Hello! I welcome you all in this presentation related with the subject Principles of Industrial Engineering and you know we are talking about the inventory. In the last time we talked about what is the inventory and what are the benefits related with the maintenance of the inventory in a company, whether it is a manufacturing or the service industry. We have talked about the primary benefits related with the inventory like it is, it will be able to supply the items whenever they are needed and wherever they are needed that to economically.

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Apart from that it will offer many other benefits like which we termed as a secondary benefits. So these secondary benefits are likely the good return on investment about this point I have already talked return on investment. And then what we have said that it acts as a buffer stock. So that it is able to supply when the demand is more and it piles up the stock when the demand is less then other points like about which I have talked like decoupling of operations.

So each of, by when a stock is maintained either of the finished goods or the raw material or of the semi-finished product, it helps to decouple the different operations. And each of the operations can be managed independently, then the so about these three points we have talked in detail. The next point is smoothing the production.

Smoothing the production, means if there is a mass production kind of situation, so the company will keep on manufacturing whatever the rate at which it is manufacturing and whenever there is a demand, when the demand is more the items are taken from the stock and whenever the demand is less, the items are stored in stock, but the company does not adjust the rate of production.

So, the production rate is kept constant and the items are kept in store. When the demand is more, items are released in greater quantity. And whenever demand is less, the store is developed. So but we do not adjust the kind of the rate of production. So the production process is maintained whether the demand is less or more, in case of the more demand the items are supplied from the stores.

Then it reduces the material handling cost. So to understand this like especially in the raw material stage or input stage or in case of the processing stage, say there are 10 stations in the processing stage 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10 at the different processes. And whatever is being processed that will be moved from one stage to another.

So, in case of the line production or where like in mass production the transport system or the material handling system is very efficient whatever is processed at one, it is moved to the next station, but in case of the process layout or where the production is made in batches, this like say that 20 items will be produced at the station 1 and then these are transported to the next station, then to the next station, then to the next station.

So here the during the production stage at particular station, items will be produced and they will be stored. And then when these become sufficient in quantity, these will be transported to the next station. So that is how it helps in especially in case of the batch production or low volume production. The material handling cost is reduced when the items are transported in batches or in small lots. So that is what is used in case of the inventory of the semi-finished products. That is how the inventory of the semi-finished products helps in reducing the material handling cost.

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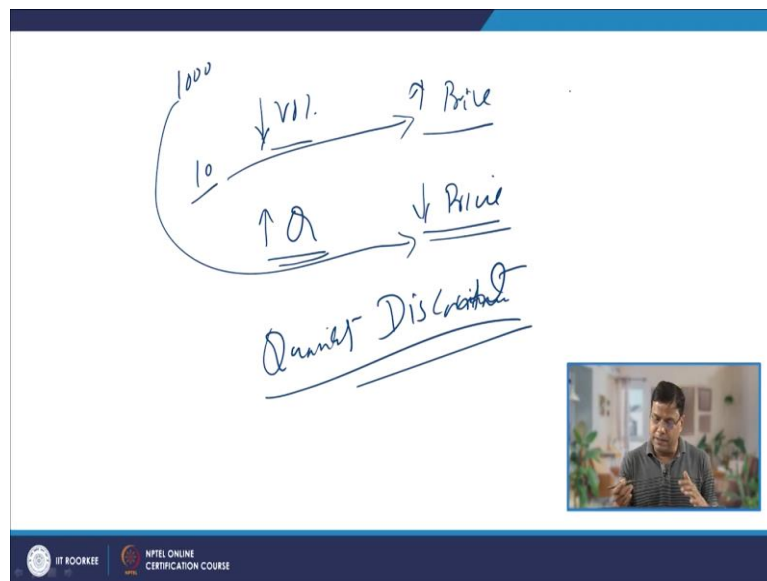
If we purchase in the low volume then in general, the price at which item is available is high. If we know that the quantity to be produced is high or the volume to be produced or procured is high, then that can help in (reduce) getting the reduced price. This is what we say like if you buy 10 pieces or 1,000 pieces, so 10 pieces will be bought at higher price, while the 100 pieces can be bought at the lower price. That is the word, there is a word which is called quantity discount.

