Production and Operation Management
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Lecture 30
Aggregate Sales and Operations Planning-II (Demand & Supply Options)

Welcome friends. In our last few sessions we were discussing about different types of issues in inventory management and we discussed them in two broad categories dependent and independent inventory management, when we talk of independent inventory management there are large number of products our organizations are offering we took example of televisions and in televisions we discussed that a company can make different sizes of televisions. We talk of two-wheelers then there are different models of two-wheelers which are coming as at products.

So, already we have discussed in detail about dependent inventory management that there are thousands are comp1nts which are required in our end item but, with continuous pressure of marketing with degree of customization increasing day by day our number of n products also are increasing and therefore, the role of aggregate sales and operation management is very important where we do not consider individual product.

Rather we put together all the type of products which you are making, all different types of LED's which you are making as single product, all different models of two-wheelers which you are making as a single product, all different types of passenger cars you are making as a single product.

So, you are trying to know what is the aggregate demand of your product in a particular period and then based on that aggregate demand you try to resource, you can use your different type of available resources maybe in terms of machine hours, maybe in terms of raw material availability, maybe in terms of labour availability all these kind of resources you can then plan properly when you know what is the aggregate demand of your products in coming time this issue we discuss that is a part of our intermediate planning where we are planning for 3 to six months or maybe up to 9 months to 1 year.

So, that kind of planning when we are having this aggregate sales and operation planning is very much required. Now, we discuss in our previous session that what are the different types of issues which are important in dealing with our aggregate sales and operation planning and to match our demand and supply we can play sometime with demand and sometime with supply

and just took have a quick understanding what we were discussing in our previous session that when we want to use demand as a tool, demand as a driver for matching the demand and supply then we can have these are the different types of you can say activities which you can do under this demand option.

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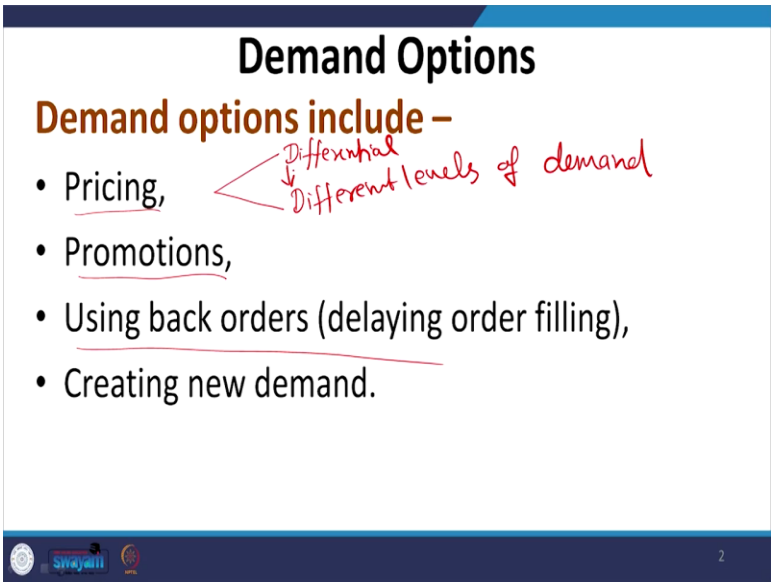

You can use pricing, now when we are using pricing we can create different types of price levels. So, you can have differential pricing and with the help of differential pricing you can create different levels of demand. So, differential pricing leads to different levels of demand and when you can fluctuate the demand by pricing for an example.

