Course Name - Operations and Revenue Analytics

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Week - 01

Lecture - 02

Welcome friends! In our introductory session, we discussed what value operations analytics is bringing to the organization. We discussed that operations analytics will help in more than one way. It will help you in better decision-making. It will help you in improving productivity. It will also help you in improving customer satisfaction.

We discussed the case of QCD and flexibility as well. All these things are contributing to improving performance from the operations management point of view. We discussed how operations management is no longer a reactive or static function. It can be a source of strategic importance for your organization, and this is the second session in the introductory series of this particular course, where we are going to talk about various applications of operations analytics. Now, when I say applications of operations analytics, we will be talking about various areas in operations management where analytics will be used, and we will be discussing these areas in this particular course in much detail.

So, we will be talking about forecasting and inventory management. Forecasting is considered a basic area of operations management. Most of our activities in operations management start only with forecasted data. How much demand are you going to have in the future? How much demand will there be in the future?

And every other planning of manufacturing resources, all that manufacturing resource planning is actually based on this information about what the demand will be in the future. For example, again taking the clue from the current time, this is June 2024. The

course is being produced at IIT Roorkee. I hope all of you are very well aware that Roorkee is in Uttarakhand, and Uttarakhand is a very popular place for the Char Dham Yatra. Now, this Yatra starts in the month of April every year, and every year when the Yatra is about to start, the government of Uttarakhand does a forecast, and with this forecast, the resources like

hotel rooms, medical personnel, other transportation facilities, helicopters, and all other things, all the paraphernalia which is required for a smooth Yatra season. That is created on the basis of this forecast. Now, what is happening is that at the beginning of the period, the government did some kind of forecast, but then they realized that within the first 15 days, the forecast had overshot like anything. So, they have to continuously update their forecast for the next 15 days. Just to give you one example of the point I am trying to make, the government started with the idea that, okay, we will do online and offline registration of all the tourists who are coming for Char Dham.

But then they realized that the capacity of these shrines, Char Dham, which are holy shrines of Hindus, is not enough to take care of that large influx of devotees. So, they stopped registration for a particular period. They stopped registration until the 31st of May. They reopened the registration process on the 1st of June, but again they realized that within a few hours, all the slots available for devotees for these shrines got filled in just 3 to 4 hours.

So, this type of information was not available to the government in the beginning; otherwise, they could have created more infrastructure and resources so that a greater number of devotees could visit these shrines, and the economic development of the people surrounding those areas could also be equally achieved. Now, what is happening due to all these issues is that a large number of devotees are being harassed, and they are facing a lot of problems with infrastructure and so on. So, the first important area where analytics will be very useful is in the process of forecasting, and when you have an appropriate forecast, it will also help you in proper resource allocation. I just mentioned these resources. So, resource allocation with respect to money, material, manpower, space, and all the different types of resources needed in your activities—I am talking about a service organization. So, different types of resources are there.

If you are a manufacturing organization, different types of resources are there. So, accurate forecasting, more accurate forecasting, will help you to allocate your resources accordingly. Second is proper inventory management. Based on the pattern of your forecast—how many people are visiting on Monday? How many will visit on Tuesday? And maybe many more tourists will visit on weekends because of the holidays. So, accordingly, you can plan your inventory management as well.

So, you can say that real-time inventory management will take place when you use analytics in this particular case, and if you are a manufacturing organization, you also know how you need to do your production planning based on the forecast. Generally, when we are doing production planning—those who already know, those who know operations management—they are aware that production planning is done keeping internal objectives in mind rather than thinking about the customers' requirements. But if I can use analytics, I will be able to match that—okay, internal objectives are also important; I need to see efficiency, I need to see productivity, but I also need to see customer satisfaction. If I only see productivity and efficiency, maybe I will not be able to serve products for customers who require those products urgently or in an emergency. So, the proper matching of internal objectives and customer requirements is only possible with the proper use of analytics.

Then, some of the examples where forecasting is used, and particularly the use of analytics. For example, lead time. We all know what lead time is, right? Lead time is the time between order and delivery. When you place the order and when you receive the supply. Nowadays, as I said in the first session, QCD, where D means you should be able to deliver on your promised date, and you should be continuously reducing the time of delivery as well. Now, appropriately predicting the lead time, and here I can take two examples which are on the extreme side.