In case of the quantity discount, we get the price of the, lower price of the item. And in inventory, we know that if we order the large quantity, then it can be kept in store. Then we can get the items at the lower price. So that is how whenever the inventory is maintained, we order for the larger quantity and we get the benefit of the quantity discount.
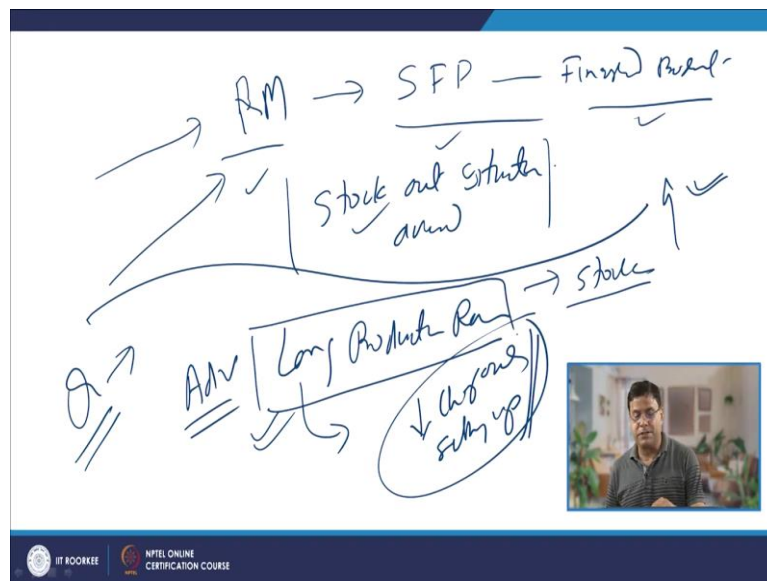
It also helps like either where it is the stock of the raw material or of the semi-finished products or of the finished products. In all these cases, whenever the stock is maintained like say if the incoming material is delayed then the production process will be stopped. So in the inventory helps in avoiding the stock out situation, stock out situation is avoided by the inventory at any of these stages.

Like say suddenly there is a demand from the customer and if the finished products are there in inventory, then those can be used to supply. So some kind of the store is maintained at all these stages to feed the requirement whenever there is demand, and that is how it helps in dealing with the in avoiding the stock out kind of situation.

And then there is a, it also helps in taking the advantage of long production run, you know, if we have to keep on changing the setting just after five producing, these 5 units or 10 units instead of that, if we continue to produce the 100 items in one go then it will reduce the changeover or setting up cost.

So these costs are like say just kind of unnecessary extra investment or the wastage of the resources. So if we can continue to produce the things for long, then that will help in building the stock and maybe making the items at the lower price. So it allows like if you have to economic production quantity, Q is identified then at least Q will be produced. So that the demand of the customers can be fulfilled. So that is how it helps in reducing the cost. It takes the, so inventory helps in taking the advantage of the longer production run if we have identified the economic production quantity that is to be made.
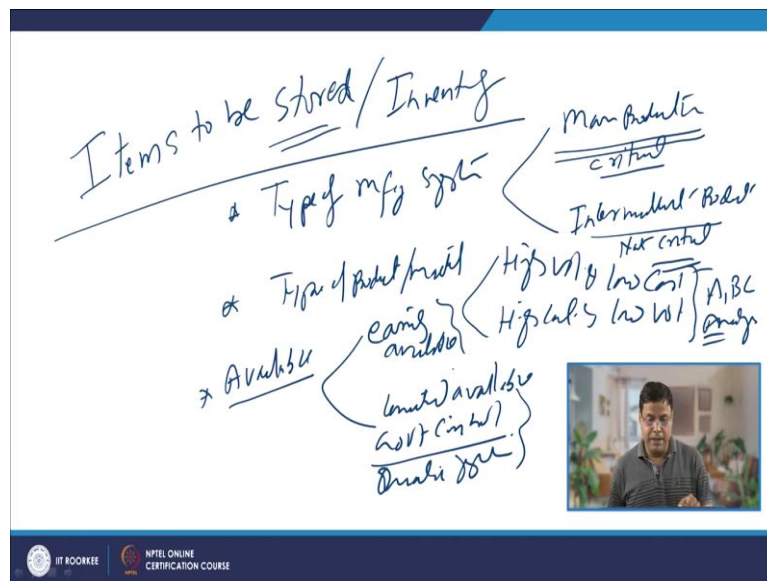
Now, the items what is to be stocked? Items to be stored or what are the items to be for which inventory is to be maintained? That significantly depends on the various factors, like what type of the, what type of the manufacturing system is being used. For example, if it is the mass production then inventory is very crucial because absence of or lack of the raw material or lack of the semi-finished goods at any stage can halt the production.

