Supply Chain Analytics
Prof Dr Rajat Agrawal
Department of Management Studies
Indian Institute of Technology-Roorkee

Lecture-34
Predictive Modelling in Forecasting In Supply Chain

Welcome back, we were discussing the last station about the role of analytics in supply chain and we discussed that there are three types of different analytics, one is descriptive another is predictive and the next is prescriptive. So we discuss that in descriptive whatever has happened describing connecting the data, presenting the data in a summary for, so that you can get some useful insights about the previous events, the past events.

Then following the same trend you assume that something may happen in the future also, same thing will have to the future also and what will happen to predict about that that is the predictive modelling, since forecasting as we have discussed in our earlier session also is the basis of entire supply chain and therefore in todays session we will see that how active modelling can be used for the forecasting in the supply chain. The forecasting is very important role because there are different types of entities in the supply chain.

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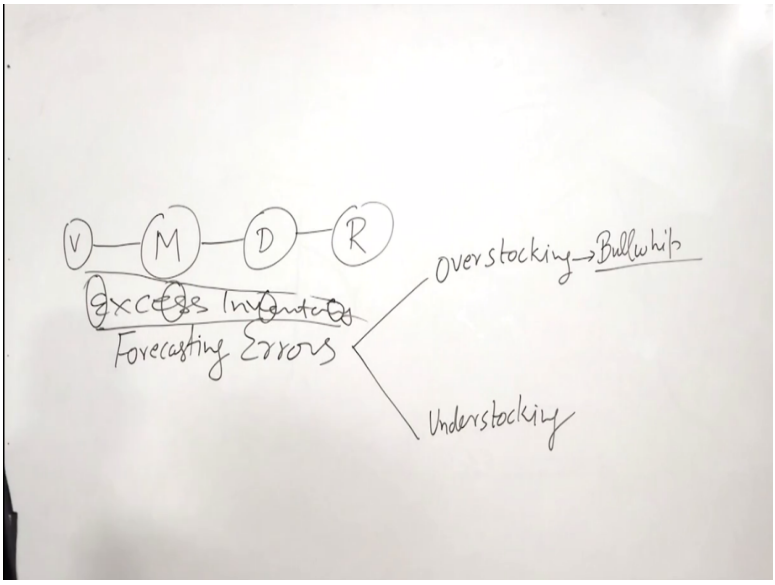

We have until then die manufacturers are there, then we have the wholesaler or distributors, then we have retailers, so in a general type of supply chain we have all these different partners, the vendors, the manufacturers, the distributors and retailers. Now earlier was

happening that all of them vendors, manufacturers, distributors and retailers, they were doing forecasting individually.

And as a result of that individual forecasting they all were having because it is a prediction and prediction maybe very close to the actual things and maybe because of your inability to predict properly there may be large amount of forecasting errors, so to some extend the forecasting errors are okay, but if these forecasting errors is start increasing, then problems start coming.

Because the forecasting errors can lead to 2 types of situations, the forecasting errors may lead to over stocking or under stocking, when you are having under stocking where you are very careful, you are very careful and it is the nature of a person that I want to play without much risk, I want to play a very safe and in that situation these are the chances that I where under stock.

And if I under stock my service level may go down, the customers coming to me I may not be able to fulfill their requirements many a times because I will be out of stock, that is the under stocking situation and when customers come to me and repeatedly I am not able to fulfill the requirements what will happen, they will not come to me in future and they may go to some computer, so that is a loss of business.

In case of overstocking when I was stocking more then the anticipated demand, so what will happen that I may end up with some extra inventory at my level may be at retailer, maybe at distributor, maybe at manufacturer, maybe a vendor. At all label there will be some extra inventory and time and again we have discussed that extra inventory may kill, may take away the entire profit of your supply chain.

So therefore that is also not desirable that you create unnecessary inventory in your supply chain, so both these errors, both these sides of the error whether you have access inventory or you have a situation of out of stock, both are undesirable, and both will ultimately result into loss of business, here customer may go to other supply chains, customers may go to other retailers, if repeatedly a customer to macro environment at my shop.

And I am not able to fulfill the requirement of the customer after two or three attempts customer will not come to me and that customer will go to some other competitor. So I need to see whether I am not under stocking too much, so we see that when we are under stocking the customer satisfaction level may go down and when we lose a good customer to out competitor, when we are overstocking then we are keeping more than the required inventory.