One example, you have, let's say, for some FMCG product, one FMCG product, and you are getting delivery in 10 to 15 minutes, that is one. And on the other side of this spectrum, you have a technology company which is developing a technology and delivering it to you. It may deliver a product, let's say, in 2 to 4 years. So, this spectrum

of lead time can be from 10 to 15 minutes to 3 to 4 years or even more. So, it is very relative.

Here, if your lead time changes by, let's say, 5 minutes, it may result in high customer dissatisfaction. While in this case, if the lead time changes by 1 or 2 months, it will not lead to that type of dissatisfaction. So, the point is that whether it is an FMCG or a tech company, lead time prediction is very important, and hence it may result in reducing the risk of delays, particularly in these cases. Order fulfillment and time prediction during this particular course. We may be doing one or two case studies, and in one of the case studies, we will be talking about this lead time prediction.

One of the very proud companies of India got some orders for the international market, and the appropriate prediction of lead time even for the supplier is also very important because the supplier has to give some kind of guarantee or commitment to the buyer. That is okay; I will be delivering to you in this much time, and that commitment or guarantee which the supplier is giving should be based on some kind of analytics. Order fulfillment time prediction: you have to predict order fulfillment times by considering factors like order complexity, which can be significantly high in the case of technology products. For example, I have to develop a new type of missile. Now, in that missile, there is a huge amount of technological complexity.

You may or may not have the production capacity. You may or may not have the kind of testing facility which is required, or the requisite manpower with the knowledge know-how. All those things are making this estimation a very complex process. So, with the help of analytics, whether it is regression analysis-based analytics or AI/ML-based analytics, it generally helps in your order fulfillment time predictions. Then another useful area is data-driven scheduling for improving your efficiency. So, you have limited manufacturing resources: Machine 1, Machine 2, Machine 3, Machine 4, etc.

Now, you need to see how you are using these machines in the most optimal manner. Different types of products may have different requirements for these machines and you need to plan your machine usage in such a manner that maximum efficiency is achieved, with no or limited queuing and no or limited starvation. All these points you need to

consider in your planning of the use of these facilities, and at the same time, you also need to see that in case any priority use comes, such as a new requirement from a very important customer. And you need to handle that requirement on a priority basis. Can you actually allow that priority-based entry or priority-based treatment for this particular customer, who is a very important customer for your organization? We have seen that at airports, whenever every operation is going in a normal manner, there is absolutely no problem.

But, the planning has been done so tightly to address efficiency-related issues that whenever any emergency case arises, they have almost no plan to handle those emergency cases—where to land that emergency flight, where to park that emergency flight, what type of resources to allocate for de-boarding that emergency flight, etcetera. So, data-driven operation management will tell you how much extra resources you should have for handling such kinds of priority issues. Otherwise, if you do not have any extra resources, and you have allocated all your resources, then it will be very difficult to handle the priority cases. And for handling the priority cases, if you have too many resources, it is actually going to cost your organization so much that you will be compromising on your efficiency, your cost will shoot up, and a lot of resources will always remain underutilized. So, we want resource allocation to be efficient, and we also want to handle priority cases, and these two are again contradictory kinds of activities, and here comes the role of data-driven activities for improving our performance with respect to both these aspects.

Then, another important use of analytics can be production planning. Production planning, which is a very typical operations management role. When I am talking about production planning, it is one important aspect of resource optimization. How many machines, laborers, and other resources are available to you? And you know your capacity; these are translating into the capacity, production capacity, and then you are utilizing your production capacity for distributing it into the various kinds of products you are going to make.

Now, what is happening? We are not making just one type of product. SKUs are increasing. All of you understand what SKU is? Stock keeping units are increasing day by day.

And when stock keeping units are increasing day by day, we face many challenges in our resource optimization. Because of two things: if you are offering more SKUs, then more SKUs should be available in the market. Now, when you want to have more SKUs in the market, you need to make frequent changes to your production plan. If you are continuously producing only one type of product, one type of SKU, it will give you a very high level of efficiency because there is no changeover of tools, no changeover of jigs and fixtures, and you will achieve very high economies of scale.

But that will limit your SKU availability in the market. So, you need to optimize by performing changeovers one after the other. So, I can use the same setup for producing more outcomes, but the order in which this production plan should take place is crucial. So, that optimization and resource allocation, or product availability in the market—different SKU availability in the market—can also be ensured. So, that is another application in the field of quality management.

