Operations Management
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Lecture – 12
Forecasting System

[FL] Friends welcome to session 12 in our course on Operations Management. As you are well aware that we are currently into week 3 of our discussion on the various aspects of operations management, in week 1 we have covered the fundamental and basics of operations management, in week 2 we have covered the product design and development.

In product design and development, we have covered the product life cycle, we have covered the basic concepts of value engineering, we have covered design for x in which we have seen design for manufacturing and design for assembly, we have covered the ergonomic design of a product and finally, we have seen the basic aspects of rapid prototyping that how to convert our product idea into a prototype quickly.

We till now know that if we have to come up with the innovative creative product, we have to do the product design effectively and efficiently. Once we have that product idea with us we have done the prototyping, we have converted that product into a tangible, we can say a commercial product then what is required? Then, we have to go for full scale manufacturing. And then managing the logistic, we have to supply the products for the customers to use that product.

For that, we require an important decision that is how much we should produce? For example, suppose I start making breads; I start a bakery, I cannot just out of maybe out of my own whims and fancies I cannot start making bread that my own, you can say decision. I have to take a judicious decision that how many breads? How many cookies I need to make? I need to judge the market, I need to see the demand, I need to see who are going to be my customer? I need to understand that what is the pattern of sales of my competitors? How many other bakeries are available in the city or the town or the area?

So, it is not a very easy decision to make that; how much I should produce? What I should produce my product as I already told you are bakery items. And I have use the

various principles of product design and development to come to that product that this is going to be my product, this has got a unique selling point, this will certainly capture some amount of market.

Now, how much to be produced? How much to be manufactured? How much to be fabricated? How much to be processed? That is the most important question. And in that series we started our discussion for week 3 in which, we had first session on the fundamental aspects of forecasting. We have seen the need of forecasting, we have seen the if we do successful forecasting, we will get lot of benefits, we will get lot of profit, we will a lot of revenue, but on the contrary if we make a poor forecast or a wrong forecast; the company may suffer losses.

So, we have to be very very careful while making a forecast and we have also seen one famous saying that forecasting is a black art. So, some people treat forecasting as art, some people treat forecasting as science, some people treat it as a combination of art and science; why? Because this science we have scientific principles, we have scientific methods, we have mathematics, through which we try to develop a forecast; we have some data with use our mind, we do the calculations and come up with the forecast.

But suppose we do not have any data then our intuitive things will come into picture our cognitive domain will become active, we will look around and see, we will see the pulse of the market, we will see the pulse of the business cycles and try to make a decision, that this is the; we can say the forecast or a judicious number or can be said as a guesstimate that this is what can be done, it is guess plus estimate.

So, it is more of guessing less of estimation. So, we use the our mental faculties to make a decision, which is not based on any science, not based on any mathematician, not based on any numbers, not based on any information, not based on any data; it is our intuitive guess that the product may capture the market.

So, we always make a balanced guess that this can be the number. So, all that different types of methods that can be used for making a forecast, we are going to discuss in our subsequent sessions; very simple mathematical problems we will try to solve and try to understand that, what is the importance of forecasting? That is the most important thing. If we can understand the importance of forecasting very easily, we will be able to prove our organisation or take our organisation on the pose positive not or towards the success.

So, we will try to see in the last class we have seen if you remember in last session.

We have seen that if we are able to make a right forecast what are the other decisions down the chain that can be helpful to us? We can do the manpower planning, we can do the material planning, we can do the time planning or scheduling. So, once we know that how much we have to produce? We can do all the other back calculation successfully, so, overall organisation will get benefited.

So, the overall operations are better managed if we have the right forecast available with us. And today we will see very quickly. What is a forecasting system? The forecasting system is the overall domain of sales forecasting, that what are the issues and challenges? What are the inputs? What are the outputs? And how we should go about solving the problem of making an accurate forecast?

So, that is the overall objective of the learning outcome of today's session that what are the various elements, factors, parameters affecting the forecasting process? And this has been taken from a book on operation management, by Kostas and published by McGraw-Hill a very very good book, on operations management and we will try to understand the forecasting system as described in the book.

