Operations Management
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Lecture – 52
Inventory Control

Friends, welcome to session 52 in our course on operations management and currently we are in the eleventh week of our discussion and the topic of eleventh week is materials management and if you remember in the previous session, we have just discussed the basic concepts of materials management, we have seen what are the objectives of materials management, what is the scope of materials management, what are the responsibilities of a material manager materials manager and we have tried to define the word inventory, which is most commonly used in materials management. In nutshell, we have tried to find out that what materials management is all about and what we need to do in order to ensure efficient and effective utilization of our materials.

So, we have seen that there are three important aspects of materials management starting from the procurement of materials, then ensuring the proper usage of materials and finally, the accounting of the materials that have been procured. So procurement, usage and accounting are the three keywords that are related to materials management and today we are going to focus on inventory control, which is a slightly specific topic.

Materials management is more general in nature and inventory is more specific in nature. In the last session, towards the end, last two slides were focused on defining the term inventory and we have also seen that what type of materials make up the inventory. So, we have seen the raw materials, the work in process, the parts that are being transported from one place to the another place within the organization, the tools and equipment; all fall under the inventory and it is important for us to manage our inventory properly. If we are not able to manage the inventory properly, we may have to suffer huge losses in the organization.

So, today we will see that how we can manage our inventory and the topic for today is inventory control. So, prior to that, let us try to highlight the importance of inventory control, that why do we need to keep an inventory. Some of you can question this and that is a very valid question that why not to procure the material when it is required. So,

we need not keep an inventory, we need not tie up our capital in the inventory, that is that, we need not spend money and keep the inventory in stock. So why do we need to keep an inventory? Why these materials at the first instance are required in the industry? So, our next slide will answer all these queries, that what is so important that we need to keep the inventory.

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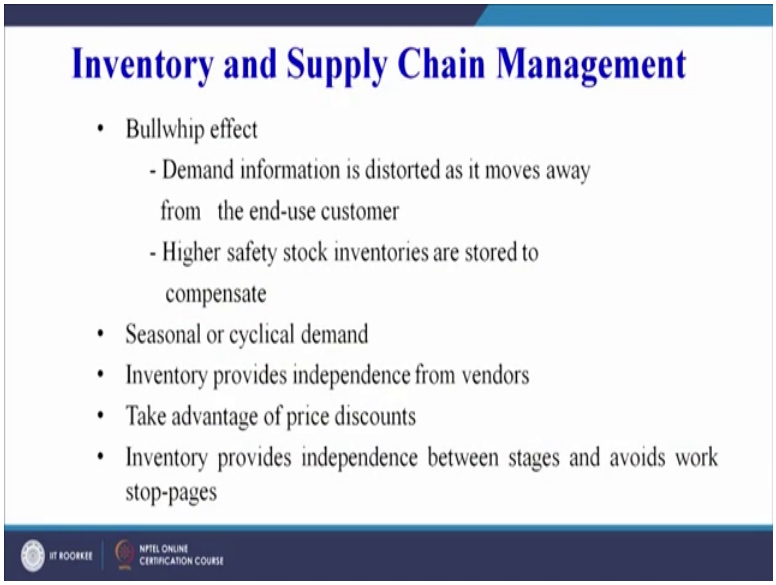

Now, the first thing that explains that is the bullwhip effect, the inventory and supply chain management are interrelated things and inventory is one of the important elements of supply chain management. So, first is the bullwhip effect, which means that the demand information is distorted as it moves away from the end use customer.

Now, as end use customer, suppose I want to buy a mobile phone of a particular company, so that is the demand at my end. So, the I am the end user customer of that mobile phone, but as I move down to the company, that complete chain of people who are involved in this chain will; this may be the information may get distorted. So, the complete information may not be there, some companies are making use of the direct interface these days between the customer and the company.

Directly you can order online to the company and they can have a better idea, that what is the exact demand of our product in the market. So, these days the use of information technology is helping the companies to reduce this effect, but many times the demand

gets distorted because of the bullwhip effect. Higher safety stock inventories are stored to compensate this. So, that is another word is coming here safety stock.