And in this situation another typical problem in a supply chain may emerge and that we all know is the bullwhip effect, this is another important problem and you will find large amount of literature is available to handle this Bullwhip effect, now because all these people they do not want to go for the situation of under stocking, so what they want to do they want to go for higher stocks.

Now everybody is going for over stocking and therefore as we move from the customer side this retailer side to this vendor side the amount of excess inventory increases and you can find this kind of increasing trend in stocking the inventory and therefore these are the excess inventory that we are keeping and this excess inventory is another problem in my supply chain, because inventory is a non value added think.

And this inventory will take away my profits, so I do not want this extra inventory also. So therefore we will look for predictive modelling where we will see that how we can improve our forecasting in real time and predictive modelling as we have already discussed that what will happen in the future to predict what accurately that what will happen in the future that is this the predictive modelling.

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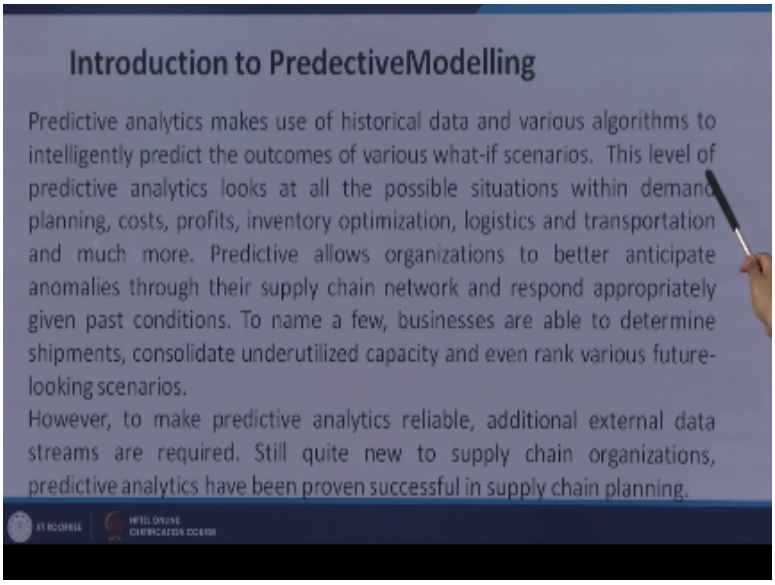

So predictive analysis used historical data and various algorithms also to intelligently predict the outcomes of various what if type of scenario, if this happens what will be the outcome**,** so if you remember you have B-Tech classes of first year, second year level we discussed this type of what if scenario in Computer Science subjects, so that type of what if scenarios we develop in different types of algorithms.

And the level of predictive analysis looks at all possible situations within the demand planning, cost, profit, inventory, optimisation, logistics and transportation and wherever you have the source of data. This predictive analysis allows organization to better anticipate anomalies through their supply chain network and respond appropriately to the given past conditions, so you understand the past condition on one side.

And at the same time you try to anticipate since it is all about future, so anticipation is there but anticipation avoiding all possible anomalies in the supply chain and to name a few days to give the example that businesses are able to determine shipment, consolidate, underutilized capacities and drank various future looking scenarios, so you can drink your different scenarios, whatever possibilities are there, you will write them that this is possibility 1, this is possibility 2, this is possible 3.

And with the help of that we will try to see that what does solution is possible, to make reliable additional external data may be required, you see more data about your historical events are available better the predictive modelling will be, so with this idea we will see that how predictive modelling can be used for making the supply chain planning more effective.

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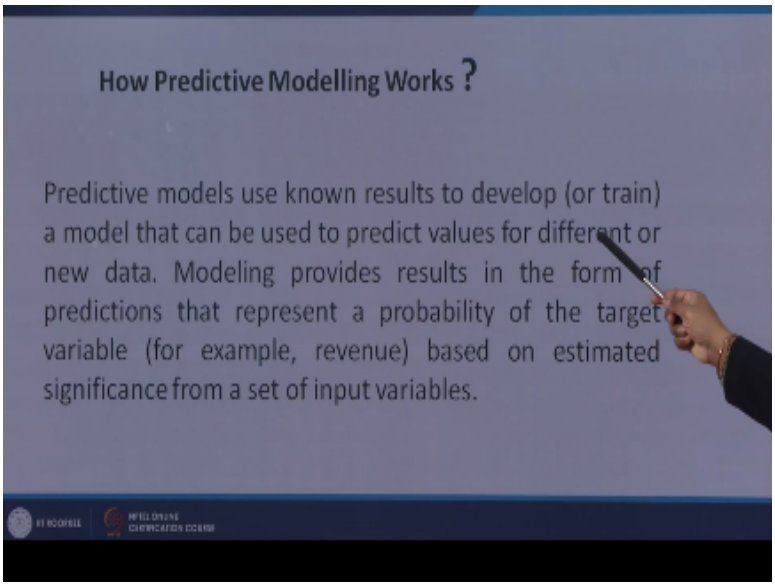

