Production and Operation Management
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Lecture 23 - Inventory Control and Management

Welcome friends! So last two weeks, we were discussing about various types of inventory management models. We discussed in detail about P-type, Q-type, single period inventory management models, and we also discussed some numerical examples for all these types of inventory management models. Now, in this particular session, we want to see the practical application of inventory control systems and how in our organisations we are managing the inventory, what type of tools, techniques we are applying.

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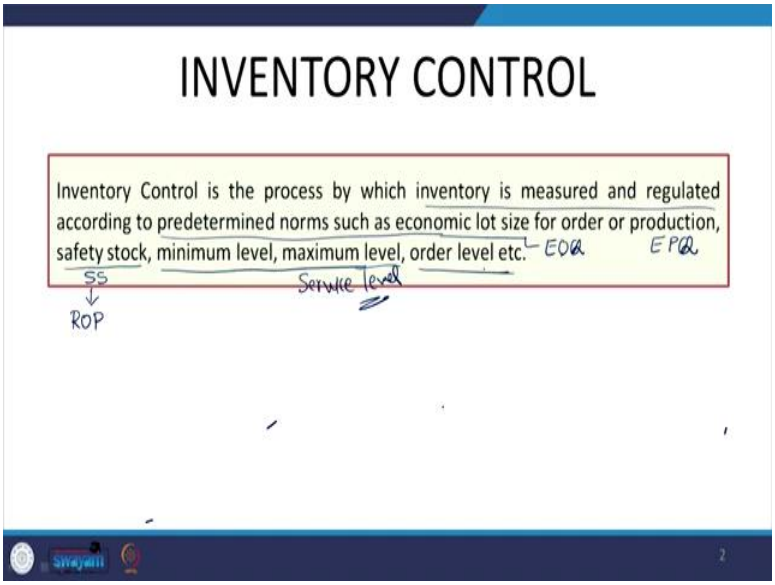

And for that purpose, let us understand the meaning of inventory control. So, inventory control is that process through which we are measuring and regulating the inventory. And this is done on the basis of some predetermined norms such as economic lot size like we have already discussed this under our EOQ. Economic production quantity which we have also discussed under EOQ cases. The variation of EOQ so economic production quantity. Then safety stock we discussed that how different types of safety stock calculations which are affecting our calculation of re-order points.

That depends upon variability in the lead time, variability in the daily demand. Then in our continuous demand cases when we were discussing the single period model, we discussed the minimum level of demand and the maximum level of demand, whether it is a continuous case or discrete case. We discussed that with the help of numerical examples also that, minimum

level and maximum level of demands are also there. And on the basis of that we discussed the concept of service level also. That what service level you are going to offer to your customers.

And then the order levels: How much you are going to order depending upon this service level. So, all these things are the important you can say outcome of the inventory control system. Then when we have answer of these questions, it means we have developed a scientific inventory control system. Now, for effective inventory management what are the requirements? Once we have understood that if I am having a scientific inventory system, I should have answer of these many questions.

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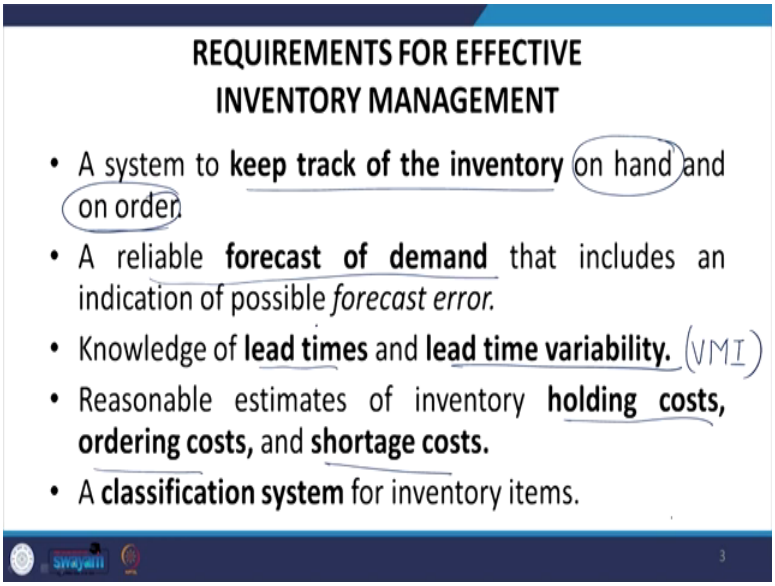

Now, we should be able to keep track of the inventory on hand and on order. Sometime because of small organizations where we do not have well developed information systems and the employees change, earlier somebody else was the store manager. Today, you become the store manager and you do not have the idea how many orders are already placed and in that case sometime you place twice, thrice the orders. And that is going to have poor effect on your inventory management system.

So, you have to keep a track on, on hand inventory and on order inventory, both these things are equally important. How much you are in hand and how you are how much you are going to get in due course of time. And particularly, this is more important when there is change of guard. Because when a single person is handling the inventory, this on order issue will not trouble you much. But, when there is a change of guard, this issue becomes more important.

The second important requirement for effective inventory management is a reliable forecast of the demand.