You need to recall our QCD: quality is the first expectation from operations management. In layman's terms, more and more people understand operations management only from a quality perspective. Now, producing a good quality product is what we, as quality management professionals, expect. But within that good quality, there are many discussions: good quality from the customer's perspective, good quality from the provider's perspective, and when, as a customer, I perceive good quality, it means fitness for use—that the product is useful for my particular purpose. That is a good quality product. So, analytics help us monitor product quality in real time.

Like earlier, we used to make a lot of quality control charts in statistical process control, and this statistical process control data was generated after a particular process was completed. But now, with the help of analytics and display monitors, we are able to display quality performance in real time. So, if I am a worker or a supervisor working on the shop floor, I have a monitor there, and in real time, I know how many defective

pieces I am producing. Because everything is now integrated, with this kind of data, I am able to see that I may be the culprit taking my process out of the six sigma limit. And therefore, I immediately stop, look for corrective actions, and then try to improve my performance.

So, whether it is Kaizen or Six Sigma, all these things are possible with analytics in a more effective manner. The use of predictive analytics in quality management can anticipate issues before these issues actually happen. And with this, you are able to actually use some kind of preventive measures so that these issues do not happen. So, predictive analytics is quite useful in our proactive approach to minimize the occurrence of defects in our processes. And this example tells that GE, which is a very popular name, uses machine learning to analyze sensor data from jet engines to predict potential failures before these failures actually happen.

You may have heard the names of different types of maintenance approaches. And in these maintenance approaches, predictive maintenance is considered to be the best because it minimizes the cost of maintenance, as many of us believe maintenance is a cost center. So, this predictive maintenance actually minimizes the cost of maintenance and at the same time ensures that your downtime is minimized. So, it is a win-win kind of situation if you use predictive analytics or a predictive maintenance approach in your organization. Then, another very useful application of analytics, which is related to operation management, can be considered.

These days, operation management is facing a lot of, you can say, challenges from a sustainability point of view. When you are doing some kind of manufacturing, when you are transporting some product from one place to another, when you are storing a product in a warehouse, and you are using air conditioning and other temperature control systems in your warehousing, you are generating some kind of hazardous elements which are going into the environment. And therefore, there are continuously a lot of voices saying that we need to be making our operations more and more sustainable. And in that effort of achieving sustainability in the operations, how we can reduce the negative impact of various operations. For example, just to give you in transportation, because of burning of fuel, a lot of carbon emissions take place, and carbon is going into the environment.

Now, if I can see that can we replace all IC engine-based transportation equipment with battery-operated ones. We have one solution which will help us to some degree in achieving sustainability. So, similarly, there may be various other areas where the use of analytics may help us in achieving sustainability. For example, forecasting. Now, if you use data and algorithms related to, let us say, better forecasting, more accurate forecasting, it will help you in minimizing the wastage.

We will be talking about how forecasting can never be 100 percent accurate and because of that, there may be a lot of piling up of inventories. And if inventory is piled up, it may lead to a lot of wastage of your material, and if material is wasted because of poor forecast, that is anti-sustainability. So, therefore, accurate forecasting will help us in achieving sustainability because of minimizing the wastage. Efficient logistics, because of the burning of fuel in our logistics activities, a lot of emissions are happening, and now if I optimize our transportation system, if I optimize our logistics, which includes warehousing and transportation also, it is quite possible that I can minimize the emissions and I can improve the efficiency. Real-time monitoring will also help in minimizing the wastage, it will have minimizing the spoilage of, let us say, all fruits, vegetables, medicine kind of products.

So, the real-time monitoring you can say will also help us in reducing the wastage, and by reducing the wastage we will be contributing to sustainability. So, these are just a few sample examples of how analytics will also help in sustainability. In the absence of data, when there is no data available to you, it is difficult to have proper forecasting, efficient logistics, real-time monitoring, etc. And therefore, it is highly recommended that on one side, operational activity should help us in achieving sustainability, but for using those data-driven decision-making processes, analytics is also going to play an important part. Some future scopes where sustainability will also happen, where efficiency will also come, where productivity will also improve, like the use of robots, use of automated vehicles, real-time monitoring, all these are areas where work is already happening.

And I am very sure that in the next 3 to 4 years, because there are many startups also coming in these areas. And these startups may help us in actually using the principles of

analytics in the operational management decision-making. So, with this, we come to the end of this particular session. Thank you very much.