Now let us see how predictive modelling works?, now predictive modelling are known reasons to develop a model that can use to predict values for different or new data, modelling provides results in the form of predictions that is the forecast, that represent a probability of the target variable based on estimated significance from a set of input variables. Our ability to get reliable input is one important guarantee for developing the reliable forecast for the purpose of predictive modelling.

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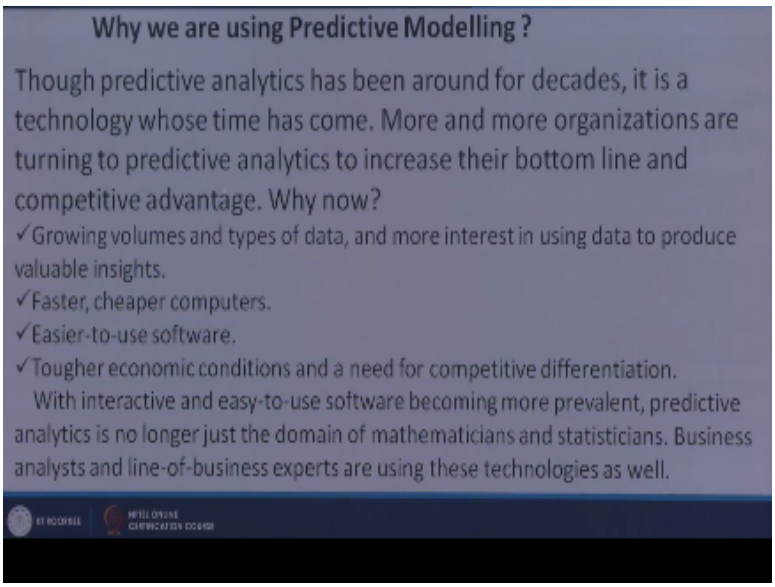

Then why we use predictive modelling in the supply chain, so this slide gives us that idea that why are we using predictive modelling, through predictive analytics we are able to get some results which we were doing earlier also, but because of development in the field of IT, in the field of computer science and our ability to get data from different point sources with the help of Internet.

All these things are major enablers for using predictive analytics more efficiently and effectively nowadays in the supply chain environment, so therefore more and more organisations are turning to predictive analytics to increase their bottom like and the competitive advantage. And some of the reasons which I just told that fastest supercomputers are available, easy to use software are available.

Then growing volumes and types of data, more interest in using data to produce valuable insights, all these things because it is the time of data, the whole business is above data and therefore we see nowadays lot of new business model are coming with the help of business analytics only and the role of business analytics therefore in supply chain also becomes very very important.

And obviously tougher economic conditions and a need for competitive differentiation, we are finding that competition is increasing day by day and therefore we need something which can differentiate us from my competitors and all these things are forcing me to use predictive modelling in my supply chain.

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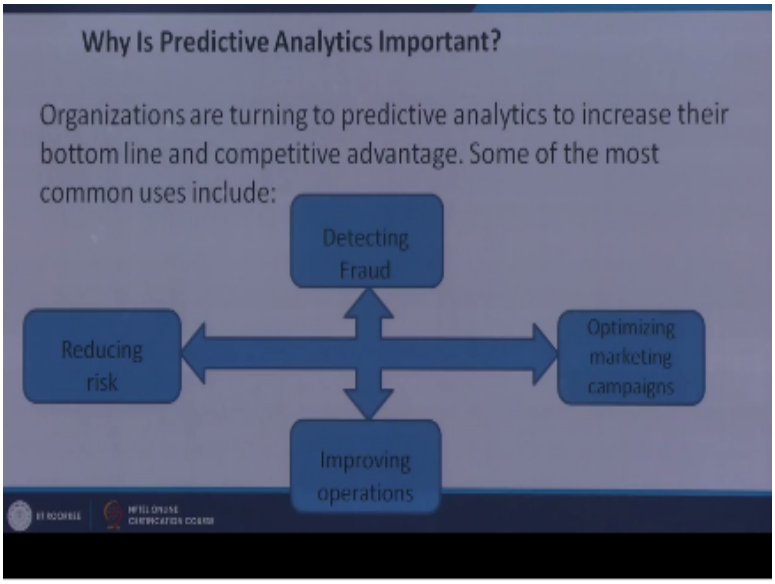