So for mass production inventory is very critical. While in case of the intermittent production, intermittent production, we get some kind of the flexibility to produce something else instead of what is being done if there is a lack of material. So it is critical but may not be that critical as in case of the mass production.

Then what is the kind of the type of the product? Or the kind of item or the material which is to be stored, whether it is of very like high volume and low cost kind or it is a high cost and low volume type? So this is based on identification of, this is based on the like say ABC analysis of the items to be stored.

So we will be talking about that ABC Analysis slightly later. Then there is availability factors. Sometimes availability is very crucial in maintaining the store, because if the items is readily available, and it can be arranged whenever it is needed, probably it will not be that critical for maintaining the inventory.

So, the availability is crucial like easily available or the limited availability. That is the another aspect like through the government control, material is available through the government control or there is a quota system. So whenever the availability is limited, it is

very crucial that proper inventory is maintained as and that will more crucial as compared to the case when the item is readily available.

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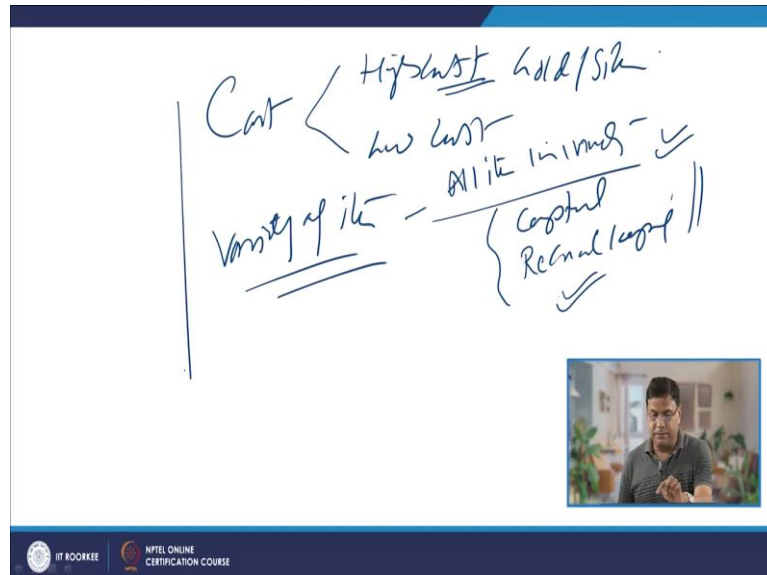
Apart from this availability, the cost is another factor like say the high cost items like gold or silver or the low cost items, maintaining the high volume of the high cost item is really difficult as compared to the low cost item. And then the kind of the variety of the inventory, variety of the items you see. It is very difficult for any manufacturing system or service industry, we need hundreds of the items for smooth production.

So, maintaining all items in inventory is really very difficult because it will be leading to a lot of capital investment and making the record keeping extremely difficult. So inventory of the limited items is, can be done efficiently and effectively, but if the very large number of items are to be kept in the inventory, then the huge capital investment under the record keeping will be really very tedious job. So these are some of the factors that affect the kind of the inventory to be maintained.
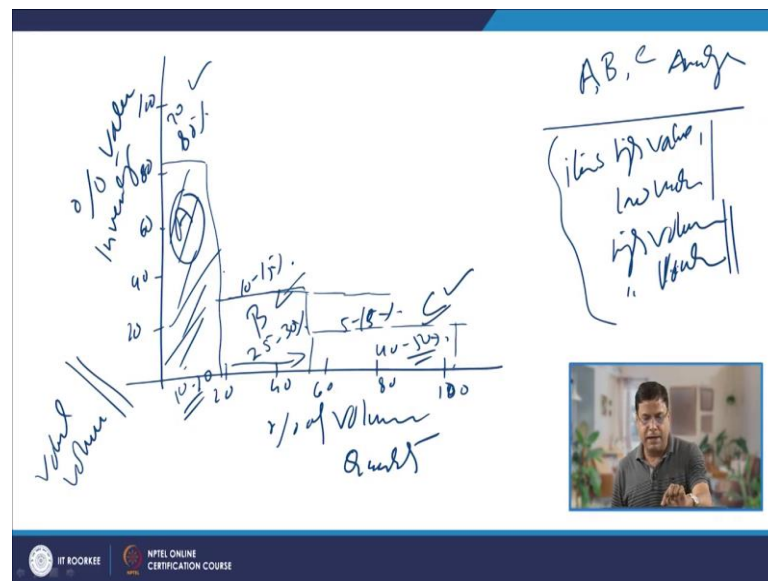
Coming to the ABC analysis, ABC analysis. This is the analysis which is used to identify what are the items which are high value, which are items of the low value and the items which are of the high volume or low volume. And based on this the focus is kept on the high value and the low volume items. So if we have the kind of the percentage of the volume or quantity and the percentage of the value that is in inventory.