So, going on to the more structured part whatever was in my mind related to the background of forecasting or the summary of what we have covered in the previous class, I have tried to just bring my thoughts together and share it with all of you. Now we will have a the structured discussion on the forecasting system. Now what is a forecasting system?

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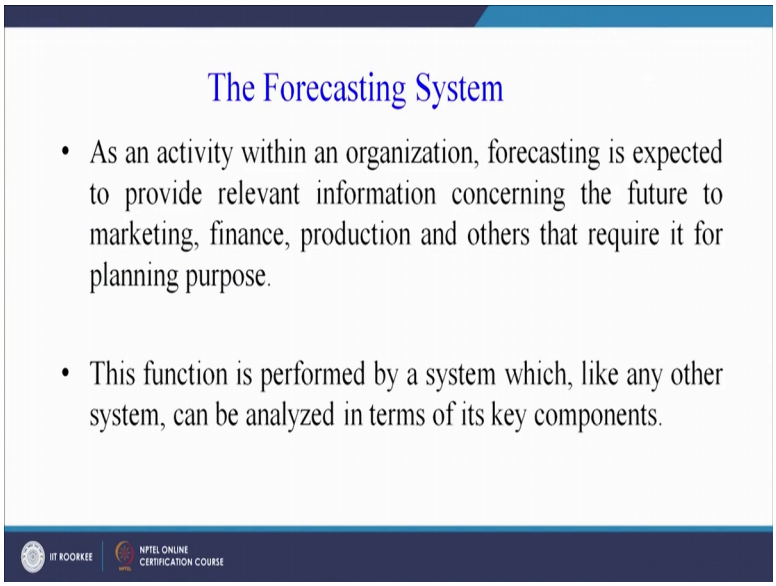

As an activity within an organisation, forecasting is expected to provide relevant information concerning the future. So, our forecasting activity is required to give us the relevant information regarding what? Regarding the future so, that our marketing, finance, production others can make use of this information for their planning purpose.

So, it is clearly written this point is very very valid, very very important from understanding of forecasting point of view, that why forecasting is all that important, because I have highlighted in the previous session also again I am highlighting, today that the information that we get after forecasting is very important and it is used by marketing people, it is used by finance people, it is used by the manufacturing or production people, in their overall planning activity. This function is performed by a system which like any other system can be analysed in terms of it key components.

So, we will see that the forecasting system that we are going to cover today has got number of components or elements, there are inputs, there are output, there are constraints, there is a performance criteria, there are decisions that the forecasting system need to make.

So, we are going to understand each and every element of the overall forecasting system. And based on that we will see that the main heart or the main cog or the main you can say activity in the overall forecasting system is to make a forecast. What are the various

methods, tools, techniques, that are used for making a forecast? That we are going to understand in our subsequent sessions.

Today we will be seeing the overall system and then we will be focusing on a specific set that is the methods, which can be qualitative in nature, which can be quantitative in nature. So, then we will focus on the exact methods that are used for making a forecast. So, overall the system will give us some output and those outputs will be used by the decision makers within an organisation for planning their activities.

Now, in forecasting system as I have already ended the previous slide by saying that it will give us some outputs which will be useful to us. So, here we can see the forecasting system output is an important element of the overall forecasting system. It is a information provided by a forecast.

How we will make a forecast that we will try to understand we will see that, we have qualitative methods of forecasting, we have quantitative methods of forecasting. So, these methods will help us to make a forecast and the forecast will give us some output, but this output will be based on certain input. So, input is also equally important. So, information is needed to prepare a forecast.