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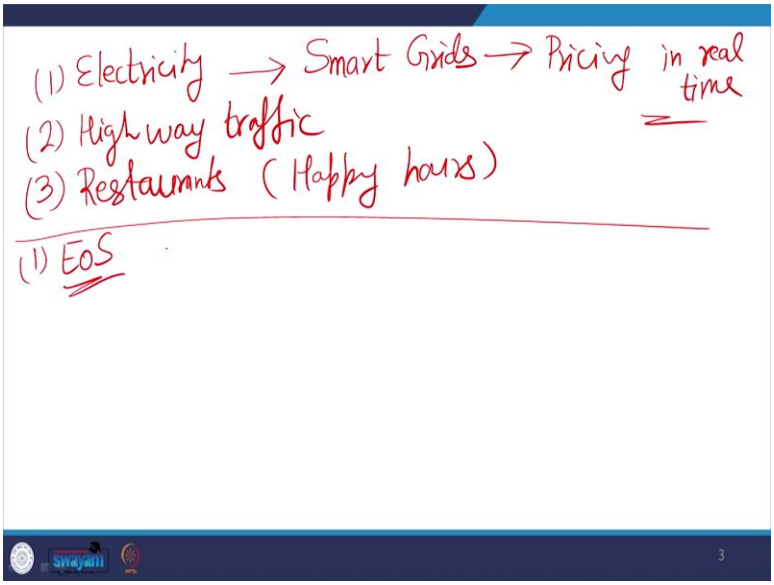

We have a very good case of electricity. Now, by using smart grids you can change the pricing in real time and therefore, a customer can choose the use of electricity, use of those appliances which are time independent and therefore, some of the use of electricity you can shift to non-peak hours.

So, that is how pricing can be used to shift the demand to some other time when you have a lean period. So, that is a very common thing which we do sometime pricing can also be used in case of highway traffic, sometime pricing can also be used in restaurants the concept of happy hours that is nothing but affecting the demand by the pricing concept. So, that the demand which is going to be there at around 8 pm, 9 pm you can shift some of that demand to lean period that is between 4 pm to 7 pm when rush in the restaurants is not much.

So, the capacity is empty you have enough supply but, demand is not there. So, you reduce the price for 4 to 7 pm and by that you try to fulfill the capacity you want use your available capacity by creating the extra demand. So, these are some of the examples which are very common many of you must have come across by using this different type of products. The second thing is promotion, by doing the promotional offers may be a very common example is sales promotion.

When you have the lean period, when the demand is not high we give some kind of discounts, we give some kind of exchange offers, we give some kind of coupons so, all these are the parts of sales promotion, the idea is to boost the demand when the lean period is there so, you have the

example of end of season sales, the best example is of promotions for increasing the demand of the product so, end of season sale, when discount are offered and by discount you feel that customers will purchase more things. So, that is a case of using promotion for enhancing the demand.

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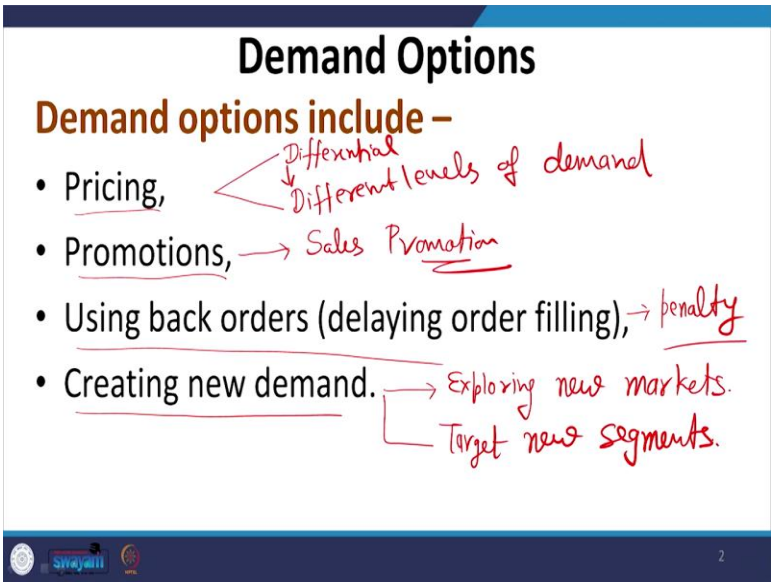

Then, third is using back orders delaying order filling. So, you are not able to fulfill the order right now so, you are using back orders but, please understand that back orders always come with some penalty, when you are supplying products in the form of back orders you are not fulfilling the customer's requirement of January 2020 and you are fulfilling that requirement in the month of February or in the month of March. So, customer will charge some penalty on you.