We have already discussed in detail about the forecasting and we already discussed that forecasting is the first step for various issues of operations management. So, good forecast will help you in minimising the issues related to overstocking or understocking, more accurate forecast better inventory management. Then knowledge of lead time and lead time variability. Now, purpose of this is or you can say that indirectly, you should be aware about the capabilities of your supplier.

How much capable your supplier is? Whether the guarantee is given by the supplier in terms of lead time able to meet or not, if supplier does not have that much capabilities, how will he or she fulfil the promises? So, lead time knowledge and lead time variability knowledge is directly related to the capabilities of your supplier. So, you should have a, therefore in our discussions, we will also talk that VMI, Vendor Managed Inventories, where your vendor is keeping the inventory and when you know that my vendor is capable to hold the inventory, you will place more faith on those vendors.

In this particular session, we are also going to discuss about JIT and concepts of JIT as possible when we have the systems like VMI in place. Then another important requirements are reasonable estimates of inventory holding cost, ordering cost, shortage cost, excess cost etcetera. So, these different type of cost parameters which are affecting and we have also discussed that sometime we have to make a balance between holding cost and ordering cost. Sometime we have to make a balance between shortage cost and excess cost.

So, if you know these parameters then only you can make a balance between these different types of cost parameters. So, you need to have reasonable estimates of these different types of cost parameters. Then another important thing is that all items do not require your equal efforts in management of inventory. So, you need to classify items in two different categories so that you can use your efforts accordingly. If you are putting more efforts for less important items then it will be wastage of efforts.

So, we should know that what are the different schemes available to classify the items, use a particular scheme. This is up to you that which scheme you are going to use, but you have to use some particular scheme to classify those items. Once you classify them then probably you will be able to manage your inventory more effectively. Because we have time and again

discussed that SKUs are continuously increasing and when SKUs are increasing, you have to use your efforts very judiciously.

And therefore, if you put your efforts equally for all the items, it is not going to benefit you. So, the classification scheme is very-very important and we will be discussing in this particular session some important classification schemes, which will help us in giving different type of efforts for inventory management.

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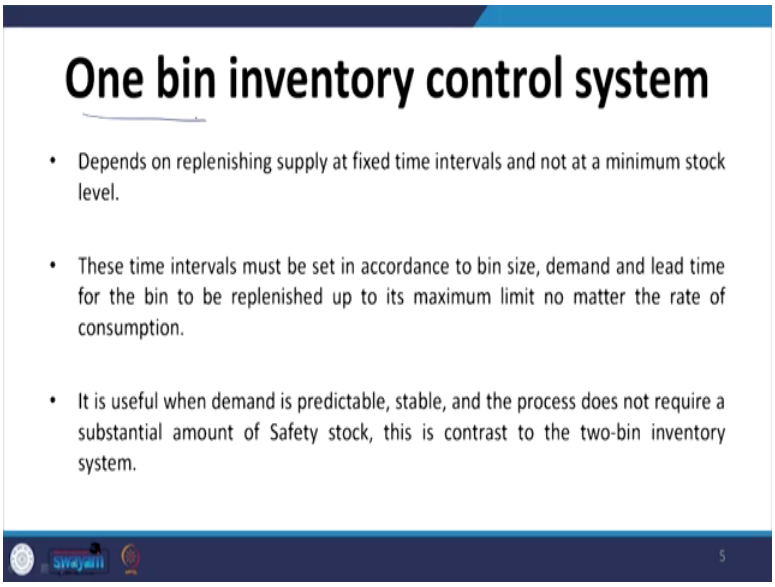

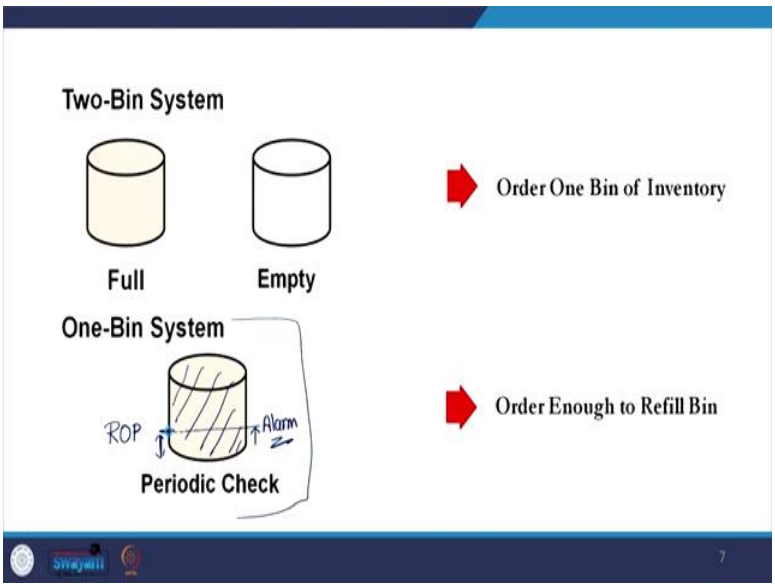

Now, in this particular case, first important point which we will like to discuss for inventory management, that is, one bin versus two bin system of inventory control. Now, in this one bin system and two bin system, it is like you have a single port or you have two ports. So, you can use both these systems for inventory management. In one of the session, I discussed the

case of your vehicle and you are using that vehicle and you require some kind of petrol and diesel. Now, in that vehicle, you have only one particular chamber where you are putting your fuel. Now, in that chamber, you have a particular mark whenever fuel touches that particular mark, you have to switch on your reserve button. And that means now you are consuming the safety stock and it is immediately require to replenish your stock.