So, we will try to understand this when we go through our discussion on economic order quantity, that what do we mean by the safety stock, but in order to compensate for this effect, many times the company keep a safety stock of materials that whenever required, we can get this material from the safety stock. Otherwise, they may have a particular service level of materials, that this is my normal may be working capital and if, in case of emergency I will draw the capital from this safety stock that I have maintained.

Normally we do in our management of our finances, mostly we will keep some amount as a working capital for daily expenditure and the other amount we will keep as a safety stock that if required, then only I will use the safety stock. Otherwise, I will manage by my day to day expenditure money that I have kept. Similarly, for materials also, for normal usage of the materials that are required in assembly oppression or in the manufacturing process, we will keep certain level but we will keep another level down that that will be the safety stock, whenever required, we will take the material from the safety stock.

So, mostly companies keep a safety stock, so that the process must not stop because in many industries for example, if you are making electricity from coal in specially in case of thermal power generation, you cannot afford to stop the boilers because a refilling may take huge amount of investment. In many other processes also which are capital intensive, you will not wish to stop the process in want of materials, therefore, you will always keep certain materials in store so that the process is not stopped and its processes continuous.

Many times, there will be seasonal or cyclic demand, so we have to keep the inventory in order to meet that demand. Inventory provides independence from the vendors. We precisely will not be look we not be required to look up to the vendors every now and then, whenever there is a requirement because if we have certain material or maybe certain amount of material in the inventory, we can very easily use that material instead of depending upon the vendors every now and then.

So, that is also one important requirement that why we must keep an inventory and why we must manage our inventory properly. Then, sometimes it so happens as I have take, as

I have already told in the previous session; also there are discounts available, you buy two materials you get two free and many times if you buy beyond a particular volume, maybe if you buy more than 100 kg of raw material, you will get this discount. So, many time, the company want to take advantage of that quantity discounts and therefore, they buy the material in bulk and store it in the form of inventory and inventory also provides independence between the stages and avoids work stoppages.

So, which I have already explained that the inventory is majorly focused on managing the line or the manufacturing line or manufacturing process efficiently and effectively as well as to ensure the continuous production of the products and therefore, we need to keep an inventory. So, with this slide, the major focus to emphasize is that why do we need to keep the materials in the store. In our house also, we will not every now and then, we will not be running to the grocery store to buy our materials.

We may may be for a month, we may buy our grocery and keep it in our kitchen cabinet or in the store adjoining the kitchen. So, that for the complete month we have stocked our rations properly. Similarly, in case of industry, there also the manufacturing is going on. So, we will buy the material and keep it in the store, so that the process is continuous and whenever the level or the quantity of materials materials go beyond or go below a particular level, we will reorder the materials, so, basically inventory management and control.

So, we will see that one of the important topics today, that how we can control our materials. So, inventory control is very very important because we need to find answers to certain questions. So, inventory control is a planned approach for determining.

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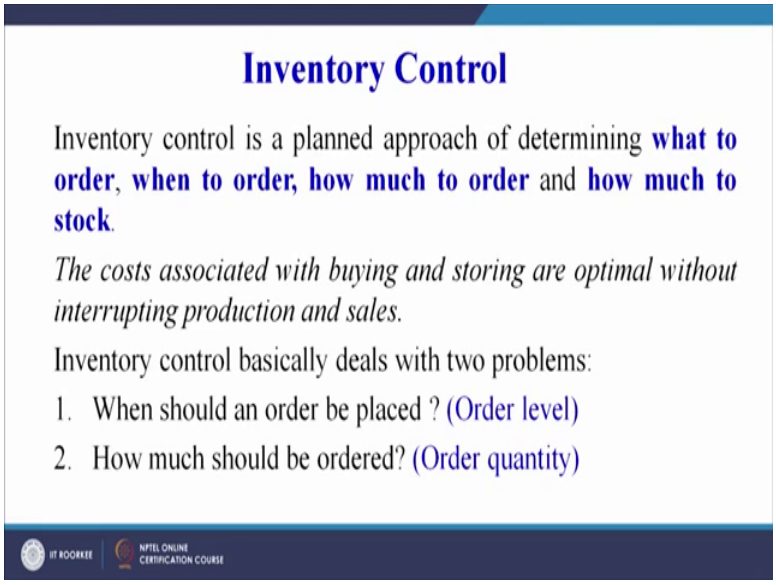