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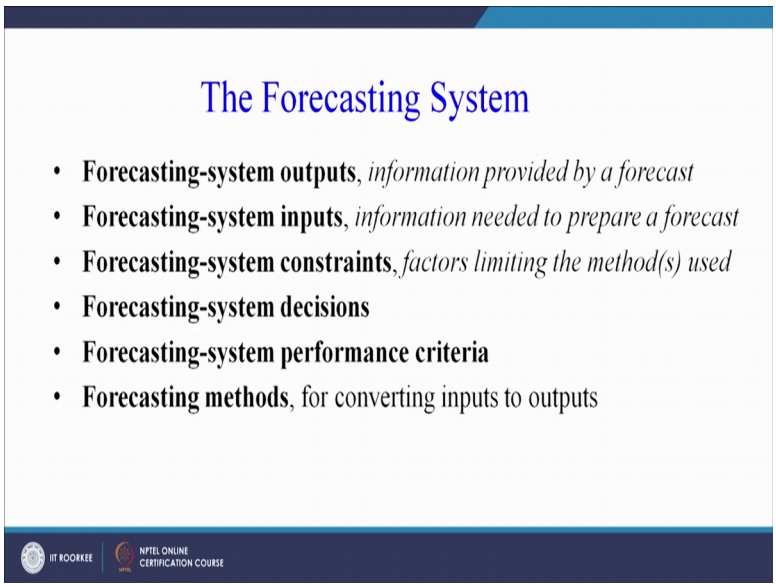

Now, what is that information we will see it can be historical data, it can be related to some technological changes or information. So, we will see what are the various types of information, that is used as a input in order to produce a forecast.

Then there are constraints what are the factors that limits the methods used. So, there may be a method which is very complicated to use, you do not have a skill to use that method how you make a forecast with that method. So, there will be certain constraints, there can be a method to make a forecast which will take a lot of time and you are short of time you do not want to spend lot of time for using that method because it is time consuming.

So, definitely there are constraints for various methods some methods may be very easy, but not very accurate. So, you will say no I want lot of accuracy. So, you have to take a decision there will be certain constraints. And then once these constraints are there you have to take your decisions. Which method to use? Why we should use that method? What type of data we should use?

So, these all are the decisions that any forecasting engineering or forecasting specialist has to take, then the system performance criteria is there. Now suppose you have 3 or 4 methods which can be used for making a forecast, you have to see that which one is the best method. What should be the performance criteria for selecting a particular method, suppose you make a forecast using 3 different methods? So, you can use 3 different methods, but then you can compare those 3 methods for specific set of issues or specific set of market segment.

Suppose you are making a forecast for automobile segment; one particular type of forecasting method may be appropriate. Suppose you are doing a forecasting for FMCG goods; another type of forecasting methods may be more suitable there. Suppose they are making a forecast for a item which as the seasonal variation. For example, the umbrellas, some other method may be time series forecasting method may be more applicable in case of items or products or commodities with seasonal variation where the demand varies over a period of time on seasonal basis.

So, we have to see that what is the system performance criteria that we have to compare the various methods based on these criteria, then forecasting method that is although this

point is mentioned in the end, but this is we can say the most important point of the overall elements.

Now why it is important because this is actually where we will give the input and it will generate a output. Now suppose let me give you just an example; that this is right this month is the month of July. Suppose I have the demand of the motorcycle suppose I take a motorcycle company x, for a company x the demand in the month of June that is known to me was 50 50 motorbikes in our town.

In may suppose it was 40 and in April it was 30. So, in April the demand is 30, in May the demand is 40, and in June the demand is 50. So, 30, 40, 50 April, May, June. This demand is actual demand that I have taken from the showroom. I want to make a forecast for the month of July or for the month of august, then I require the demand for July also.

Now suppose I want to make a forecast for the month of July simple average method can be one method one you can say technique for making a forecast 30, plus 40, plus 50 divided by 3. So, very easily you can get an average value of 40.

So, that is the simplest method of making a forecast that we called as a simple average method that is one method, but you can have a variety of methods depending upon the data that is available to you. Different types of data is available random variation there can be a trend in the data, there can be a cyclic variation in the data, there can be a seasonal variation in the data, sometime is a data may not be available. So, this we have seen in the last class, that how the data varies over a period of time and how judiciously we have to extract the data which is going to be useful for us. And there is the situation, where the intelligence, where the experience, where the information available with the forecaster will come into picture.