Now these are some of the areas where predictive modelling is used, now to detect fraud, to reduce risk, to improve the operations and to optimise my marketing campaigns. These are some of the areas where you can find the use of predictive modelling, detecting fraud and reducing risk. These are two important things in a global supply chain. In a global supply

chain you see that we have international supply chain and there are possibilities of risk related to exchange it.

There are possibilities of risk related to International Political situation also, then there are possible frauds also where you have a situation that you are getting products from a less reliable vendors and he may not supply you the right kind of quality which you have improved during the simple stage or you supply a productive a downstream supply chain to a less known customer and you have supplied and you are not receiving the payments.

So these are possible fraud and risk and predictive modelling can help us in detecting the fraud because where is the location of problem, that is one important things which predictive modelling can help us, it can help us in reducing the risk of exchange rate, it can help in reducing the risk of uncertainties, lot of uncertainties are there in the supply chain, so we have discuss them time and again.

So those type of risk can be reduced by using the predictive analytics, then obviously you have more accurate information about the future and these accurate information will help us in improving the operation and we can optimise according to demand, according to consolidation of our very often unused facilities you can optimise your marketing campaigns also.

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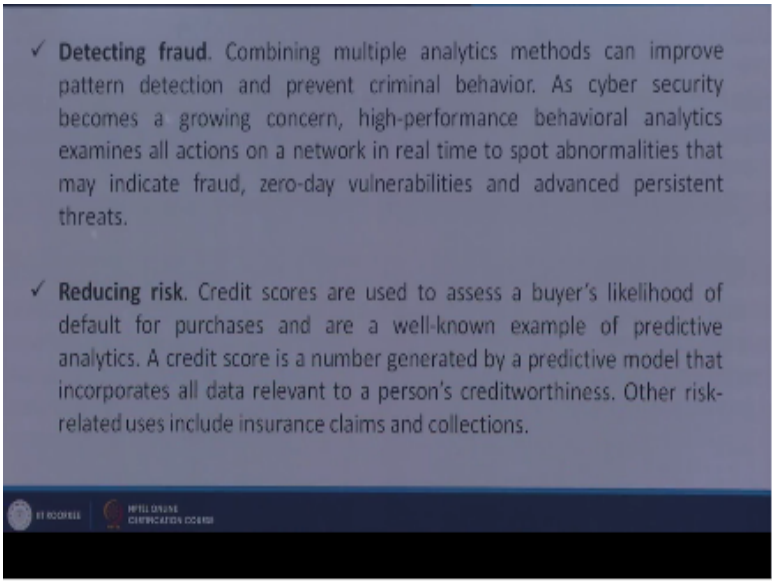

So detecting fraud as we just discuss these are combining multiple analytic method which can improve pattern of detection and prevent criminal behaviour, so in international supply chains

where you are dealing with those unknown customers and vendors you are possibly have a situation of fraud and with this predictive modelling you can detect with the help of multiple analytical methods that where is the possibility of fraud.

And risk that we are using things like credit scores for assessing the buyers likelihood of default for purchase and these are some of the very good possible you can set tool of predictive analytics where even for the individuals you have this credit scores and our ability to repay the loan is checked on the basis of the credit risk, credit score, so these are examples of the predictive analytics based on my historical information.

These credit score are given, and on the basis of that you knows that this customer, this applicant is a genuine applicant or what is the level of risk involved with the particular customer, so that is also a very popular many of us have experience the use of this type of tool in our life.