So, we need to find out answers when we are managing our inventory that what to order that is one thing. When to order, that is in the time domain maybe every fortnight, every month or every 3 months or every 6 months or every year; whatever is our time window that we have to decide. First is what we have to order, when we have to order, then the third question is how much to order. Whether we must buy the materials required for next 1 year at one go or we may break it into two orders of 6 months each or we may break that or may divide that order into four orders every quarter.

So, we have to take a decision what to order, when to order, how much to order and how much to stock, that is a safety stock that how much safety stock we must keep in order to avoid any discontinuity in our manufacturing process. So, these answers we have to look for in our topic of inventory management and control the costs associated with buying and storing are optimal without interrupting production and sales. Now, all these answers we have to find out, subject to that the cost associated with buying and storing is optimal, without interrupting the production and sales.

Again, I have read the sentence for all of you that answers to these questions. We have to find out either mathematically or intuitively or by our experience, but what must be always kept in mind that, the cost involved in answering all these questions or finding solutions to all these cost questions must not be very high. At the same time, we have to ensure that the process or the manufacturing process must not stop. The assembly of our cars or assembly of our automobiles must not stop.

So, that is also very very important. Now, inventory control basically deals with two problems so, the first problem is when should an order be placed and how much should be ordered – so, order quantity. So, the answer to the second question first is the economic order quantity model. Usually, we term it as EOQ model and we will cover the EOQ model in our next session. In many competitive exams also, in many you can see university exams, there are numerical problems, quantitative problems related to the economic order quantity and it is an important topic not only from the academic point of view, but also from the application point of view, from the industry point of view. We must know that what is the economic order quantity, using our simple mathematical formula we can do the calculation for EOQ and the first answer to the first question is, when should an order be placed that is the order level.

So, that we will see, usually we term it as a reorder point of reorder level. Also, that when should an order be placed. That is, how much is left in our stock when we must place the order, that will depend upon the lead time also, that after placing an order what is the gap of time by which we will receive our order. So, we have to see what is the lead time, what is our consumption rate. Based on these two parameters, the consumption rate that is, how the material is getting consumed over a period of time. Today, if we order after how many days or how many weeks we will get our order. So, these two things, we will decide that what is going to be our reorder level. We will try to understand this with the help of a diagram also. So, first of all, we have to learn that what is inventory control and how to find the answers to all these questions.

So selective control of inventory, that is when what we can do, refer. Now, selective control refers to the variation in method of control from item to item on selective basis. So, from part or component to component wise, we have to exercise different type of control. So, selective control refers to the variation in method of control from item to item on selective basis. So, in this system, the items are categorized in a few groups depending upon the selective criteria, such as value usage frequency and consumption such grouping helps the organization for scientific inventory control.

So, we have to manage the materials in our organization and we have to frame a criteria to classify these materials. So, that we focus on the materials which are important and put less focus on the materials which are less for less important. Although, all materials

are important in the industry, but a relative grading can be worked out on the high value materials as well as on a low value material.

So, we can classify the materials and that one of the methods for this classification is the ABC classification. So, we will see one problem related to ABC classification today, but there can be other methods of classification based on the usage, based on the value of the products or value of the parts that we are focusing our attention on or value of the materials that are in our inventory. So, we may have 15 different types of materials in our inventory and we wish to classify them into five different categories so that classification can be based on the usage of those materials. For example, one material is used very frequently every day.

Maybe, 10 ton of that material is required; other material may be required in a very less quantity, maybe 1 percent of this high valued or high volume material. One material is required maybe 10 tons per day; other may be required as 10 kg's per day. So, based on the usage we can classify one material high volume material, another is low volume, only 10 kgs required per day that is based on usage. Another one can be based on the value of the material, another can be the frequency of usage, some materials may be very frequently used, some materials may be less frequently used.