That is one of the classical example of one bin inventory system; that you have to understand that you have a single bin and in that single bin you have a particular mark of inventory. Like in this particular case, we have this example. Here, you have a one bin system. Now in one bin system, you have this particular point which is your re-order point. We have already discussed the meaning of re-order point in our previous classes.

Now, when your this is filled up to top, when you are consuming this particular material and as soon as you touch this ROP, it will give you some kind of alarm and that alarm is good enough for replenishing this stock and below this you have some limited amount of material which is going to be lasting during the period of this replenishment. So, this is one bin system which is applicable in variety of practical situation.

So, example of your scooters, motorcycles, cars etcetera. So, the fuel tank is an example of that one bin system. So, in this one bin system some important characteristics if I read, it depends on replenishing supply at fixed interval times and not at a minimum stock level. These time intervals must be set in accordance to bin size, demand and lead time for the bin to be replenished up to its maximum limit no matter the rate of consumption.

So, you will always fill this bin up to the top level whatever rate of consumption it has. So, whenever it touches the lower limit, you will apply that replenishment cycle or you can always use a fixed interval time system also. That you do not, if you do not have that system of indicator in this particular case, so you may fill that particular bin on a regular interval so every third day you are going to replenish the system. So, you can follow this fixed interval time interval system also in this particular case.

So, every time you will fill a variable quantity in that bin. Then it is useful when demand is predictable, is stable and the process does not require a substantial amount of safety stock. This is contrast to the two-bin inventory system. So, here since we are using most of the time in a one bin system fixed time interval system. So, it is only possible in a regular sense when you have a system of constant demand. So, again going back to the example of that two-

wheeler who is riding the two wheeler daily for going to his office and coming back, so he knows that daily consumption is of about 750 millimetre millilitre.

And you are replenishing your stock let us say every time by 3 litre and using that 3 litre you are able to survive for 5 days. So, every sixth day you go to petrol pump and you replenish your stock by whatever quantity so that your tank is filled completely. So, this is a system which is practically used in one bin inventory control system.

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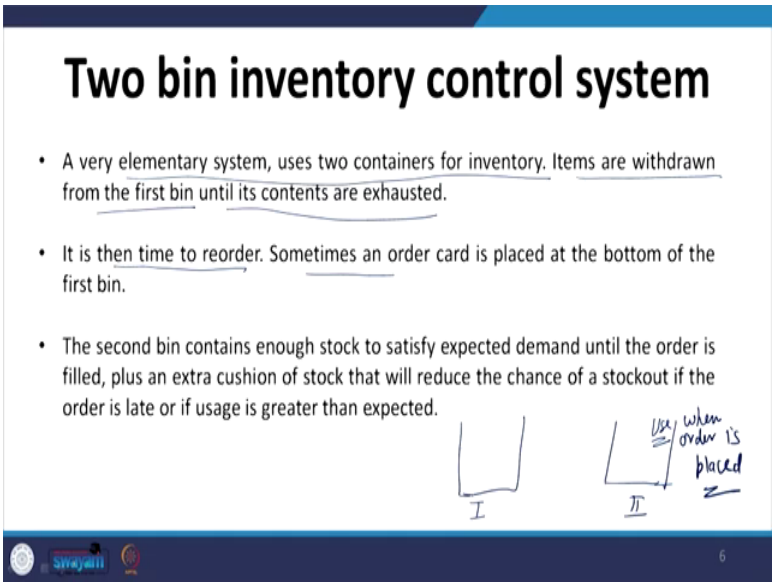

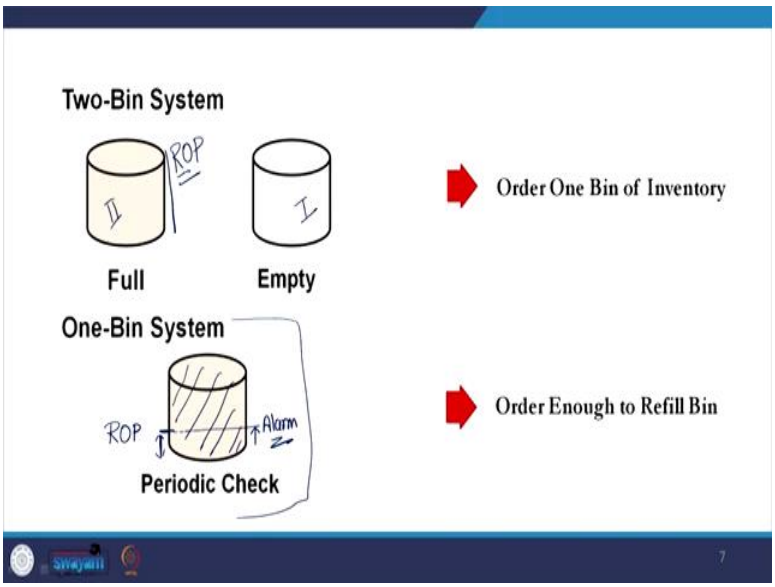

Now, coming to two-bin inventory control system. Here we have two separate bins. Here we have two separate bins. In one bin, we have the quantity from which we are regularly using our material. So, a very elementary system uses two containers for inventory. Items are withdrawn from the first bin, so this is the first bin, this is the second bin. So, you will