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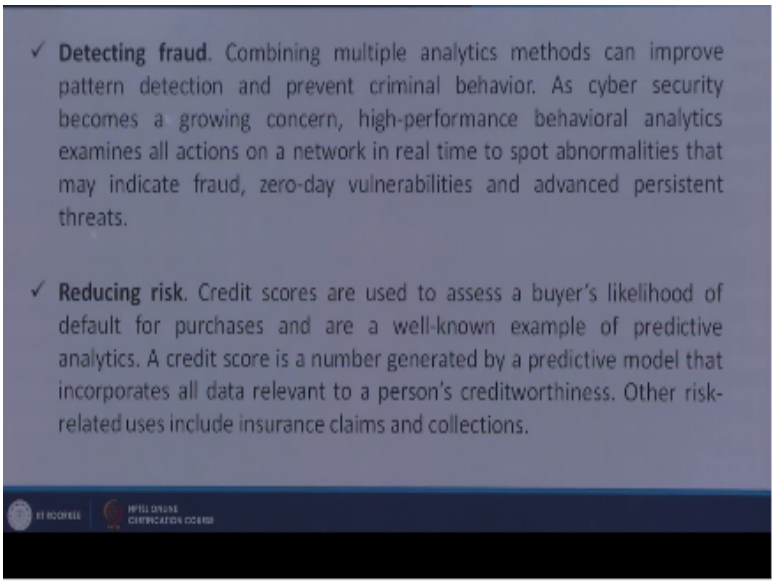

Then optimising marketing campaigns that is also a very interesting use of predictive analytics where predictive analytics are used to determine customer response or purchase as well as promote cross-sell opportunities, but a customer who is looking for camera, so you can have the cross an opportunity to sell the memory card to that person also, you can have the opportunity to sell the back of the camera also, so these type of things consolidate or optimise my marketing campaign. I need not to find I need not to start a new marketing campaign for selling the bags of the camera.

I can optimise my lot of marketing efforts with proper integration of my sale opportunity, so that is also very very important, that nowadays we know that if I am booking a hotel, I am in Roorkee and I am booking a hotel in Bangalore, so it means when I am booking a hotel in Bangalore I am going to Bangalore and then those companies which are offering the travel booking system.

They can optimise their marketing campaign if they are into this predictive analytics that if someone who is going to Bangalore from Delhi or from Roorkee, so he will also need to have some kind of trouble requirement, so they may start me start sending me the quotation, they will send me the offers available to travel from Delhi to Bangalore and maybe MakeMyTrip, yatra.com and all these types of travel agencies will be behind macro environment.

So that is the optimisation of marketing campaigns. Next is improving operations, many companies use to forecast inventory and manager resources. For examples Airlines use predictive analytics to set ticket prices, hotels try to predict the number of guest for any given night to maximize occupancy and increase revenue, you know that there is a seasonality in India about the travel during the festival period.

During the period of summer and winter break for your children and with the help of predictive modelling Airlines predict analytics to set ticket price during those festival offers, so that they can maximize their revenue, similarly hotels they know that one Christmas and New Year eve or in a routine way maybe on the weekends they may have more number of guest in the hotel and how to attract and if it is leave period when you know that not many guests are going to come.

So accordingly you can reduce the prices to increase the occupancy and increase revenue, so you will have improved operations on the basis of this predictive analytics where you can find better utilisation of the resources of the organisation for getting higher level of revenue.

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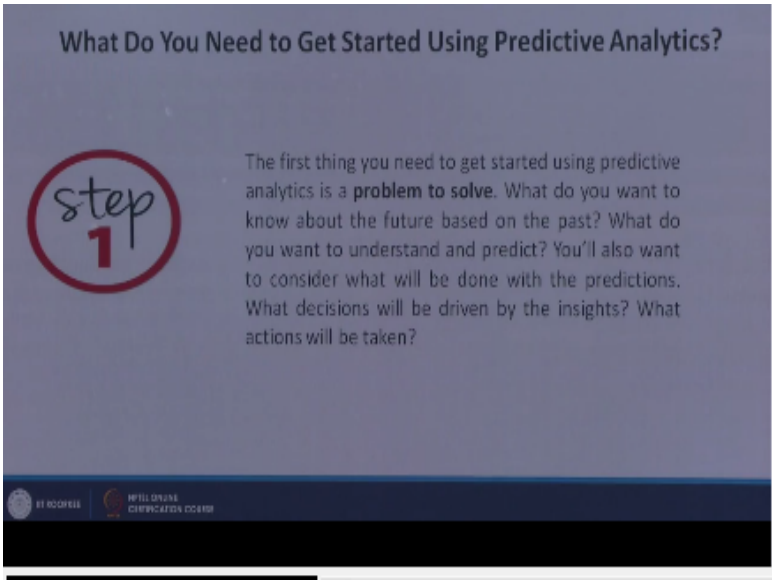

Now what do you need to get started the predictive analytics in your organisation, the first thing you need to get starting using predictive analytics is a problem to solve. It is very simple, but it is simple to say when we are using predictive analytics it is important that I should be able to write the problem, I should be able to write the problem, the meaning of writing the problem is that when I am writing a problem on the board.