So, back orders is a way to fulfill the demand but it is not a desirable way to fulfill the demand because here you incur some loss, some penalty is charged on you. So, that is another way then creating new demand. Creating new demand means, exploring new markets. So, countries like India we are continuously looking for new markets maybe in African countries, maybe in South American countries. So, these are new markets because we feel many a times that our domestic market getting saturated so, how to target new markets for getting new demands.

So, creating new demand is also targeting new segments. So, these are the ways through which you use demand for helping you in matching the supply whenever, your supply is high you need to use demand tool so, that it can match the supply then, you can use supply also for meeting the

demand. So, many a times supply is very rigid, very rigid means, you cannot alter the supply because, of some constraints your supply change is not possible but, in many situations you can alter the supply also if, you want to increase when I am talking of agricultural products.

So, in short term you cannot alter the supply of agricultural products because, that is fixed in nature but, there are large number of industrial products, large number of products which are manufactured in organizations, large number of service products also where even in short term you can change, you can increase or decrease the available supply. So, supply option is possible only when there is a possibility of change of supply in short term.

In long term, even in case of agricultural we can increase the supply, we have seen in case of India also that when green revolution took place so, we doubled almost the food production of India. So, by using better techniques, better seat quality, better techniques of agricultural you can increase the food supply also in long term but in this particular case as I told you in the beginning our discussion is for the short term and intermediate term. So, whatever is possible within 1 year that is the subject matter of our discussion?

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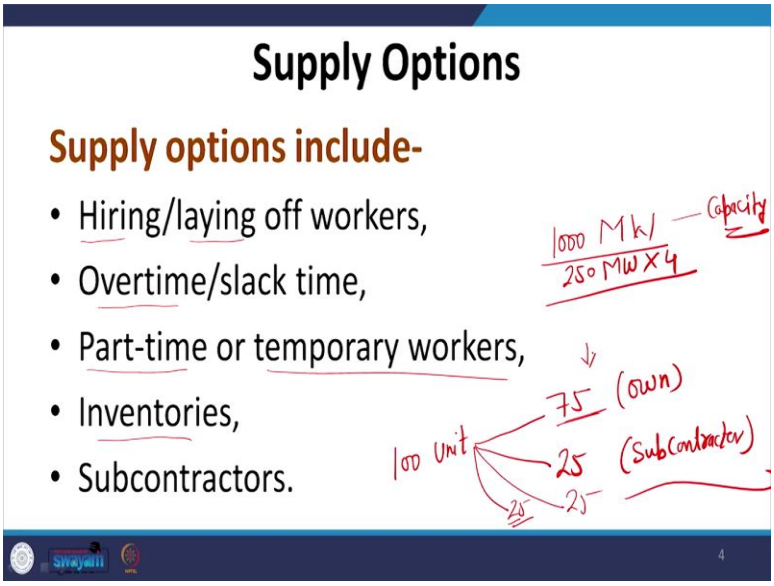

So, many situations are there where within 1 year you cannot alter your supply much but, in some cases particularly in manufacturing organizations by increasing or decreasing, hiring means keep more people, laying off means you decrease the number of people. So, if you have some kind of organization by altering the number of employees you can increase or decrease the

supply available with you then, you can also give over time when you have more demand. So, you can ask your employees to stay longer duration in the organization and obviously when they are staying for a longer duration you need to pay them some extra thing.

So, by over time also you can increase the supply of the products, slack time that even in their routine time if they are working for 8 hours a day, you are not assigning any task for two hours. So, they are practically working only for 6 hours so, when they are working less hours that is also the reducing of the supply. For an example, you maybe know that there are various power plants.

Let us, there is a power plant of thousands megawatt and this power plant has 4 turbines of 250 megawatts each now, when this is the capacity of the plant but, depending upon my requirement, depending upon the demand sometime I may run only 1 turbines, sometime I may run two turbines, sometime I may run 3 turbines so, that is the slack capacity available with me that I am not using my remaining capacity for power generation.