For example, if we go to a shopping mall, so, there will be a high frequency material which is like kind of vegetable or may be daily grocery things, then there can be high valued materials in the shopping mall. For example, the led TVs or maybe refrigerators or air conditioners or the sales frequency may be less for high valued material, but sales frequencies more for the low valued materials like vegetable or maybe the grocery items and then, the consumption may be another criteria for classifying the material. So, we can classify the materials based on usage, value, frequency, consumption.

So, there can be different criteria now such grouping. Why do we need to group the materials because we as managers as engineers we have to focus on specific group of material. So, we whatever is our objective whatever is our may be the target we have to classify them. So, that we are able to achieve our target. In many cases we may not like to focus on a material which is not very costly. So, based on the value we can classify that this material is not very costly, even if we focus our attention on this material we are not going to gain much.

So, wherever you must focus? We much must focus on high valued material because even if we are able to say some amount of money in this high valued material, we will be able to save substantial money for our organization. So, similarly that maybe, focus area can be identified by classifying the material. So, I think I have tried to highlight the importance of classifying the materials and now, let us take an example of various types of analysis.

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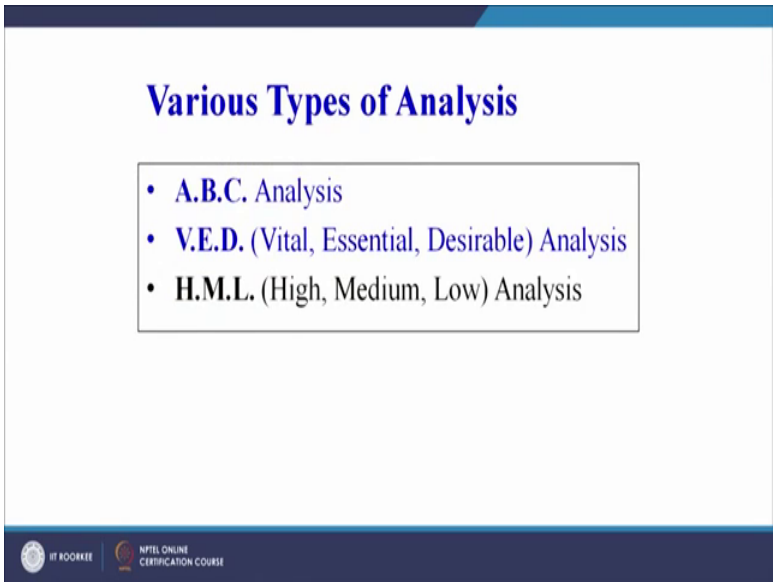

So, we will take 2 today, that is ABC analysis and the VED analysis, that is vital essential and desirable and there can be HML also high medium and low analysis as I have already told, the criteria can be the usage, the value, the consumption, the frequency. There can be different criteria for classifying the materials. One of them is ABC, that we are going to understand today with the help of a diagram and an example; and we will try to understand the very basic concept of VED analysis also.

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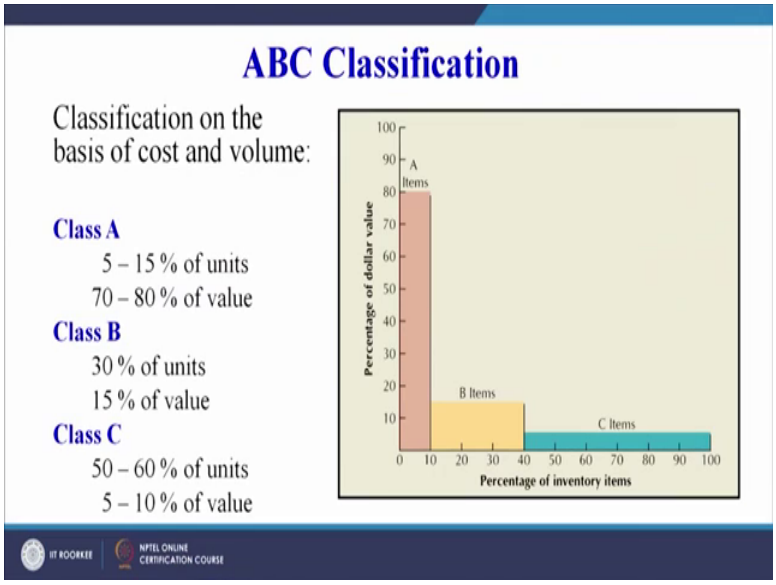