When I am writing a problem on my diary, on computer I get more perspectives, I get more insights about the problem. So clarity about the problem is the first important thing to start the predictive analytics, without clarity it is difficult to start the predictive analytics for your supply chain purpose, so what do you want to know about the future based on the past, what is the things for which you want to link passed for the future, that is one thing.

Like you talk of independence in 1947 India got independence, but at that point of time predictive analytics will talk of what will be the future of India, but you cannot link that future of India with past events because past was ruled by the Britishers and the future was going to be entirely new set of circumstances which was I think at all was linked with the past and therefore you should know that what do you want to know about the future based on the past.

So at that time if I you want to know about the governance of the future based on the past that was a wrong problem to solve, but those is most of the things at stabilized with respect to our governance, so many things are possible that which we can determine on the basis of the past that what will be the future, what do you want to understand and predict you will also want to

consider what will be done with the predictions, if I know these things what managerial implications will be there, so all these things are some of the examples to clarify that what is the meaning of problem to solve.

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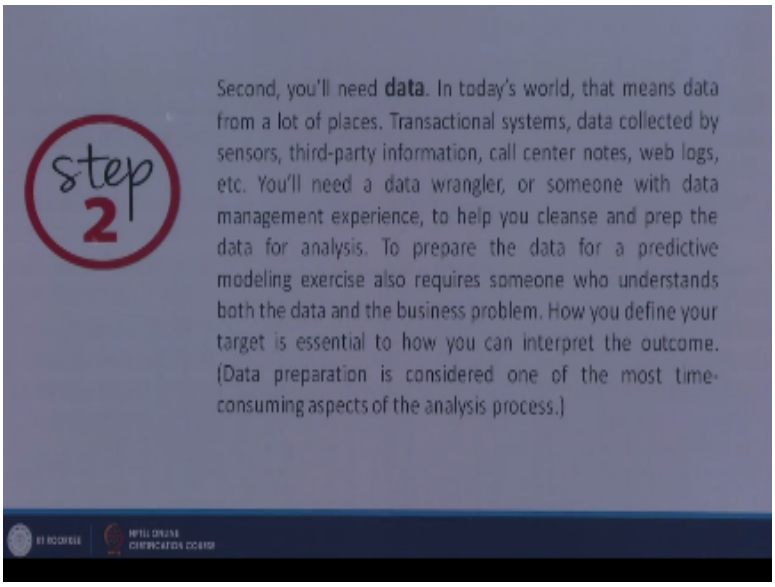

The next step is you will need data once you are clear about your problem the next step is data you need data for solving the problem, now data is to be found out from variety of sources, data means for a lot of places that maybe your point of sales also, that maybe the policy is of government also, that maybe the roofs of your competitors also, so there are large number of places from where you can get the data.

So like transactional systems data collected by censor, third party information, call centre notes, weblogs etc. All these are the different places, different sources from where data has to be captured and it is very very important in our predictive analytics that we should have a good idea that from where the data can come and we need to list out all possible sources of data. Earlier in our manual discussions we were only limited to this transactional systems.

The customers coming to my shop and I am giving a product that customer that is a kind of transaction we used to have, so that was the only source of data earlier, but nowadays because it is possible to collect data from variety of sources, so we need data from all these different sources, you will eat a data handler or someone with data management experience to help you clean and prepare for data for analysis purpose.

Now the data which comes maybe it will have a variety of information and all that information may not be required for the type of problem I am looking to solve, so you need to do cleaning of the data, the unwanted data you need to remove from your total set of data and that is the second important thing in this process of data and data preparation. After that was you have data also depending upon the type of data you have to build a predictive model that is the third important step in this process.