So, if demand is not there I may not use all my resources at the same time I may use only limited resources so that I can fulfill the demand. So, that is slack time or you can say slack capacity then another third way is part time or temporary workers, I have some regular workers with me and with them I can go with over time for increasing my capacity, increasing my supply but, sometime it is possible that due to some IR issues, Industrial Relation issues I may not be able to involve them for over times or even with over time also I may not be able to fulfill the demand.

So, in that case for some small duration I can hire some part time workers that are available only for small duration of period maybe for 1 month particularly, in those products which are affected by seasonality we hire part time workers, temporary workers so, that during the season when the demand is very high I am able to fulfill the extra demand with the help of these part time or temporary workers.

So, many a times in our household activities whenever there is a function maybe of the label of marriage so, if you have two maid in your house. So, during the marriage period for 1 week or 10 days you may hire some 4, five additional servants in your house. So, that is a kind of temporary hiring of the workers and that is very common in India. So, this type of example is to increase

the capacity on a temporary basis, then inventories, I know that in a particular month because, of seasonal factors there is going to be extra demand and for that I start preparing much beforehand.

So, that let us say normally in India Deepawali comes in the month of October and during Deepawali we all use lot of fire crackers but, the fire crackers are not made in the month of Deepawali the preparation of those products start in the month of May, June and up to September the inventories built up and then from September onwards those inventories are supplied across the country so, that when the festival comes these products are sold at different places.

So, inventories are also kept so, that all of a sudden whenever demand is going to search so, how to fulfill that extra demand all of a sudden. So, you need to plan like whenever school season is going to come in the month of April. So, school dresses, school uniforms. So, all those shopkeepers who are in the business of school uniforms.

So, they keep inventory, they start collecting inventory 3 months, 4 months in advance so, that when the season will come they should be able to fulfill the extra demand. So, inventories are also a very useful way but, you have to be very-very careful that you should stock inventory of those items which are going to have a sure short search in their demand otherwise, we have many times discuss that inventory may create problem, inventory may eat all your profits.

So, inventories are there but, handling of inventory carefully d1, then subcontractors that is also a very interesting way of increasing the supply, you see that you are not able to fulfill the complete demand and therefore, you may go to some other suppliers, you may go to some other contractor and you may further sublet your order to that subcontractor if, you have a demand of 100 units.

So, out of 100 units you may have two parts, 1 is of 75 another is of 25 so, 75 you are going to make in our own factory and 25 you may give to subcontractor. So, by using some contracting facilities because, your own capacity is only of 75 units but, you may use not only 1 subcontractor more than 1 subcontractor also so, you can fulfill additional 25 units also, additional 25 units also so, you may take order of more than your capacity but, by using subcontractors you can fulfill the additional demand.

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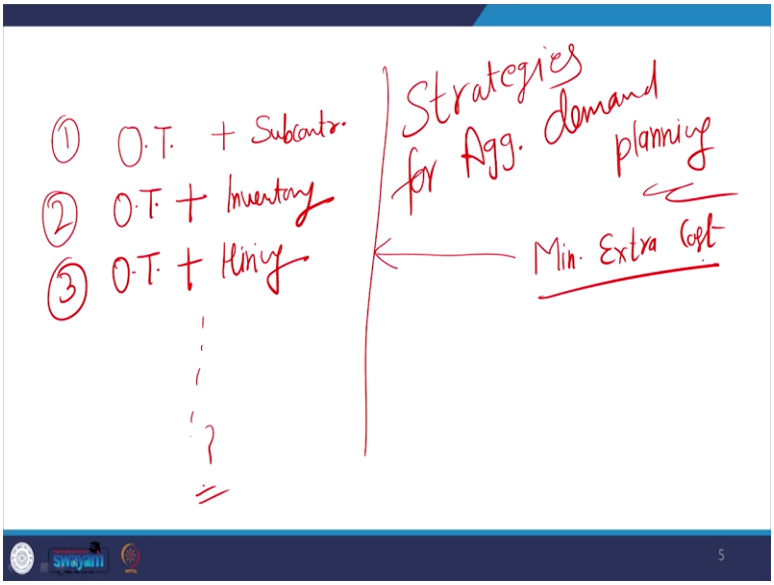

So, there are different type of supply side options also but, in practice we may do various combinations also we are taking over time and with over time you may do some subcontracting, you can do over time and then you can also create some kind of inventory, you can do over time plus hiring also.