continuously use items from your first bin till the contents are exhausted till this is totally empty. Then it is the time to reorder, when this first bin is completely empty, it is the time to reorder. You have to place a new order and during this period when you are going to receive supply, you are starting use of the second item.

Use when order is placed, so before placing the order you are using the first bin. Once first bin is over, then you have started using the second bin and you have also placed the order. So, second bin actually keeps the safety stock. So, first bin and the second bin two bins are there. So, here when the second, the first bin becomes empty, the second bin is there and then you have started using the second bin and you have placed the order. So, two separate bins give you a better visibility and the second bin acts as a reorder point. So, you have separated your order quantities in two parts.

Similarly, when you are receiving the supply, you will first complete your this empty vessel and then whatever is left that you will put in the second vessel. So, whenever a new supply is coming, you will put the supply in two separate vessels. First, you will complete the first vessel and then the leftover will go to the second vessel. So, this is again a very popular system of inventory management, we physically separate out our items in two places. Maybe two separate locations are there or two separate boxes are there. So, you need to do this physical separation of your items under two bin system.

So, these are the two very popular systems, two bin system is more critical and one bin system is a simplistic way and where the demand is relatively more stable. Now, after understanding these two bin systems and one bin systems, then there are another important issues which we need to answer in case of inventory management.

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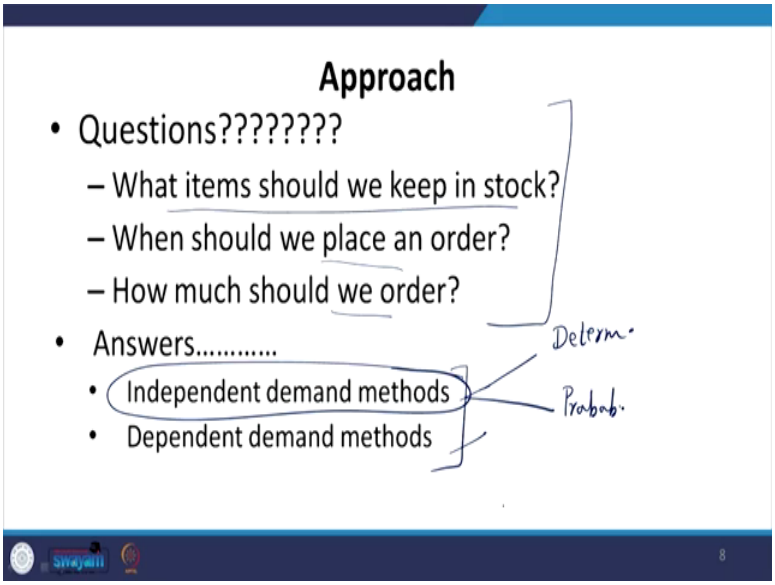

There are questions which keep coming and we have time and again answered this. What items should we keep in stock? All items may not be necessary to keep in stock because it takes place, it takes some kind of space in your warehouses. So, which item are more critical you will like to stock only those items. When should we place, how much we should order? These are the different questions and their answers will come from these different kind of issues.

Independent demand methods and dependant demand methods, so far whatever we have discussed that all is part of independent demand methods. P-type, Q-type, single period model, all these are the part of our independent demand methods.

And in independent demand methods also, there are two types of issues. One is deterministic and another is probabilistic and we have discussed both these types of issues when we have constant demand, constant lead times, all those are the part of deterministic cases. When we have variability in demand, when we have variability in lead time and when we discuss the single period model, all these are the part of probabilistic demand cases. So, independent demand we have discussed in detail. Dependant demand method we will be discussing under MRP discussions.

When we will go for MRP material requirement planning, manufacturing resource planning, ERP Enterprise Resource Planning, all dependant demand discussions will be taken place at that time. So, these are two important issues which we need to know with respect to inventory analysis. Now, we discussed just now the classification of items are very important for proper

inventory management and one very popular approach of classification of inventory items is ABC analysis. This is one very popular approach of inventory analysis.