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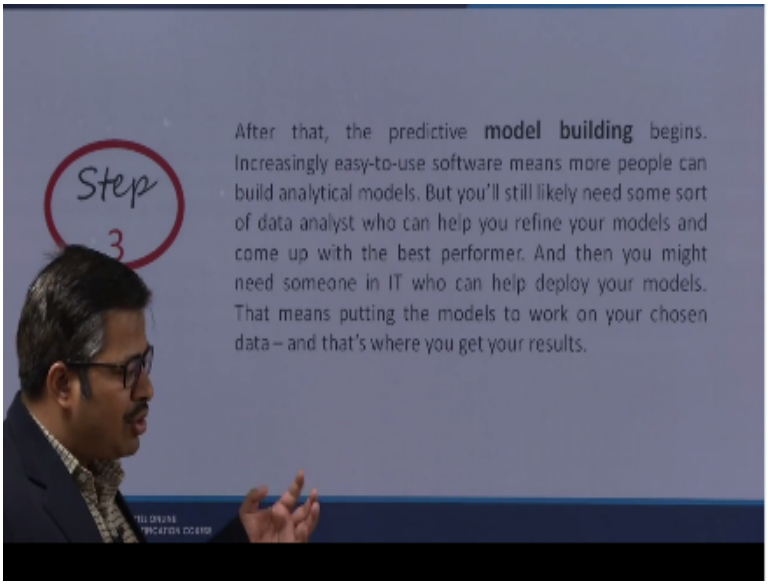

That model building is the important part and here comes the role of you can say the cross functional people also because this work collecting data they are the field persons mostly marketing people, those who understand the problem they may be marketing or operational people, but those who are developing the model from the IT and computer science and the mathematical background also.

So they are the different people those who developed the model and nowadays we are using easy to use software with people can use easily and you want some kind of readymade software for that purpose and though I am talking of readymade type of software but initially you still need someone who is expert in the field of data analyst and so that he or she can refine the model as per your this is what we call as customised the model as per your requirement and employ that model in the system of your organisation.

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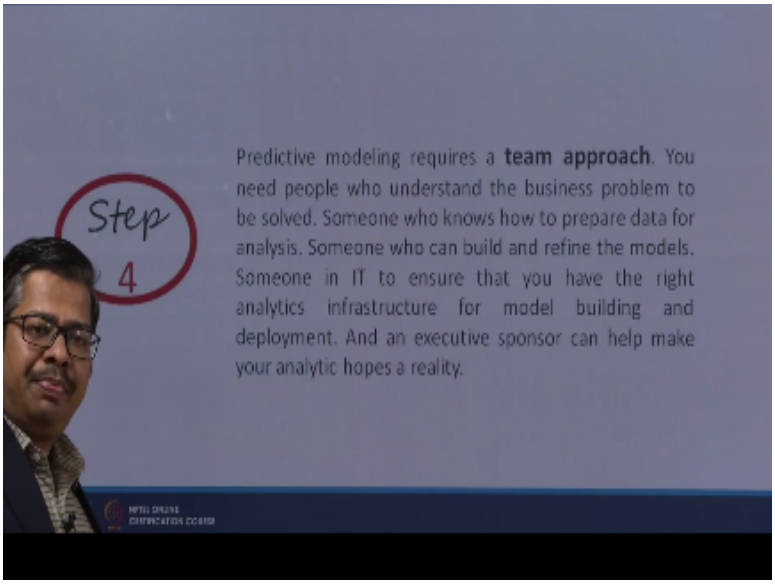

The another important thing with respect to predictive modeling is that is a team approach as I just mention that someone is there to understand the problem, then there are another group of people who are expert of understanding that for this problem what are the different set of data from where data has to be captured and then they also need to have some kind of exposure.

If I say that you go to villages and collect data about their preferences for a particular, now someone who has never gone to village, someone who has no connectivity with the villages will not be able to connect data from the villages, so we require people from the ground also in our team who can help us to facilitate the data connection from the villages, so same thing is here that it is a team approach and we require people from different background.

So that they can help us in doing the right kind of data analysis. There is a very interesting story which we discussed during operation research classes that there was a problem in 1 multi storey building, only one elevator was there and it was taking lot of time for all the uses of the elevator to wait and they were giving complaints to the owner of the building that please install few more elevator, so that our waiting time can reduce.

So he thought that it is a queen problem and as a result he invited one co all team operation research team to study that how many elevator should be there in that building, in quality also we follow this team approach and under the same approach one psychologist was also there in that team and he was also meeting with the people he was also collecting the data and

when it came about solving the problem that how many elevators can optimise the problem of reducing the waiting time for the users.

So he said that psychologist said that there is no need of any extra elevator, I have a very simple solution of the problem and solution was that please install large full side mirrors in the waiting area and when passengers users are waiting for elevators they will see their full body, they will see their full dressing and they will be busy in just making them self more smart and with that they will not feel that they are actually waiting.