So, ABC classification, you can see on your screen now the classification on the basis of cost and volume. So, we can see here, the usage is also taken into account and the value is also taken into account. So, the cost is may be corresponding to the value of that particular material and the volume can be the usage of that particular material. Now, we will classify as the name goes ABC classification. We will classify the materials as class A material, class B material and class C.

Now, let us see; what is class A? Now, class A material is that, it will be only 5 to 15 percent of the units. Now, suppose we have 10 different types of materials, so, we will have either one or two materials only, which we will fall in class A, but their overall value, will be around 75 to 80 percent or 70 to 80 percent of the value. So, these will be costly items, the number of items will be less, but their value will be more. Similarly, class B may be 20 to 30 percent of the items will fall in class B, that is if we have 10 different types of materials, we can have 2 to 3 items or materials which can fall in class B and the value of these materials will be 15 to 20 percent only and the last is, class C items which are maybe cheaper items.

The value is very less, but their numbers may be more. For example, if we see of in an office, we may have computers we may have 3 computers only. The number is less, but the value is more. But the stationery items for example, the pencils, pen, pen stands and the other resistors etcetera. So, their number is more, but the value is less. So we, if we classify the materials that are there in an office. So, the computers will have maybe high value, but the number is less, but the stationery on the other hand the number of

stationery items is more, but the value associated with these items is less. So, we classify the material as A, B and C as given on your slide. Similarly, we can try to understand this with the help of this diagram.

So, class C items, you can see the percentage of inventory items out of 10 as we have taken an example, may be, 6 items are class C items, but their overall value is approximately 5 to 10 percent only. Class B, here we have maybe 30 percent of the item, out of 10, three items are may be class B items, but their value is maybe 15 to 20 percent, but there is maybe one item out of 10 which is class A item and the value of that item is 80 percent. So, this is the way we can classify them as A, B and C.

So, A items are high value item, 70 to 80 percent of the value is associated with them, but their number is less and on the contrary, class C items, their value is less. They may account for 5 to 10 percent of the overall value, but they are highly numbered; the number is large. So, that is more percentage of the units in class C items. So, let us take a very quick example. So, this is one example how do we do the calculations for classifying the material as A, B and C.

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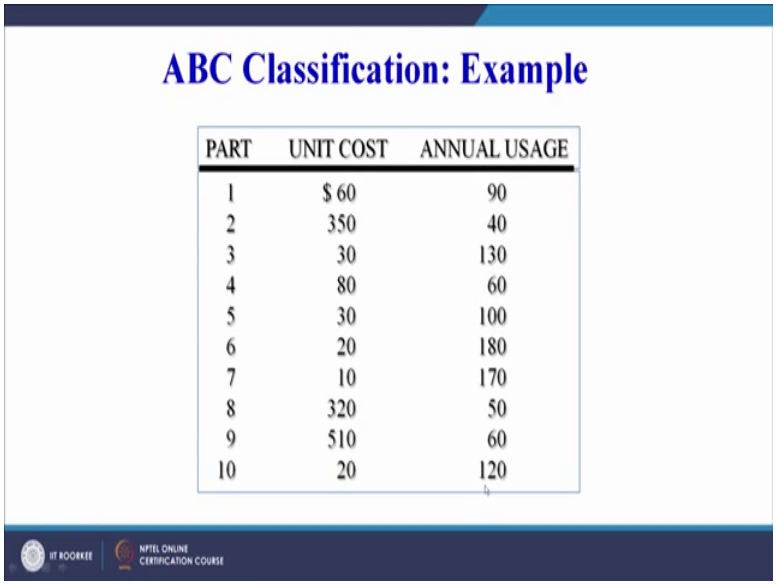

So, this is annual usage is given. The part numbers are given there are 10 different items. Here, part 1, part 2 to part 10 unit cost for each item is given or each part is given. So, what we can do? We can multiply this to establish the overall value that which item is

having the maximum value and which item is having the lower value and consumption is already given to us. So, we can do the calculation further.