So, we will see try to understand within the shorts span of 2 and half hours that is available with us on forecasting. That how much you can cover related to the various forecasting methods. Regarding the outputs and inputs constraints decisions we will cover it today, but last point that is forecasting methods we will carry forward in our subsequent sessions also.

Today is the second session on forecasting and we will be having 3 more sessions on forecasting and we will see that what are the various methods that can be used for making a forecast?

Now, coming back to our topic today that is forecasting system on your screen you can see the forecasting system.

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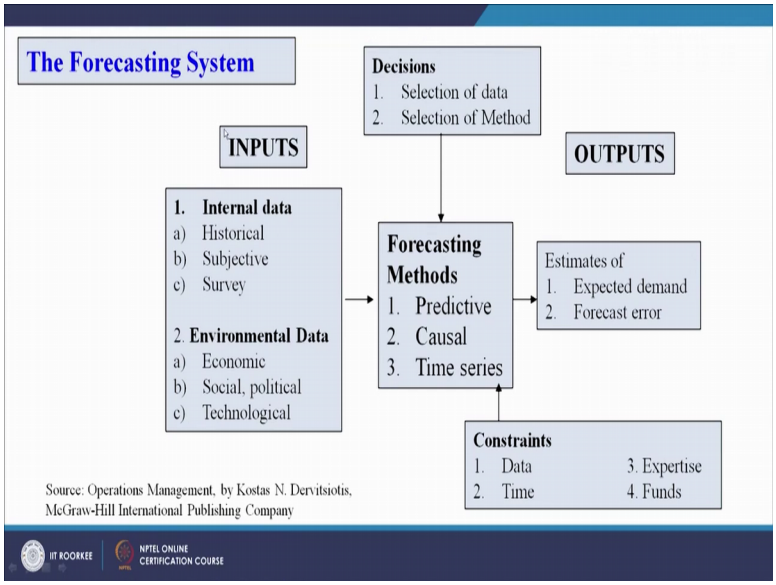

The force is also mentioned rare operation management by Kostas Dervitsiotis McGraw-Hill publication. So, this book has given a very beautiful very good very clear representation of the forecasting system. So, you can see here the inputs the inputs are the internal data that is available with the company, environmental data, which is external data we can we can also called it. So, you have certain inputs then there are forecasting methods, which can be classified as predictive causal and time series methods.

So, you give some input in the form of information, you use some method May be as you as I have explain today simple average methods; sum the 3 previous year previous months divided by 3 and forecast for July. So, you use a method that is a simple average method, there are other methods also like causal method time series method that we will see in our subsequent sessions.

And the finally, the output the output would be the estimates of the expected demand and the forecast error as we have seen in our previous session; it is always difficult to make an accurate forecast. And therefore, there is bound to be an error as an engineer our target will be to minimize this error we would always wish that our expected demand should match our actual sales.

So, whatever is the demand in our market we should forecast that demand accurately, but sometimes it is not possible, because of the be continuously changing business environment there are certain rules and regulations being passed or there competitive companies coming into the picture, pricing policies there are so many things happening at the same time. And therefore, whatever forecast we make sometimes is quite different from the actual demand in the market and therefore, we get a forecast error.

So, basically these are the 3 important things in any forecasting system you have certain inputs, you have the methods and finally, in the output you produce, your expected demand and you calculate the forecast error. There are 3 types of methods given here we will see how much time permits and how many of these we can cover in our subsequent sessions.

Now, we have to take certain decisions as in the previous class also or previous session towards the end, we have seen 4 or 5 distribution of data if you remember on x axis it was the time, on y axis it was the demand data.

So, we were seeing the scatter of the data points. So, we have to take a decision that how much data points are relevant to me. What is the spread of the data? What is the variation of the data? What is the trend of the data? Sometimes it may so happen that maybe 10 years down the line or 10 years may be from today is 2017 running we talk of 2007 10 years back.

That data whatever was the amount of sales of cars or maybe the motorbike may have become irrelevant today, because the economic conditions have change the per capita income might have change. So, depending upon what was there 10 years down the line we cannot make a forecast today by using that data, because things have change, but yes if you take the date of 2016, if you take the date of 2015, certainly that data is going to be helpful to us, that information is going to be helpful to us, but what was the sales or what were the sales in 1975 or 1980 for a particular product may not be that relevant.