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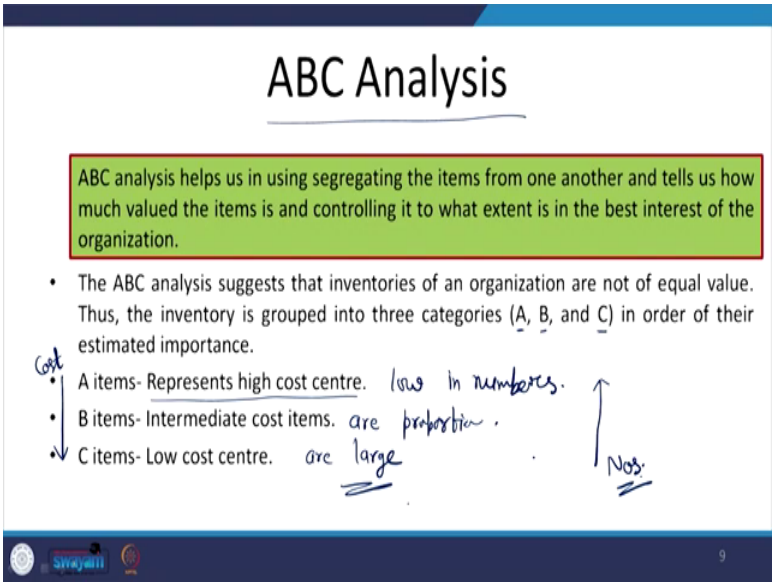

Now, what we do in ABC analysis that we divide all our storehouse items into three categories: A, B and C. We divide all our stock items into three categories and these three categories are done on two criteria, on two criteria. A items are those items which are our high cost centres and they are low in numbers. Then B items are our intermediate cost centres and they are proportionate. According to their cost, these numbers are equally represented. C items are our low cost centres and they are large in number.

So, the cost parameters are decreasing and number parameters are, so cost parameters are decreasing and number parameters are again decreasing as we go from lower to higher side, so this is the numbers. So, you have a maximum number of C items, intermediate number of B items and very low number of A items.

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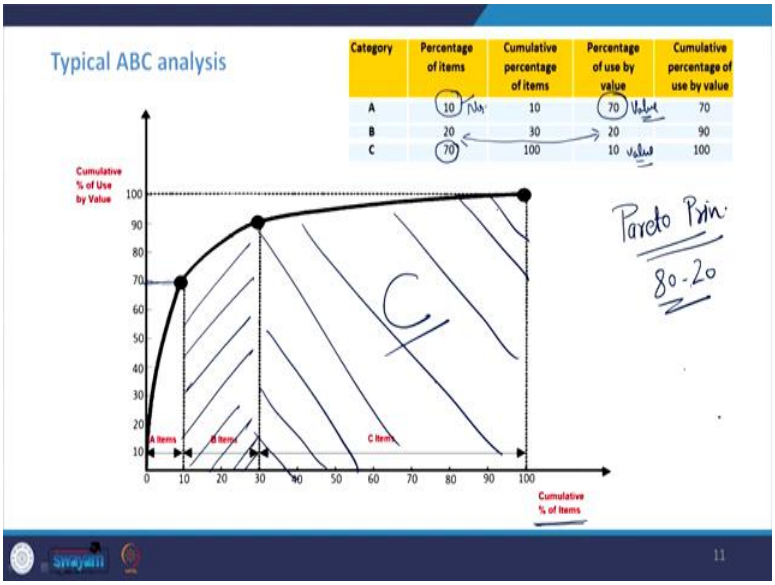

We have a diagrammatic representation of A, B, C items which will help us in understanding the meaning of these three items on these two parameters. So, here we have this graph from the x axis, we have the number of items. And on y axis, we have their value and on the basis of this classification scheme A items are around 10 to 15 percent, 10 to 15 percent are the A items and they constitute very high value of inventory items. So, if you see this diagram around 70 percent of the value around 70 percent of the value is being taken by these 10 percent items.

So, A items which are just 10 percent of the total value total number of inventory items but their value is around 70 percent. They are 10 percent by numbers and 70 percent by value. B items are these type of items, these are the B items. They are in proportion so you see they are 20 percent items and they take around 20 percent value. So, 20 percent items, 20 percent value so we discuss that they take numbers and value in proportion. And the C items these are the C items which are very large in number. Around seventy percent items are C items.

These are the 70 percent items but their value wise contribution is very less, around 10 percent value they are taking. So, you see it is based on a very common principle which is known as Pareto principle which is also known as 80-20. Now this 80-20 Pareto principle says that most of the things will have very less effect on the system. But, few things will have majority of effect on the system.

So, 10 percent of your inventory items are constituting 70 percent impact on your inventory value. And large items 70 percent items are contributing only 10 percent impact on the inventory value.

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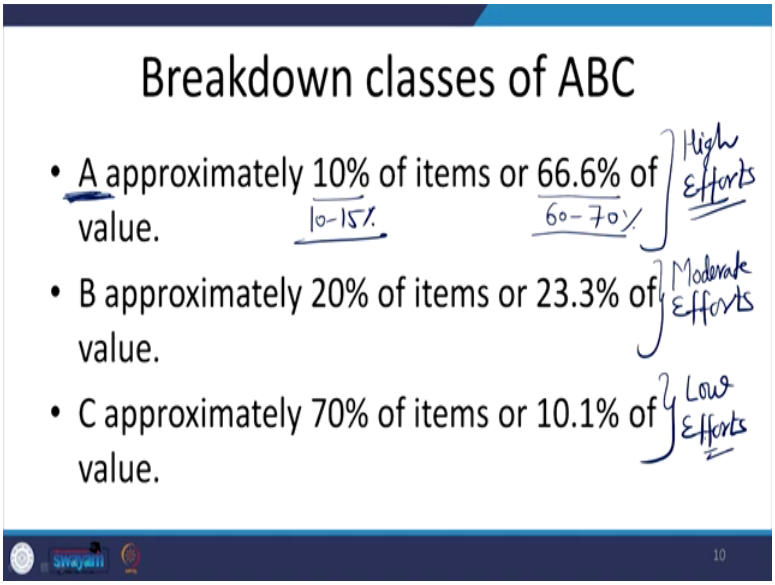