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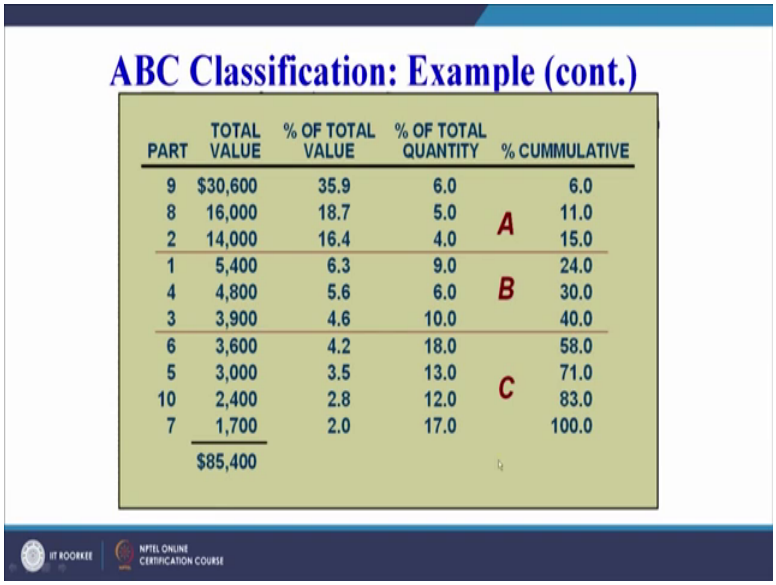

So, first we will arrange this based on the total value, because our one criteria for classifying under ABC, is the total value associated with the product. So, here we can see item number 9; 30,600 dollars. So, you can see item number 9, here 510 multiplied by 60. So, when we multiply this, we will get this value – 30,600. Similarly, when we multiply the usage and the cost, we will get the total value. So, we have unit cost also available, annual usage also available.

So, based on these two data point data and the multiplication of these values, we will get the total value and then, we can calculate the total value is coming out to be dollar 85,400 and then, we can calculate how much is this contributing in the total value. So, the percentage contribution of this can be calculated by dividing this by the total value. So, 30,500 divided by 85,400; we will get maybe 35.9 percent.

So, value that will we will get is 0.369 multiplied by 100, we will get 35.9 percent contribution of part 9 towards the total value. Similarly, part 7 is contributing only 2 percent to the total value total value. So, the total value 35 percent contribution is coming from part 9. Similarly, percentage of total quantity also, we can calculate. We know that the total usage, annual usage is available with us for each and every part; from there we can calculate; what is the percentage of total quantity for part number 9.

So, part number 9, we can see in the previous slide part number 9, only 60 items are used per maybe year because this is a annual usage given to us 60 parts only per year for part number 9. So, if we add this, we can calculate the percentage contribution in the total annual usage by part number 9. So, we can calculate that and here, we can calculate the percentage cumulative, that what is the cumulative percentage of this, may be part in the overall consumption and based on that, we can classify the material.

Now, maybe this figure, we have done the calculation, we have multiplied the unit cost with the annual usage, then we have calculate the percentage contribution of a particular part in the total value, we know the annual usage based on that, we have seen what is the percentage contribution of a particular part in the annual usage. So, we have found out the percentage contribution of individual part in the total value, we have calculated the contribution of individual part in the total usage or the annual usage, from that we can classify. Now, if you remember A, B and C A are items which are having high value, 70 to 80 percent value contribution in the overall value.