So here if we have like say 20, 40, 60, 80 and 100 and here 20, 40, 60, 80 and 100. So when we have the, if all the items that are needed are grouped, all the items all needed are grouped and their value and the volume both are determined and then they are segregated and what is found that the 20 like say very few items will be needing the huge investment like say 20 percent items, 15 to 20 percent items needing the high investment.

Then there is another category where 25 to 30 percent needing like say 10 to 15 percent investment like this. And then 5 to 10 percent investment is needing for the third category of the item. So the category one item, category A item those of the high value needing the 80 percent, about 70 to 80 percent investment and the volume is like say 10 to 20 percent.

Then for B category items where the value is like say 10 to 15 percent and the volume is like say 25 to 30 percent the volume wise. And the remaining like say 5 percent, 5 to 10 percent is for the C category items. The volume is like say 40 to 50 percent. So that is the C category. So these are very high in volume but the low value, the B category items or of the moderate value and moderate volume and A category items are of the high value and the low volume. So basically, all items are listed their value and the number of units to be stored for inventory

are identified and then they are grouped to determine in which category particular kind of the item will be coming in.

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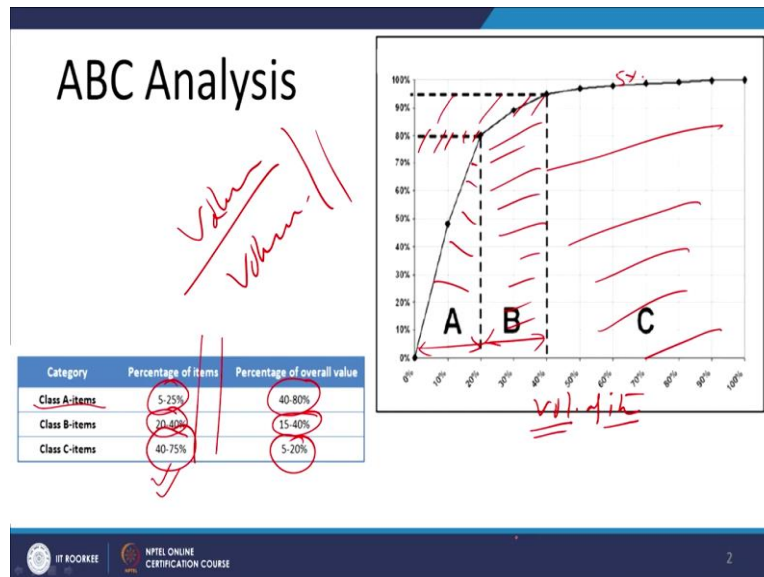
Just to see here like here this is about the volume of the items. So about 25 to 20 percent of the items like this is the category for the A items (invest) needing the investment of the 80 percent, remaining like say 15 percent of the investment is going for the B category items, where about 20 to 25 percent of the volume is going for the B category items. Balance 5 percent of the value is going for the remaining 50 to 60 percent of the item.

So that is what is the ideal, general range is just to have the idea class A items needing the, in the percentage of the item like 5 to 20 and the percentage of the value is very high then somewhat moderate values for the class B item and very low value 5 to 20 percent and 40 to 75 percent for the C category items. So these are the general ranges but it will talk about the kind of the value of the items and the volume that is to be stored. So accordingly, the importance is given for maintaining the inventory.

Now, we will see how to maintain the inventory and what we do actually in inventory management, inventory. Because in inventory management, basically the stock is to be maintained so that we can really extract all those benefits about which we have talked, like decoupling operation, smoothing production, the quantity discount and making things available whenever and wherever they are needed.