So, it becomes very simple for us to understand that we need to give maximum efforts, we need to give maximum efforts for A type of items, which are 66 percent or maybe from 60 to 70 percent, you can understand that way and their value is from 10 to 15 percent. So, in this range you can understand that A items are only 10 to 15 percent and they are contributing 60 to 70 percent value. So, you require high efforts in maintaining the inventory of A items. B items are around they have 20 percent items and around 20 percent of value, so moderate effort and C items which are large in numbers 70 percent and their value is very less 10 percent around that, so low efforts.

So, you will like to see your maximum application of scientific method of inventory management for A type of items and you can go with very intuitive type of inventory management with C items. So, that is the purpose of breakdown of ABC analysis. If you are top person in your company so you should not waste much of your efforts in maintaining the inventory of C level items.

You can delegate that work to some first an executives. But, as a CEO of your company as a Senior Executive of your company, you need to put more efforts or the inventory of A type of items should directly be under your control. So, that is the meaning of high efforts, moderate efforts and low efforts. If top management is involved in maintaining the inventory of C items, it is wastage of efforts. So, this ABC classification helps us in classifying inventory items on the basis of efforts requirement. Now, on the basis of this ABC classification we can also have a numerical example.

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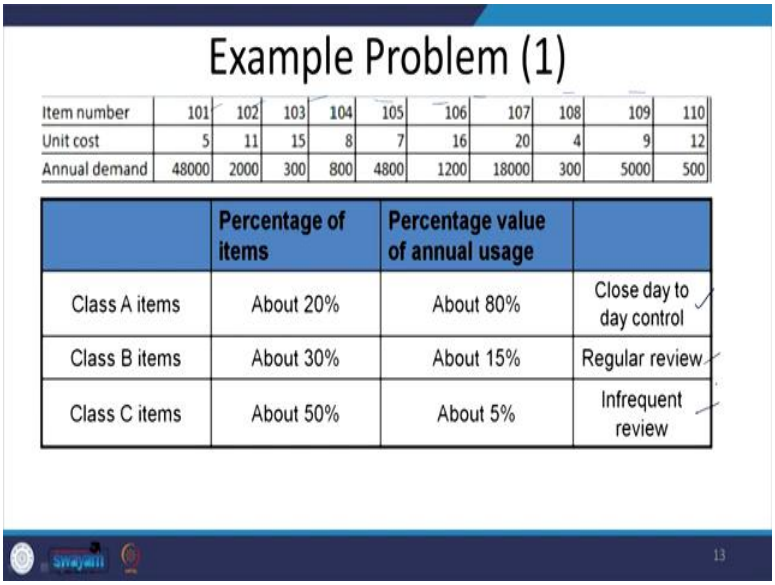