But their numbers are less, maybe 10 to 15 percent of the total usage. So, we can see, we can classify them as on your screen you can see A item high value low usage and part C, where we see low value high usage. So, maybe here we can see A, B and C. So A we can, if we add up these three; total value percentage contribution 16 plus 14 comes out to be 30 plus 30. So, A total uses can be, maybe say, more than 60 percent here. So, and the usage is percentage cumulative usage is 15 percent. So, their number of items is less, maybe three items only, but their percentage usage is 15 percent and the total value is maybe nearly 70 percent. Usage less value, more A uses more value less C. So, that is what is given here. So, items 9, 8 and 2 are classified as A, because their percentage of total value is more and their percentage of total usage is lesser.

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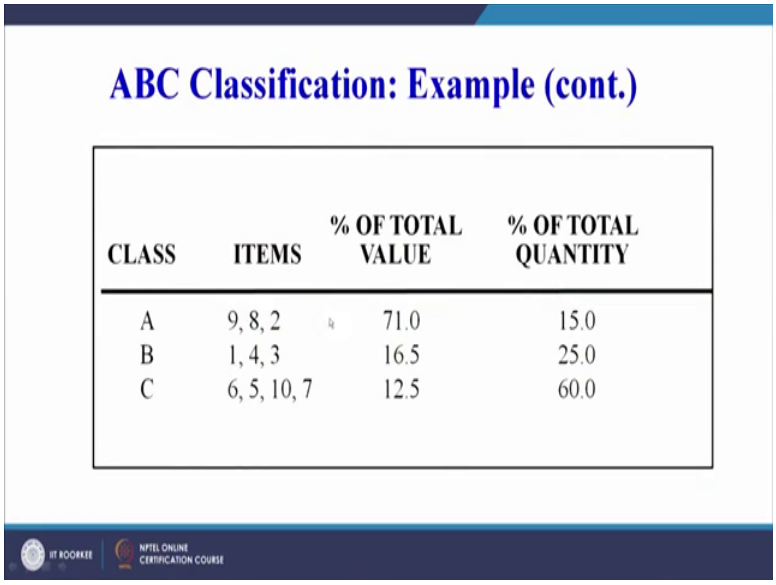

Total quantity contribution is less whereas, C items; four items are there, the total value is only 12.5 percent, but the percentage or total quantity you can see is 60 percent. So this way, we can classify if we have the unit cost available with us for all the parts or the components, we have the annual usage available, we can multiply them, we can calculate the percentage contribution of individual part in the total value of a maybe materials and then, we can calculate the total usage also. Percentage contribution of total usage by every component and then, we can classify them high value will be high valued components will be given as class A and low usage on the other hand for class C, we will see the value is less for these materials, but the usage is more.

So, this is one particular classification that is ABC classification. So, advantages of ABC I will very quickly I will read this for you.

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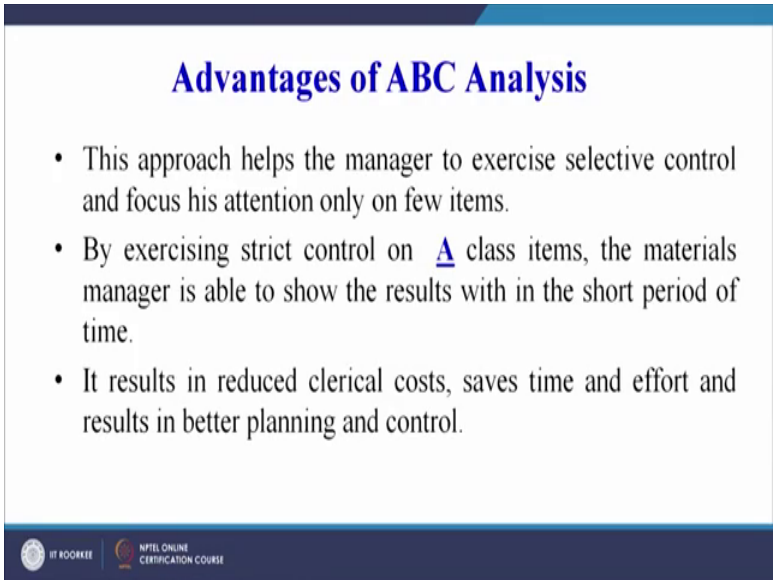

This approach helps the manager to exercise selective control and focus his attention on few items only, though he can focus on high value products or high value components or parts only by exercising strict control on A class items, the materials manager is able to show the results with short, within a short period of time only. So, he can show the gains by exercising control on class A type of items, which are high valued items; it results in reduced clerical cost, saves time and effort and results in better planning and control of the materials.

