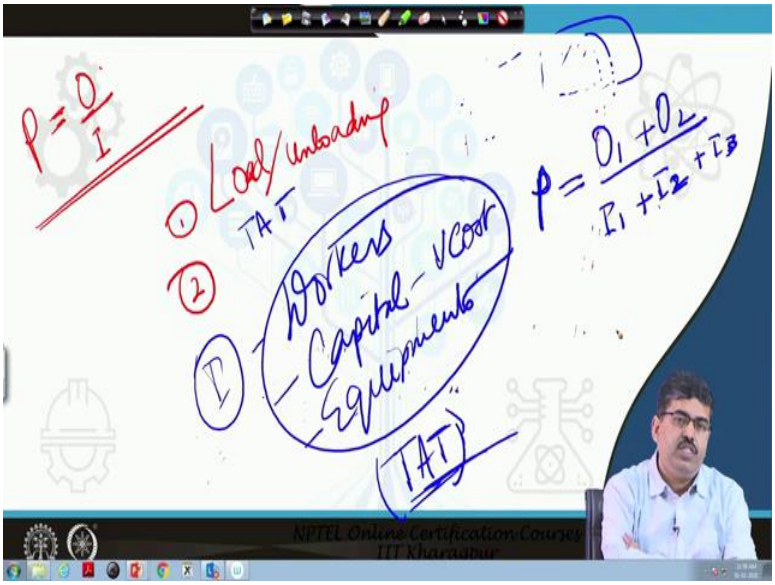

So these two are my output and then my inputs are you need workers, you need money, you need capital. You need workers, you need capital. And with that capital, this capital let us say it is the variable cost and you need equipments. So my inputs are workers capital, that is a variable cost. Let me put it variable costs, otherwise we will forget.

The workers capital variable costs and equipments. So when you are doing this, when you are actually measuring the performance of a warehouse, what are you doing? We are having two output variables, that is loading unloading time and the truck turnaround time. So my output, so my basically, so my formula becomes performance, so my performance is equal to output O1, that is loading unloading plus output O2 that is truck turnaround time divided by input 1, that is workers plus input 2, that is capital and plus input 3, that is equipments.

So input,1 input2, input. So if you see simply this is the performance measurement of a warehouse. Output 1, output 2 divided by inputs 1, 2 and 3. Now, you can give weightage to it. You can give, definitely give weightage to it. Output 1 can have a particular weightage, output 2 has weightage and of course input1, input2, input3 has weightage. So this is simply way by which all along we have calculated input and output measures in supply chain .

But what has happened over time is that this alone is not enough. This alone is not enough. There are different questions. What are the questions? The questions are I have this much of inputs and these much of outputs. Fine. But then and with that I get a particular efficiency for my warehouse. Try to understand, I have this much of inputs, this much of outputs.

So I will get one performance score. What is my performance score? Output by input. Say my output is 3, my input is 4. Now, output 3 input 4. So what is my performance ratio? 0.75. Agreed? Output 3 input 4, so performance is 0.75. What do I do with this number? So measuring performance is not a problem. There are so many other questions that are there with supply chain performance, that is what you need to understand.

So my performance score is 0.75. What do I do with this? Obviously, you will say that your performance score should be greater than 1. Why? Because output by input, if same outputs and same inputs then the score is 1, output divided by input, but ideally 1 also should not be, you should have more output given a quantity of input. You should have more output given a quantity of input. So your performance score should be greater than 1 stop with this much of input, you were generating this much of output.

So your performance score is greater than 1. What performance score did we calculate? 0.75. What is the ideal performance score your friends have told you? Greater than 1 because then bit less inputs you are getting this much of output. How do you move from 0.75 to greater than 1? Repeat, how do you move from your present score of 0.75 to 1? Has your mathematical model answered that question? No. The mathematical model has given you a score of 0.75 and your mathematical model or business prudence hints at the score should be greater than 1.