So, we have to be very choosy we I must say or very judicious, are very intelligent, in extracting the data, that we want to use for making a forecast. So, first decision in forecasting system is the selection of the data. Then we have to see the selection of the method, because many of these methods that are listed here may require a previous year's data or maybe previous 3 years, 5 years, 7 years, 10 years' data.

Now, suppose today we do a invention and the product we want to launch in the market. There is no previous date available with us for that product. So, we have to choose a method, which do not require any previous data. So, the selection of the data and the selection of the method both are equally important.

So, we have to decide what data we are going to use if data is available, if data is not available we have to see which method is going to help us in making a forecast, even if the data is available we have to see that which method will give us the best results, how we can take or how we can select a method, we can select a method based on the forecast error, we will try to minimize the forecast errors.

So, if the method is giving us the minimum error the forecast being done by that method is giving us accurate demand, forecast we will say this method is good because a forecast error is less. So, that is basically we can say that decision. So, we have inputs, we have outputs, we have the methods, now for those methods we have to see what data, we have to use and which method, we have to use.

Finally, we see that there are constraints it is easier said than done, it is easy to say that you have input, you have output, you have you can select a method, you can select the data and do the forecast and forecast will be accurate no there are certain constraints. Now what are those constraints the constraints are the data, sometimes data that we get may not be very very consistent it may not be we can say accurate sometimes the data maybe fictitious data.

So, data is one constraint expertise available is another constraint many times in small scale industries you will see people just make the product, without having any much idea or any idea about what is going to be the demand in next year or so. So, sometimes they this stand to lose, because they have made something which is not going to be sold in the market, why because there is no demand of that product in the market or there are better

products available in the market. So, if you are not able to forecast properly you are certainly bound to lose.

So, the expertise sometimes is not available with the companies and therefore, they do not make use of a forecasting technique, then sometimes time is not available, time is a most important commodity these days the lead times of product development cycles have reduced. Suppose today I have an idea I wish that my product should be in the market within a weeks or 2 weeks' time.

So, I do not have a time to spend on how much will be the sales I feel that mine is the product, which no other company has made it is going to be a monopolistic type of environment for this product, yes then you can start making and start selling, but if the product has to compete with the other products that are already existing in the market then you definitely need to make a forecast that how much market share this product will be able to capture maybe in the next 3 months' time, then in the next 6 months' time, then in an years horizon.

So, that type of forecasting we need to make, but many times in the hurry to launch our product in the market we do not have time to spend on making a forecast. And many time the funds may also be a limitation, but seeing the type of benefits that we derive out of making a forecast funds must never or should never be a constraint, in case if you want to be successful in the market.

So, these are all the elements of a forecasting system that we have input we have output we have mades we have to make certain decisions under some constraints. So, forecasting methods as have been classified here predictive causal and time series. And from inputs point of view just, I am reading that you can have your internal data within the company, it can be historical data, sometimes it is subjective data maybe some reports that are available which will give a some information.

So, that is another type of data available then the company sometimes may go for service for which can be done, from the existing customers and that information can be helpful for making a forecast. Similarly the external data or an environmental data such as economic data what is the business cycle, whether it is economic boom or it is economic depression, then the social and political data, sometime the change in the government or change in the government policies, often decide the how the markets are going to

behave. Finally, the technological information there may be some technology which may challenge the product that you are selling in the that you are making for sales in the market. So, that technological information is also very important as an input for making a forecast.

So, you have a internal data, you have a external data, you can have your own companies data, previous years data, then social, political, economic conditions, technological, breakthroughs all these are the inputs that are used for making a forecast or given as a input to the forecasting methods for making a forecast. Now some of you may be wondering that how so many things can be incorporated into a method.

So, there can always be certain constants in the equations and these values of these constants can be manipulated or moderated based on the prevailing conditions may be, if it is economic boom time we can give a higher value to the constant or if it is depression we can give a slightly lower or a lower value to that particular constant and that constant can be one of the important parameters in the equation for making a forecast.