So, multiple type of combinations are possible and these multiple type of combinations are going to be the strategies for aggregate demand planning that what is the most optimal combination and the meaning of most optimal combination is that whatever these type of systems you are going to use and there are many more whatever type of system you are going to use it should result in minimum extra cost, there is a cost which you are going to incur by using your time only in the routine hours with your routine number of employees.

So, that is your routine cost but, whenever demand is more which you are not able to fulfill in your routine time with your regular number of employees then you have to go for some kind of strategy or some kind of combination of strategy and whenever you are using these strategies you have to incur some additional cost and we are going to work in this particular session that how to minimize this extra cost and whichever combination minimizes our extra cost and also fulfills the additional demand that becomes a suitable strategy for our aggregate planning.

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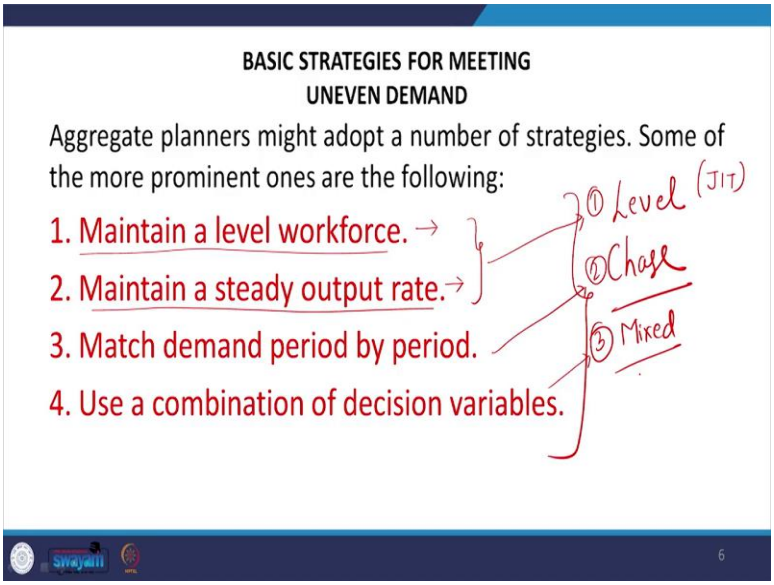

So, let us see that how to do that particular thing. Now, for maintaining these different kind of strategies for developing these kind of strategies we have a some kind of you can say naming of these strategies and by naming you will understand that what we going to do them and largely these names can be divided in two board categories, these names can be divided in two broad categories, one is level and another is chase these are the two board categories in which these strategies are divided.

Level means, throughout the year you are going to have a constant rate of production, you are going to have a constant rate of production throughout the year and particularly, if you follow Japanese system of management things like JIT Just in Time. So, they favor this level system of production that you need to have a very-very constant system of production and because of that constant system of production sometime inventories will also be built up and sometime you may have some backorders so, everything will automatically be balanced but, you will not have much fluctuations in varying your supply.

The second kind of system is chase strategy. So, chase strategy favors that we need to make only that much unit which are required. So, if demand is more you do some additional work so, that you can fulfill the requirement immediately when demand is less you remove your resources do not keep your resources because, resources will again incur some kind of cost. So, the chase strategy follows that approach, that as per the change in demand level you have to change the

resource availability so, that you keep only that much resource which are required to fulfill your immediate demand.