So those, so just to facilitate this in inventory management, basically, the two things are identified. How much quantity is to be reordered? Something is there in stock, stock is consumed, so reorder so the stock is to be refilled. So for that we have to, some quantity of the item is to be reordered. So how much quantity is to be reordered? And when is to reorder? So when the order should be placed? So the quantity Q and the reorder point R, R determine how much to reorder and when to reorder. So that we get the items, so that the related inventory benefits can be realized.
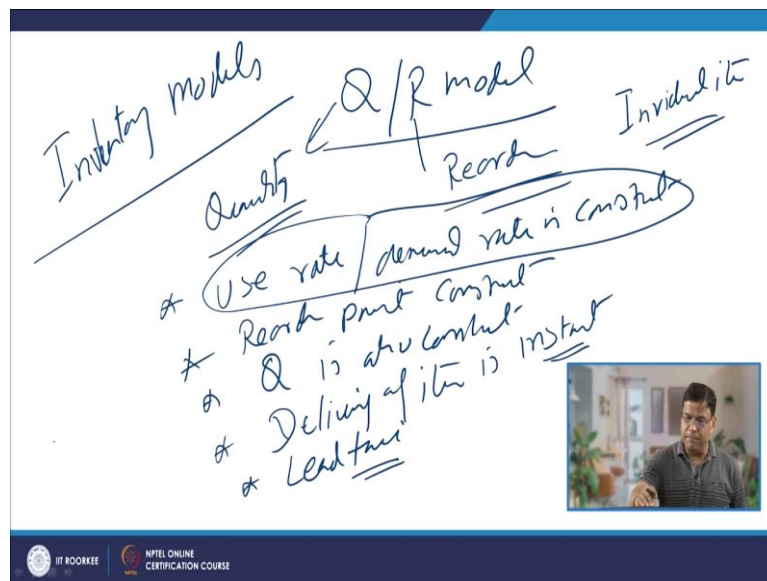
And for this purpose various models have been proposed, we can say like inventory models. So the QR is one of the most commonly used model where Q is, Q indicates the quantity to be ordered and R indicates when the reorder is to be made. So the reorder point and the quantity to be reordered. So now we will see what is there in the QR model. So QR model assumes that the use rate or the demand rate is constant and these models are for the individual items.

The demand rate for the item is constant and whatever the reorder point is there, that is also constant. And whatever quantity that we order quantity, quantity is also constant. So initially for one simple model when the use rate is constant, we will try to see the detail. In these models, it is also assumed that the delivery of the items on placement of order delivery of items is instant.

The moment order is placed, the delivery is received and stock is refilled, that is one and initially, there can be situation of the lead time. What is the lead time? The movement order is placed, how much time it takes to get the supply? So this lead time may be 0 or this lead time may be of some value, lead time may be constant, lead may fluctuate or lead time may be 0.
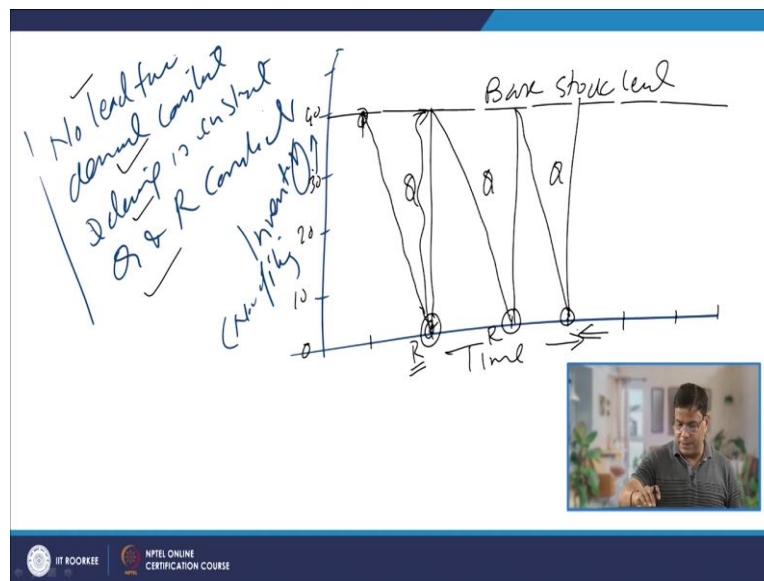
So when we go for one typical model, when there is no lead time, demand is constant, delivery is instant and the Q and R are constant, say these are the some of the points. So how the inventory which is basically indicating the quantity of the items, number of items in the inventory, this may be of any unit like this number of items. So say here in x-axis, we have how the inventory or the stock will be changing as a function of time.

So let us say there is a base stock level, that base stock level, this is the predetermined stock level that is say maintained. So here in the first says there is a full stock situation and with the consumption since the demanded is since the demand is constant or use rate is constant, so it will be decreasing gradually and then it will become 0.