But has your mathematical model given you a way or indication as to how you should move from, how you can move, can, how you can move from 0.75 to 1? Answer is no, it is not given. So our job is, so when we are measuring performance of supply chain, when you are

measuring performance of supply chain, you should be very careful. Number 1, you should measure the performance of a supply chain given that supply chain is a cost centre.

Number 2, you should measure the performance of a supply chain being prepared that there will be multiple inputs and multiple outputs. It is not a single input single output. So number 1, it is a cost centre, so you should be very careful with the measures. Number 2, the common prudence says output should be greater than input but number 3 which is most important is, from the efficiency score, you should be able to tell what to do with this particular unit, whether to increase resources, whether to reduce resources to improve that performance level. That is where you need to do the modelling. Understood? That is the part where you need to do the supply chain modelling.

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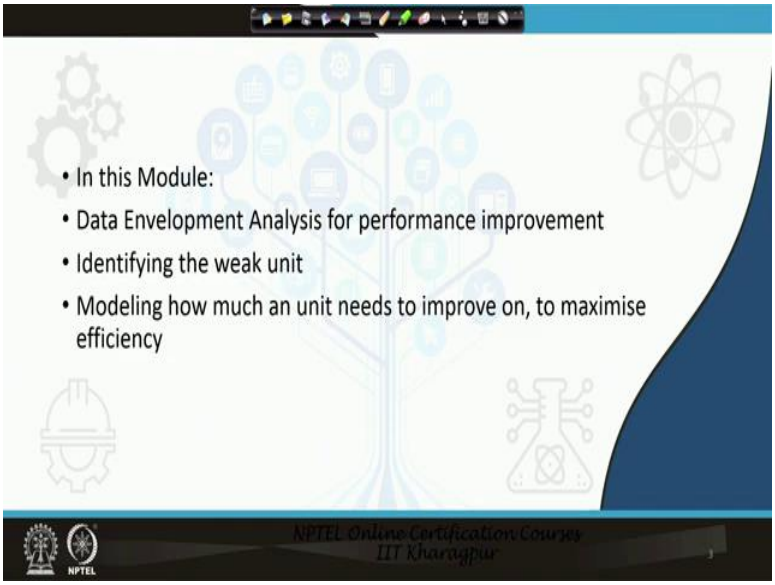

So what we plan is, in this particular module, we do data envelopment analysis for performance improvement. And as we are mentioning, we identify the weak unit and we model how much an unit needs to improve on to maximize the efficiency. This was the question that I was just telling that we need to know their lies, because the first two points can be done output by input, but the third point is we need to know how much and in this unit needs to improve on to be at par with the best performing unit.

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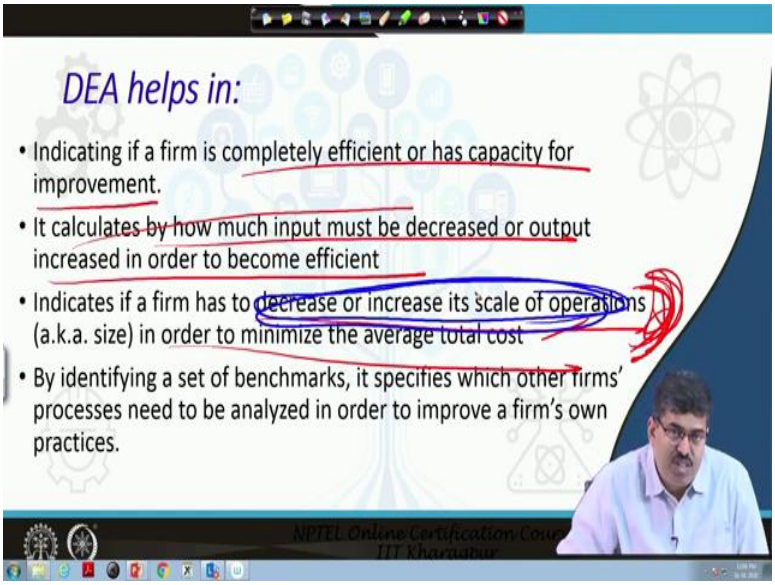

So here we introduce a concept called data envelopment analysis. Now, if you look at it, data envelope analysis was there, is there from a long long time, but the DEA as a concept, we have seldom used in supply chain. DEA has always been used in economics, but now, we have borrowed the concept from there and sometimes we are using linear programming, sometimes we are using some softwares to fit it to supply chain requirements.