So, these are primarily two types of strategies and then obviously the third strategy comes that is the mixed 1, which is a combination of level and chase that some basic level you are going to maintain and then on that you have to follow what is required in different periods. So, now based on that we have different types of strategies maintain a level workforce, level workforce that is constant number of employees you are going to have and when you are going to have a constant number of employees you are going to have a almost fix number of output.

So, second is maintain a steady output rate, you are going to have the constant output rate so, both these strategies are favoring your level strategy, that you have the level workforce and you are maintaining a steady output rate, then third is match demand period by period. So, whatever is the demand in a particular period you have to adjust your supply according to that and that is your chase strategy that whatever is the fluctuations you have to follow those fluctuations.

And then you have a combination of decision variables that is mixed strategy so, here you can use different combinations overtime, sub-contracting, inventory, hiring all these are the different types of decision variables. So, using these different decision variables can also be done and that is our mixed type of strategy. So, these are different types of strategies which we can follow for making our demand meeting the supply.

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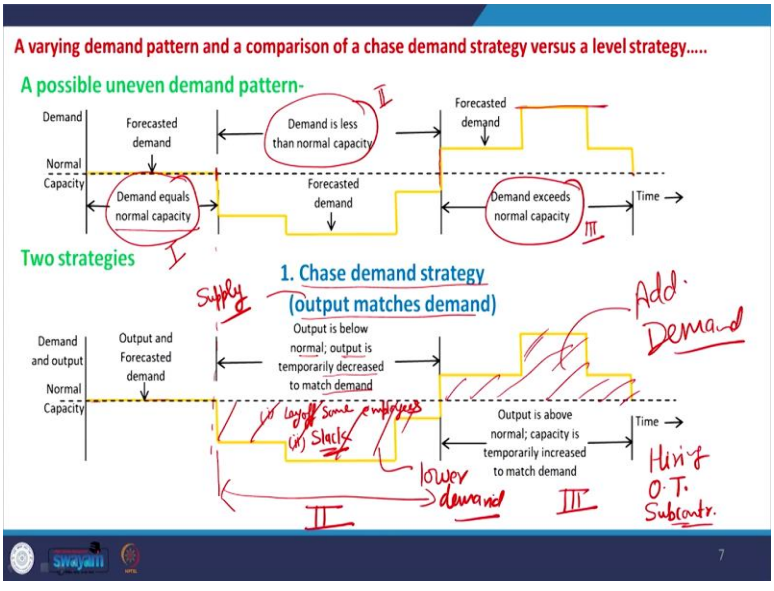

Now, these diagrams will give us a better understanding about what we just discussed theoretically. Now, here if we see this is a case of chase demand strategy, chase demand that means output matches the demand, output is your supply, supply is matching the demand that is what we are doing.

Now, what is happening here this line is representing my normal capacity, normal capacity of let us say 100 units per day so, this line, this dotted line is representing the normal capacity. Now, on this vertical direction you have the demand for initial few time, initial few days the demand is meeting, the forecasted demand is equal to the normal capacity during this period then, the forecasted demand goes down. so, in step function it is coming down and then it increases to normal level and then it increases to more than the capacity and demand that way increases to this high level also and then again it reduces and it comes to this level.

So, there are 3 different types of phases in this diagram, the first phase where demand is equal to capacity, the second phase demand is less than the capacity and the third phase when demand exceeds the normal capacity, these are the 3 phases we have tried to show here. Now, in this particular case the first strategy which we are trying to discuss that is the chase strategy. Now, in the chase strategy as our demand is fluctuating sometime it is decreasing, sometime it is increasing we will adjust our capacity so, that it follows the exactly that type of system.

Now, here the normal capacity is like this so, there is no issue and you have a very well whatever is your capacity and that is equal to the demand. So, you need not to do anything up to this period. So, up to this period you see you are ok with your capacity and the demand but, from this period to this period when output is below the normal, output is temporally decreased to match demand.

Now, what we do that either in this period you may lay off some employees, you can use slack times that you do not give your employees the extra work or the full work. So, that they have some extra time at the work time and that way we will decrease the production capacity during this particular period, this second period we will use these kind of strategies.