We will try to see whatever possible and whatever possible methods that we can discuss during the remaining session. So, this is the overall forecasting system one thing that is left here is the performance criteria so that we will try to cover in our subsequent slides. Now the forecasting system outputs let us quickly read this I have explained everything whatever is written in the slide. So, quickly I will read this from the production manager's point of view.

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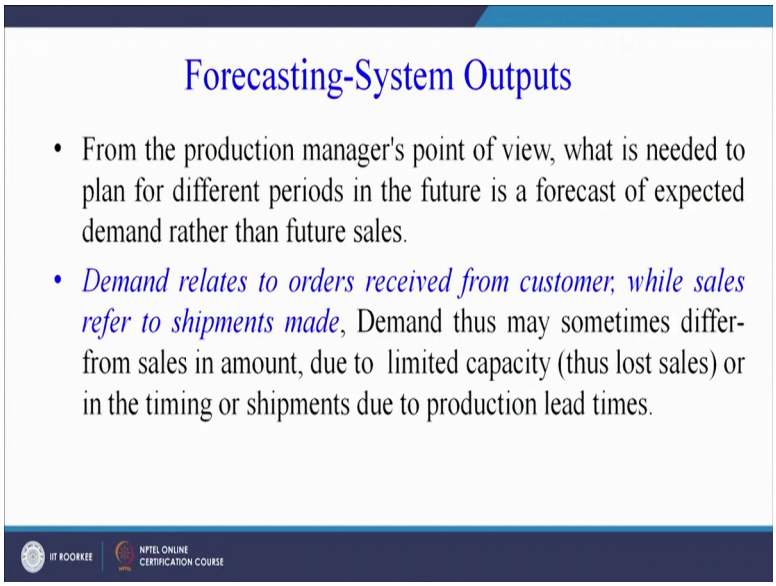

What is needed to plan for different periods in the future is a forecast of expected demand rather than the future sales. So, from production manager's point of view what is needed to plan for different periods in future is a forecast of expected demand. So, as I have already told you if the demand data is known to the production manager, he can plan all the activities accordingly, he can plan is procurement, he can plan is machines, he can plan is manpower, he can plan the schedule that he is going to follow.

So, all that is depending upon the demand data that is available from the forecast demand relates to orders received from the customer while sales refer to shipments made. So, demand and sales is different demand is the actual demand that is raised by the market and that is what we are trying to forecast, but sales are the actual sales that are being done whatever material or whatever products are being sent out from the company into the market and are being sold in the market that represents the sales. Sometimes the demands and sale data may not match.

Now, what are the inputs output as I have told you it is a demand data there will be forecast error also as an output, the demand data will be used for further decision making. Forecasting system inputs very quickly let us see the data needed to prepare a demand forecast can be obtained from internal and or external sources.

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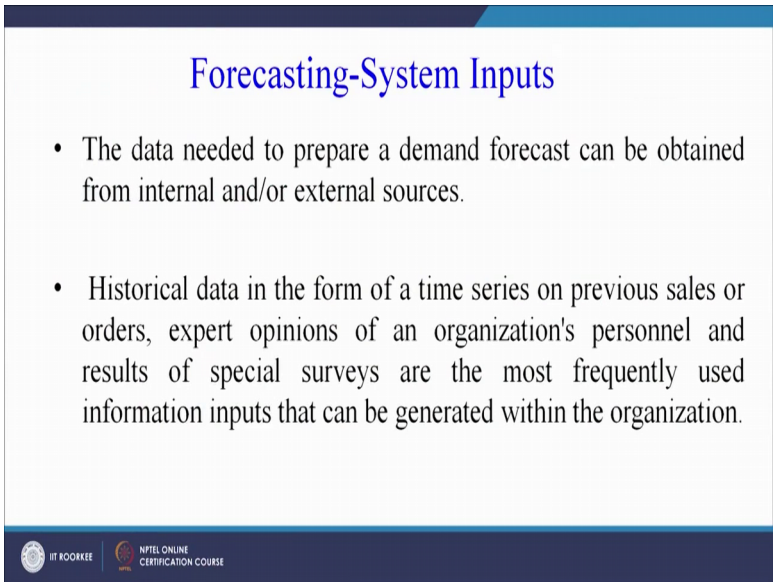

If you have been attentive in the session you know that what are the internal inputs internal inputs can be surveys or historical data, that is available external are the social political, economical and technological information that is available. So, based on the internal and external data that input is being given to the forecasting method and any method which has this input will definitely be used for making a forecast, output will be forecast, input is the internal and external sources or data available from internal and external sources.