So here stock is like say 0, 10, 20, 30 and 40 just for example, so here this stock becomes 0, at this moment we place the order. So order is delivered or supplied immediately. So this quantity for which order is given is Q like this. This is Q and the time when order is given and in this case, the order is being given when the inventory is reduced to the 0 level. So this becomes the R or reorder point.

The moment order is placed, the inventory is replenished and it is brought to the base stock level, again then consumption will start and consumption will be taking place at the same rate and then as soon as again the stock reaches to the 0 level, the order is placed again for the same Q quantity.

So it is replenished, stock is replenished then consumption will start and then it will be consumed. So again, it will be depleted and will become 0. So here order will be replaced again, order is, this is the reorder point, so order is placed again for the Q quantity.

So this is the simplest model which assumes that there is no lead time. The delivery is immediate, demand is constant, delivery is, demand constant, delivery is instant and the Q and R both are constant here. The reorder point according to this model is 0 because we are getting the delivery instantly.

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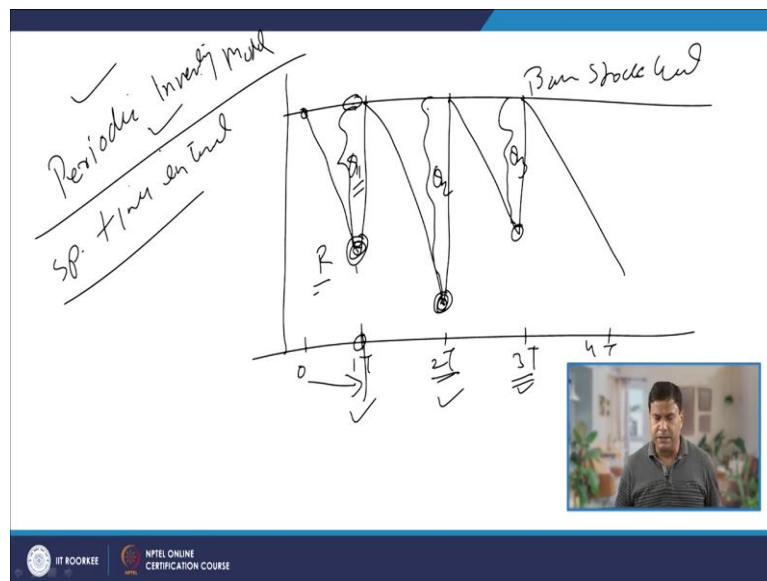
Then there is another simple model, in which case periodic inventory model. In the earlier model, we keep the record of the things as a function of time and as soon as we reach to a particular level or zero level say in simple QR model, where lead time was 0, order is placed and we immediately get the inventory.

But in this case, the inventory is checked at specific time interval periodically say the 0 and then 1T, 2T, 3T, 4T. So these are the time intervals. So and there is say some base stock level. So what we do, say inventory is here. So it will be consumed. Say in this case, it is being consumed at a certain rate or at a fluctuating rate. So here say inventory is being consumed say after this time. It has been consumed up to this level.

So we will be checking at this moment of time. We were informed that inventory level is this much then whatever is the amount to be ordered, that will be the difference of the base stock level under the current stock level and that difference order will be placed for this difference Q1. So the item is delivered.

Again here also, the delivery is instant, but the item Q1 is being obtained from the difference of the stock at that particular T1 time and the base stock level. Then inventory is, so this is how this is the reorder point. Reorder point is simply the fixed time interval. That is the 1T, so whatever is the stock at that time that difference from the stock level and the base stock level is identified and the order is placed, then items are consumed and say after 2 time 2T time, again the stock is set and we found that the stock level is this much.

So again difference of the basic stock level and the current stock level that is Q2 is identified and order is placed. So when reorder point is a particular specific time interval and what is the order quantity? Order quantity is the stock level at that particular moment and the base stock level difference for which order is placed.

Then again order is consumed, sorry the stock is consumed and at 3 time for third time interval the stock is checked and whatever is that difference from the base stock level the again the order is placed and then inventory is replenished. So this is how the periodic inventory model works in. Now, I will summarize this presentation. In this presentation, basically, I have talked about the few secondary benefits of maintaining the inventory, the ABC analysis and the two types of the inventory model, one was the QR inventory model and the periodic inventory model. Thank you for your attention.