So, that my output decreases because, my demand is less than the normal demand and then comes this period when the demand is exceeding the normal capacity when demand is exceeding

the normal capacity I may go for hiring, I may go for overtime or I may go for subcontracting, I may do anything depending upon which one is cheaper.

So, here I am increasing the demand, increasing the supply so, that it can match the additional demand, this is the additional demand, this is additional demand and this is lower demand.

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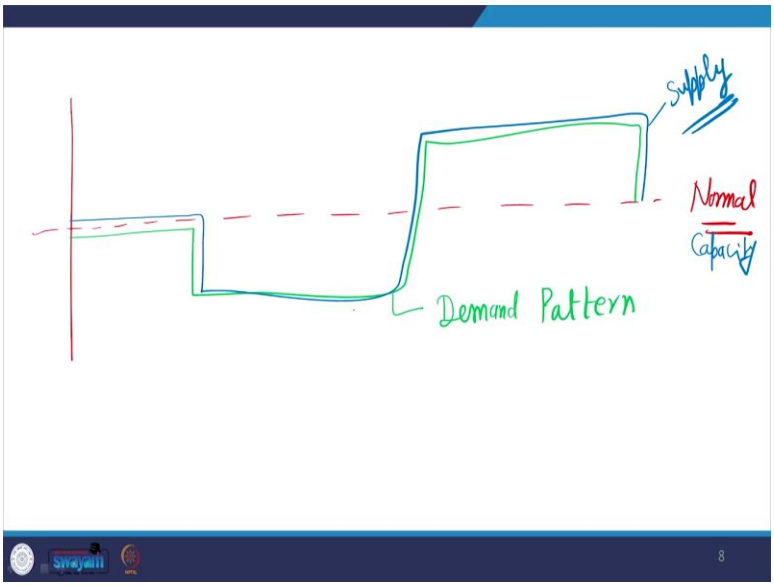

So, here if I see my this is the normal capacity, and then I have this system of just to give you the idea. So, this is the demand pattern. Now, let us go with the supply pattern. The supply pattern will also vary like this, this is the supply. So, these 3 are the colors we have used, the green color is representing the demand pattern, the red line is representing the normal capacity, and then with this blue color we have shown that in a chase system of aggregate planning we will follow the pattern of demand and accordingly we will either reduce our resources or will increase our resources. So, that we can fulfill the extra or lower demand. So, that is the chase strategy.

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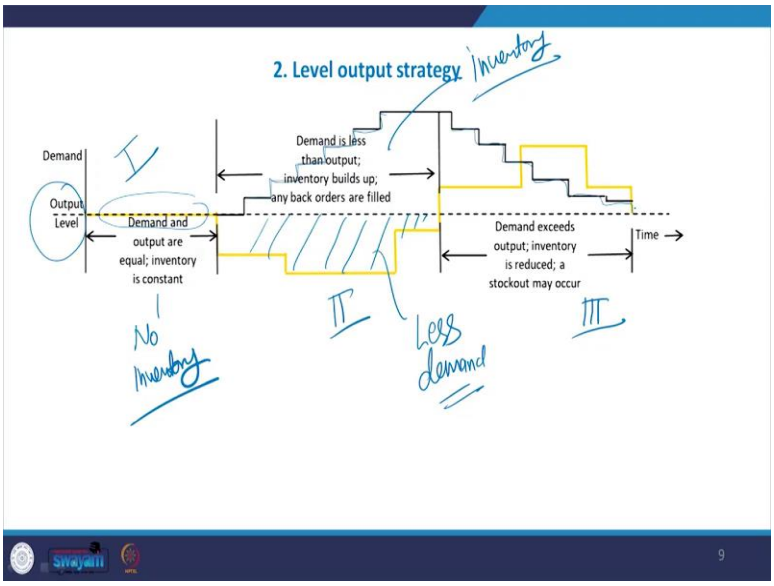

Now, let us see the other kind of strategy that is the level output strategy here also if, we see this diagram this dotted line, black dotted line is representing our normal output level, here what is happening that during this period the demand and our supply is matching so, here in this period no inventory because, whatever you are consuming, whatever you are making that is being consumed simultaneously but, in the second period, this is the first period, in the second period demand is less this yellow line is representing the demand.