Historical data in the form of time series on previous sales or orders expert opinions of an organisations personnel and results of special surveys are the most frequently use inform information inputs that can be generated within the organisation. So, that is basically the internal data which is available within the organisation, it acts as an input to the forecasting method for making an forecast.

Now, what are the constraints already all of you know I have a try to explain the constraints, that constraints most important constraints are the time available to prepare a forecast, the lack of relevant data from internal and external sources, the quality of available data the expertise within the organisation and the available computing facilities?

So, there can be limitations or constraints on pa on a count of all these points listed on the screen, which may not agar well for the accurate forecasting of demand.

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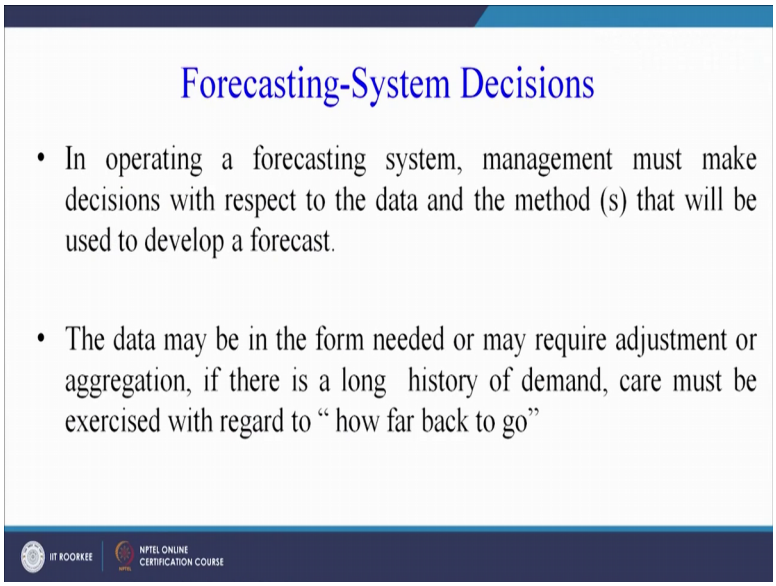

What are the decisions as all of us know, now if we have seen the diagram the decisions are choice of data and the method choice of method and choice of data. In operating forecasting system management must make decisions with respect to the data and the methods that will be used to develop a forecast. The data may be in the form needed or may require adjustment or aggregation, if there is a long history of demand care must be exercised with regard to how far back to go.

As I have taken an example 1980's and 90's data may not be relevant today. So, we have to take a decision that we are going to use previous 5 years data, previous 8 years data or the previous 2 years data only that is the decision that we have to take. And we have to decide which method we are going to make use of for making the forecast.

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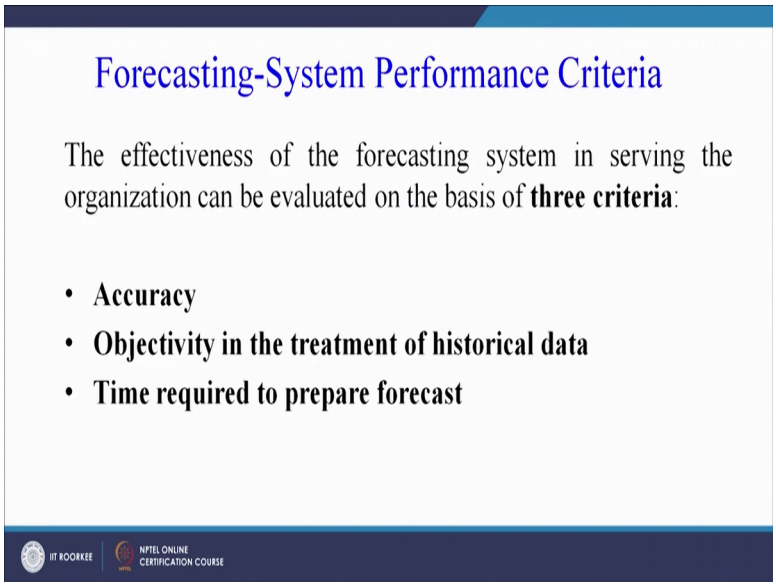