And this simple solution solvent the entire problem and rather it increase the satisfaction level of the uses also, so the team approach is very very important that many a times you alone cannot solve the problem and a different person in your team will give all together a different perspective to the solution of the problem, so we need team approach, we need people from different background.

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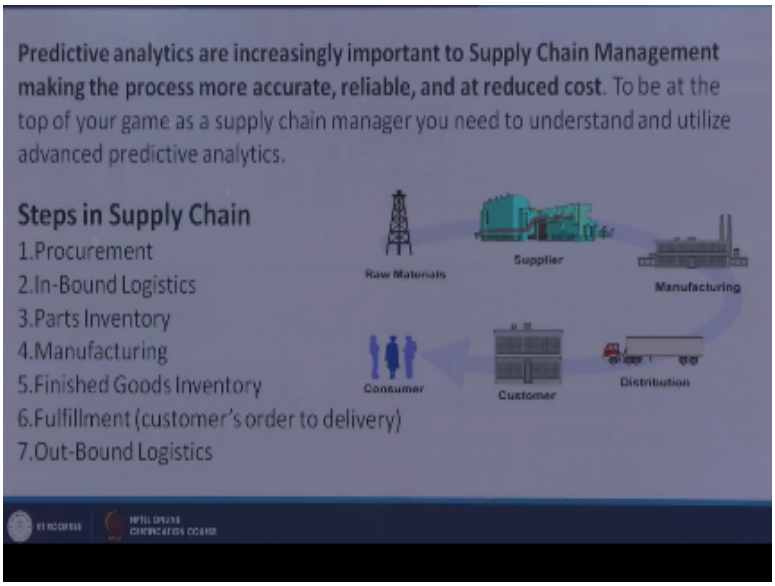

So with this you can see that how predictive analytics are increasingly important to supply chain management because it makes the process more accurate, reliable and it reduces the cost of your supply chain activities from raw material to suppliers to manufacturing to distribution to customers and finally it is coming to consumers and these are the various steps in the supply chain from the procurement inbound logistics, then you have manufacturing activity, then the finished goods inventory is going to the customers are the steps we have discussed many times.

So at all these steps your predictive analytics will help us to predict what is going to happen in the different stages of the supply chain.

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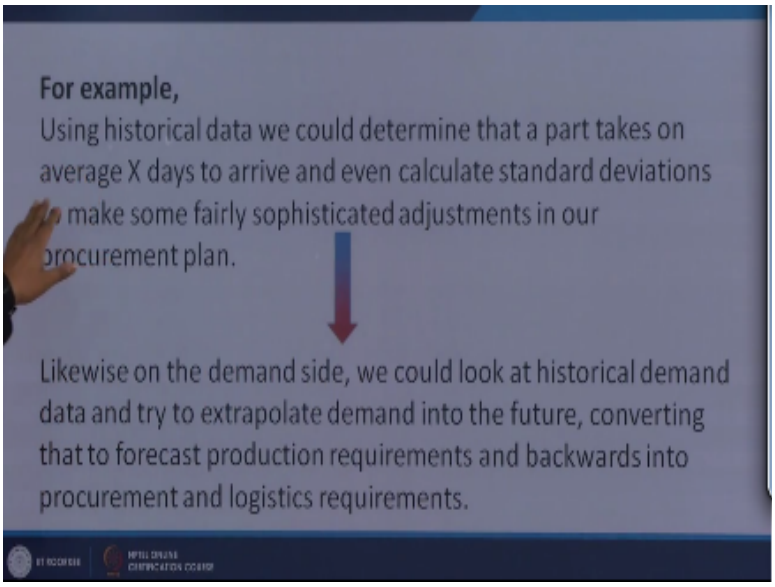

So just to give you the example that how things can change so using historical data of we could determine that a part takes on average X days to arrive at even calculate standard ration to make some fairly sophisticated adjustments in our procurement and similarly on the demand side we could look at historical demand data and try to extrapolate demand into the future converting that to forecast production requirements and backward into procurement and logistics requirement.

So these are some of the examples where predictive modelling can help us our resource, it can help us in better planning the activities and therefore we will be in a better situation to deliver as per the requirement and deliver at the low cost. So this is the use of predictive modelling in the supply chain activities and in the next class we will see that how some of the models can help us in reducing the uncertainties where we are talking of predictive modelling, so how some of the models can help us in reducing the uncertainties related to our future activities. Thank you very much.