So what is DEA? Date envelopment and analysis indicates if a firm is completely efficient or has capacity to improve. Very, very important point, that is the only purpose. It indicates if a firm is completely efficient or has capacity to improve. It calculates by how much input must be decreased or output must be increased in order to become efficient. So if a inefficient it tells you how you can be efficient, right, indicates if a firm has to decrease or increase its scale of operations in order to minimize the average total cost.

We will come to this point just now. By identifying a set of benchmarks it specifies which other firm's processes need to be analyzed in order to improve the firm's own processes. . That means, it also tells you which companies or which units to benchmark against. If you look at the third point, third bullet, which we said we will come back to later on. We will come back to later on.

It says, it indicates if a firm has to decrease or increase the scale of operations in order to minimize the average total cost, look at the word, decrease or increase ist scale of operations. What do you mean by that? This is basically what you see all around you today. Almost every store has come up with the franchisee model. They are giving franchises; they are

giving franchises. T junction, Cafe coffee day, Batas sell some time back, some sort of, some sort of, Bata is own shop but some sort of franchisee model. McDonald's franchisee.

What it basically means is without expanding you cannot survive without expanding the business. But whether that expanded business is okay, whether they are consuming more output and generating less input, etcetera.,, that can be found out from this. That is data and envelopment analysis.

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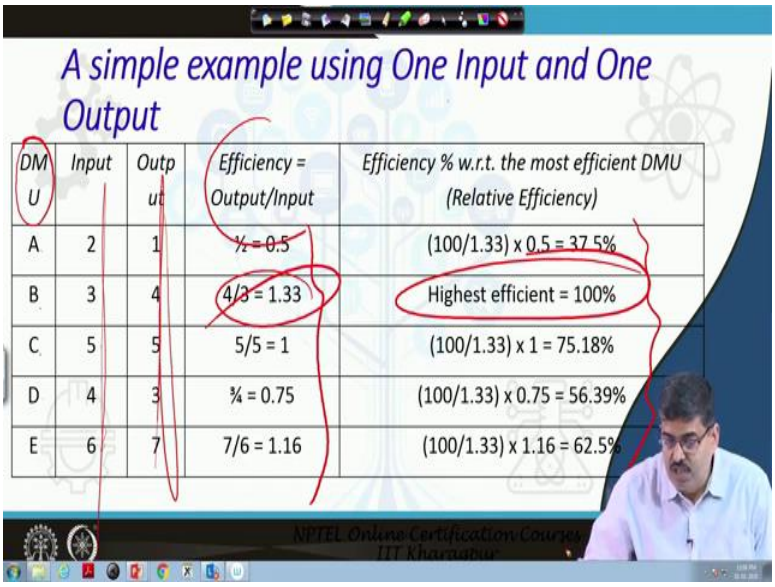

Now, this is a simple example using one input and one output. Let us try to understand this very carefully because this is where, this is from where our actual study starts. A simple example using one input and one output. This is DMU, ABCDE. DMU are decision making units. Means any unit which is responsible for its own decisions. ABCDE that means, assume for simplicity these are the 5 companies or 5 departments.

They have used different inputs, 23546, different inputs and they have given us different outputs. Different inputs, different outputs. So by simple, the thing that we wrote right at the beginning, by simple formula efficiency is what? Output by input. Output by input. So this is what we have done. Output by inputs. So very simply this is my efficiency. Who is the highest efficient? 1.33 and all others compared to it are lesser efficient. So best is B followed by C. Now, we will for the time being stop here and in the next lecture, we will pick up from this table itself. Thank you.