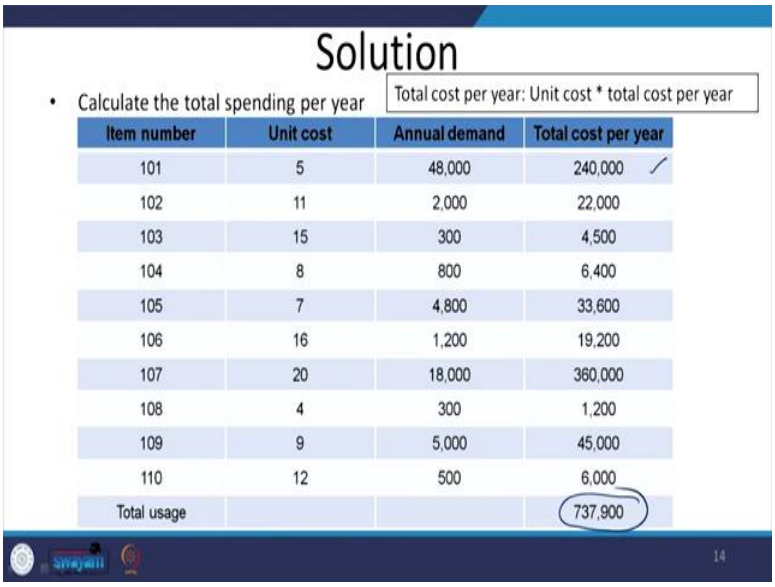

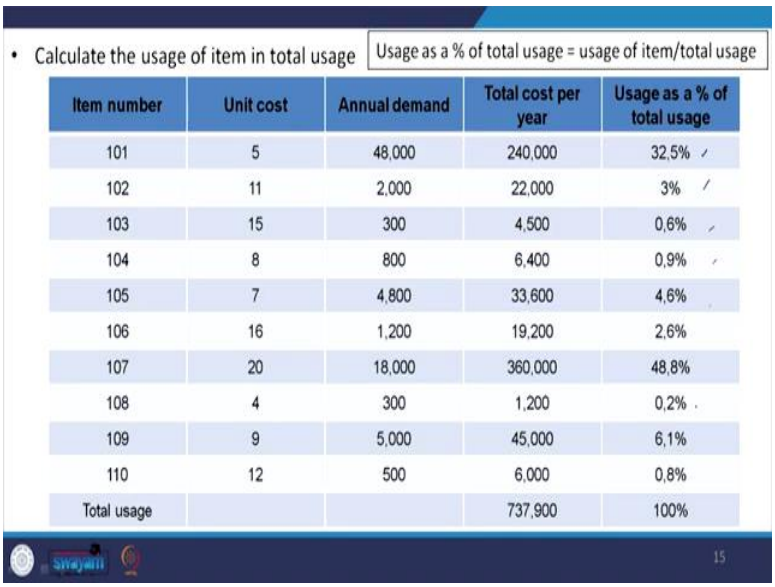

Now, in this numerical example, we have different types of items, so items are given by their code numbers. 1012, 110, these are the code number of items and unit costs are also given like 5, 11, 15, 8, 7, 16, 24, 9, 12, these are the unit cost of these different items. And the annual demand is also available from 48,000 units to 300 units to 5,500, the unit annual demand of these different products are also given to us. Now, we can do the ABC classification of these different items.

We need to see which item are more important means which are A type of item, which are B type of item and which are C type of item. So, we already know that what is A, what is B, what is C. So you need to have very close control, the regular review and you require almost very little efforts for C type of item. Let us see the calculation part of this ABC analysis. These are the different items from 101 to 110 and the unit cost annual demand. So, we have multiplied the unit cost with the annual demand and this is the total cost coming per year and now you have this last column of this table, where the total cost per year is available and this is the sigma value of total cost per year.

Now, on the basis of that, we can calculate the percentage contribution of these different cost factors in this total cost. So, you have 32.5, 3 percent, 6 percent, the 0.9 percent, 4.6 and so on for different type of items in these total cases.

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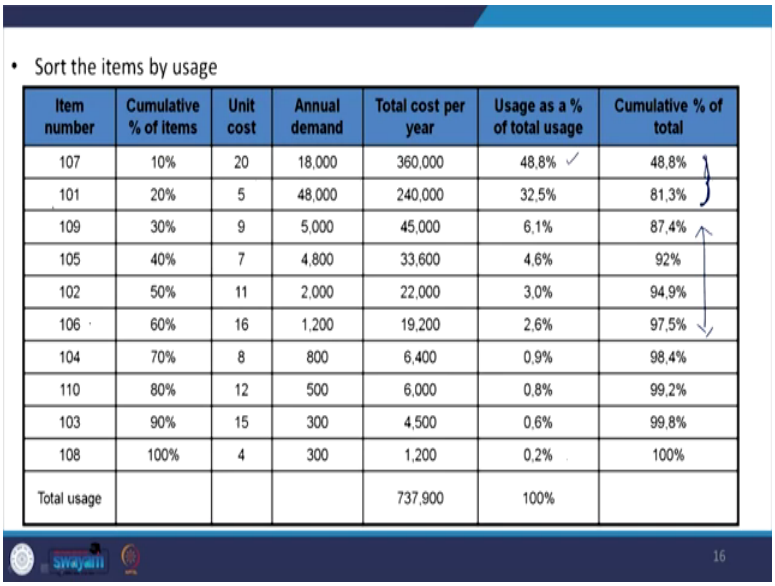

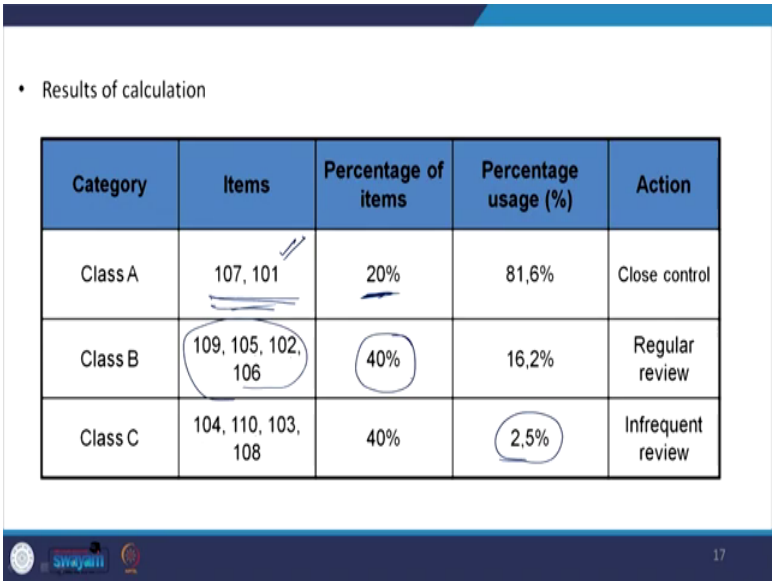

Now, here you see we have developed the sorting scheme on the basis of usage of these items. So, here the sorting scheme has given that, 107, 101, 109 so this is in the order of descending usage. So, we have sorted out these items that the maximum usage is of item number 107 which is contributing about 48.8 usage.