So, this demand is less than the normal capacity. So, when demand is less than the normal capacity you see thus steps are shown here, this steps are shown here, this steps are showing that you are building inventory during this period as you have less demand but, since we are following a level output, the continuous output is at this level output level.

That all the time you are going to make with the constant output rate. So, because you are having less demand this is showing less demand because, of less demand inventory is being built up and then you are in this third phase, your demand is increasing yellow line is now going above to this dotted line and when this yellow line is going above to this dotted line you will consume the extra inventory which were filed up in the second period, which was developed in the second period that you will consume in this third period.

So, you have seen that all these step curves are now towards the decreasing side and slowly and slowly you will consume the extra inventory. So, in the level output strategy in some period

inventories will be built up and in some period inventories will be consumed. So, during your lean period of demand you will increase the inventory levels.

But, when the demand will increase you will consume that extra inventory of previous periods for fulfilling the demand of that high periods sometime, it is quite possible that if this period 3 and 2 are reversed if, period 3 and 2 are reversed in that case what will happen because of high demand in period two in that case that is going to happen this way.

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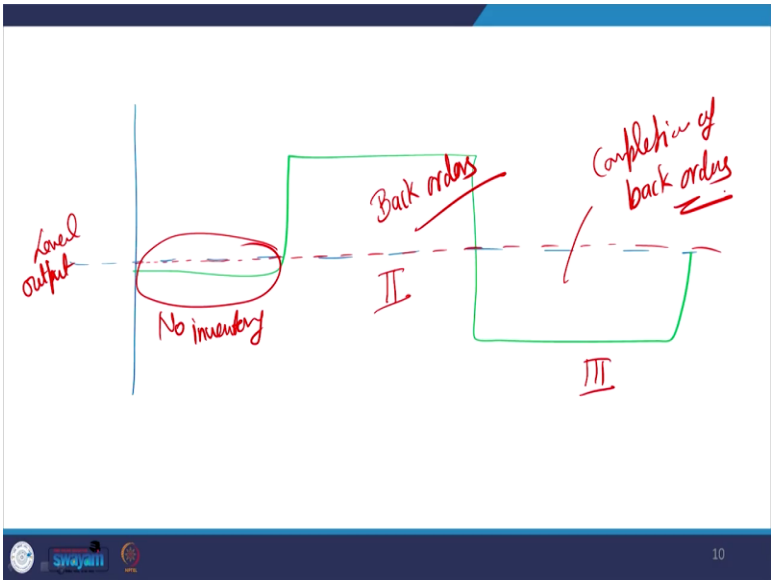

That this is my normal inventory level here let me show you that this is the extra demand during this period and then demand decreases and this way it is going to come here. Now, let us see because we are following this particular level output, this is the level output. So, in this period no inventory but, during this period the demand is more but, your output has not increased so, what you are going to have you will have lot of back orders during this period, you are not able to fulfill the demand during the second period and that you will fulfill, that you will fulfill in this third period completion of back orders.

As I told you in the beginning, that this completion of back order may involve some penalty also because, customer may say that you have not given me products in time so, some penalty may be 5 percent, 10 percent depending upon your negotiation will be charged but, it is this way also so, in the level strategy both these cases are possible that initially you have built the inventory in this diagram and that inventory helped you in fulfilling the requirement in the later period or it is also

possible that initially you may have some back order and then you fulfill the back order in the later period.

So, both these cases are possible in the level strategy but, in our next session we will see some kind of examples that how to evaluate these strategies because, once you have some numerical data available with you then only you can understand the usefulness of these different kinds of strategies and then you say that yes this is the most suitable strategy for my case. So, with this we come to end of the session. Thank you very much.