Now forecasting system performance criteria, which was not given alongside the diagram or the figure, the forecasting system performance criteria is the effectiveness of the forecasting system in serving the organisation can be evaluated on the basis of 3 criteria.

Overall forecasting system whether it is working fine or not we can check it check from it is accuracy, objectivity in the treatment of historical data, and time required to prepare the forecast.

So, our system is performing better, it is performing the best, if it is making a accurate forecast, time required to make a forecast is less and it is using objectively the data that is already available. So, we based on these criteria we can say that the overall system performance or forecasting system performance is good better or best.

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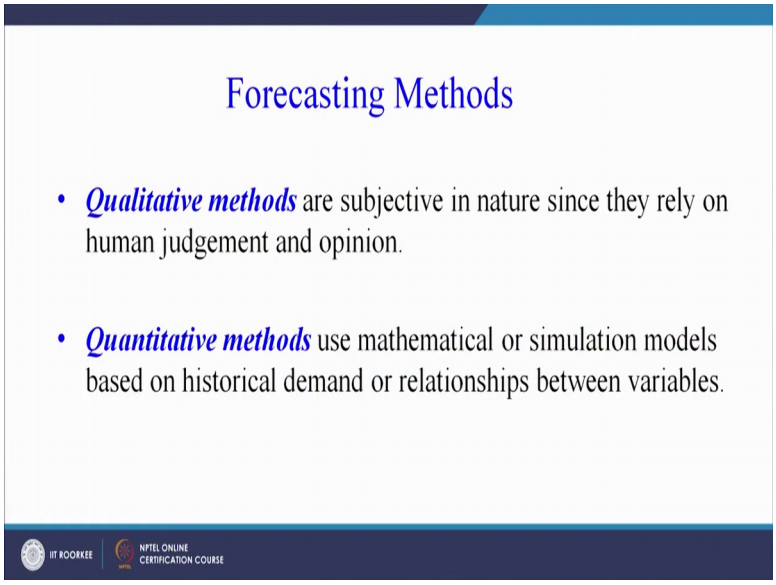

Now, two types of forecasting methods are used we know the overall picture of the forecasting system, we know that there are certain inputs, output will be the demand or the forecasted demand, there will be some methods that we will make use of as we have seen predictive causal and time series method there are certain decisions that have to be taken under certain constraints and there is a performance criteria.

Now we are focussing only on the central rectangle in which the forecasting methods are given, certainly all these methods will require some input and they will give some output in the term of forecast.

So, our focus now is on the actual methods of making the forecast and there are 2 different types of methods; the qualitative methods and the quantitative methods. Now qualitative methods are subjective in nature since they rely on human judgement and opinion and therefore, sometimes people called forecasting as arts, because it many times may depend on human judgement and opinion.

And these type of methods are really important where we do know have any previous data available with us or any historical data available with us. We have no other options, but to use the human judgement and opinion and make a forecast. And then on contrary if the data is available with us we will go for quantitative methods of forecasting. And quantitative methods used mathematical or simulation models based on historical demand or relationship between the variable.

So, in quantitative methods we may sometimes try to derive an equation based on the data may be based on regression we may have a equation and equation can be used for making a forecast.

So, with this we close today's session and in next session we will cover some of the methods may be qualitative or quantitative for making a forecast. We will learn at least 4 to 5 different methods for making forecast. And this forecast will help us in the overall better management of our operations.

Thank you.