And the least is for 108 which is only 0.2 percent, so that is the contribution of different types of items with respect to their usage in this entire inventory system. Now, when we see this classification, now you see that percentage of items which we want in A category is between 15 to 20 percent. And here the two items, out of we have a list of around 10 items, these are 10 items. So, two items which are having the maximum contribution that is these two items. Because by adding these two items, it is becoming somewhere around 80 percent. So, 20 percent of 10 is 2; so these two items, 107 and 101 these are my type A items.

Then another category is those items which are in B category. Now, these are the 10 items so somewhere around 40 percent usage of 40 percent items can be in B category, and 10 items are there, so 40 percent means four items can be classified as B type of items. So, and their usage should be between that percentage only. So, we have seen that next four items which are there these are next four items, which are 109, 105, 102, 106 these are the items 109, 105, 102, 106 these four items are now B type of items.

And remaining items are C type of items which are only taking 2.5 percent of my total inventory value. So, these are 104, 110 last four items are falling under the C category. So, you can see now out of 10 items the maximum efforts are required for only these two items because they are taking 80 percent of my usage. But, you may require some kind of moderate effort for these four items which are under B category. But, for this C category items because

their contribution is only 2.5 percent, you need not to put any kind of serious effort and you can go without much effort for their inventory management.

So, this is one very popular system of our inventory classification and which is very frequently used in industry also. There is one more classification scheme, which is used in the industry that is VED classification.

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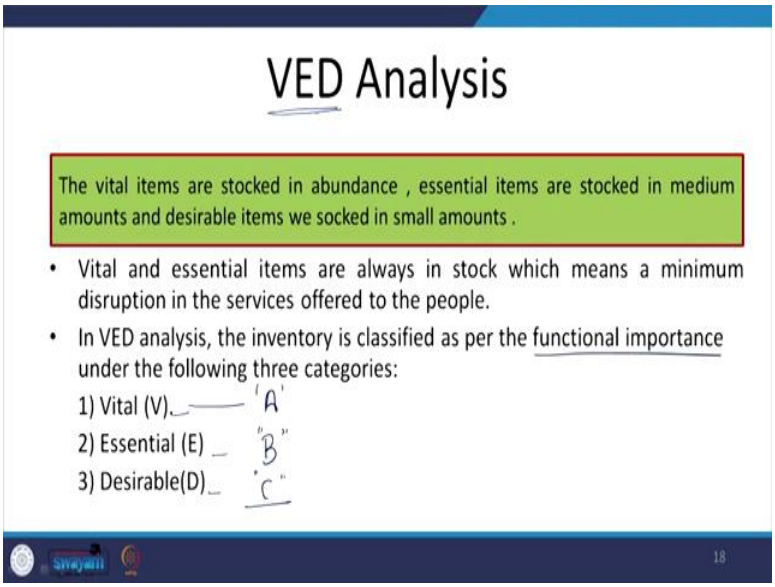

Now, in this VED classification as the name indicates, we classify our items on three different parameters, into three different categories. V stands for Vital, E stands for Essential and D stands for Desirable. So, items are classified into three categories: vital, essential and desirable. So, those items which are very-very critical for the organisation, these are the vital items so these are you can say, type A items as we have discussed in ABC analysis. So, you have to have very high monitoring of these items, because sometime it is possible that the monitory value of that item may not be very high. But, that item may be very critical for the running of your organisation.

So, maybe like you have bearing in your organisation, so the bearing may not have very high monitory value. But, if a bearing is broken, you cannot run your organisation unless until you replace it with the new bearing. So, those type of items which you know are highly critical, that may not have very high monitory value, so in that particular case VED analysis is useful. Otherwise, if you go by ABC analysis, you will not give any kind of importance for those items because of their low monitory values. Maybe in a year you require only one bearing, and therefore you have very low level of efforts for maintaining the inventory of those items.

But, that is very critical for the running of your items, so you need to have few bearings all the time available in your stock, so that is vital type of items. Essential is not very critical but still you need to have some kind of inventory management system for them, so these are the essential items. So, you can compare them to some extent as B type of items, because you require moderate effort for maintaining the inventory of these essential items and then the last is desirable. Desirable are those items that if you maintain inventory of these items, it is going to help you.

But, you can reduce your efforts for maintaining the inventory of these items as compared to V and E, so you can compare to some extent these items with your C type of items. So, VED analysis is also very useful when your monitory classification because ABC is purely on the basis of monitory classification. That those items which are constituting more value in your stock, they are given priority. But, sometime the functional utility is more important and when the functional utility is more important, then VED analysis should be used. So, if all items are not able to classify on the monitory basis, then the functional importance becomes very important way of classifying the inventory item.

And VED analysis takes care of this functional importance of items. So, in this way, we understood the important things related to inventory control and management. We discussed one-bin system, two-bin system, what are the important things in the independent inventory management, and finally, we discussed the classification of inventory management by doing ABC and VED classification systems. Thank you very much.