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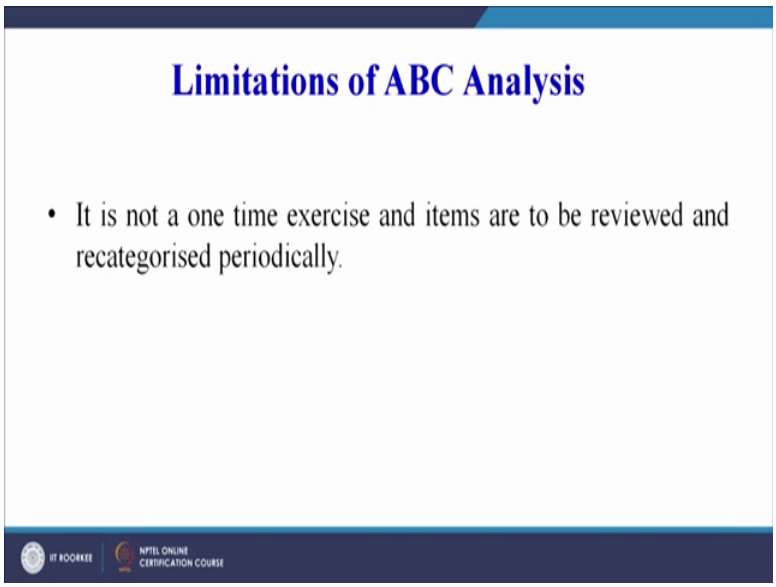

Now, what is a limitation? That it is not a onetime exercise and items are to be reviewed and re categorized periodically. So, the usage may keep on changing, the unit cost may

also some time change because of certain discounts or other criteria. So, we maybe every year or every 2 years, we can recalculate or re categorize the materials as A, B and C category materials or A, B and C class material. So, last part maybe for today, just an introduction what is VED analysis instead of based on the total value or the usage, we can also classify our materials as vital essential and desirable.

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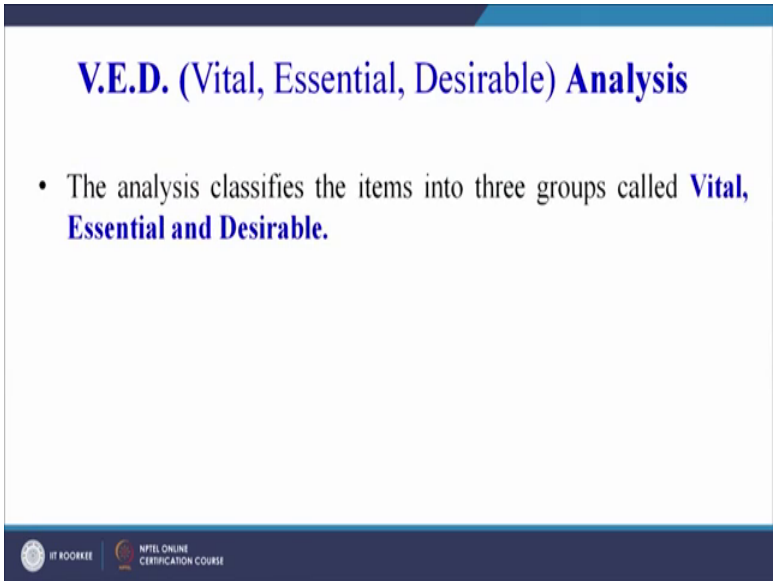

So, the analysis; classify the items into three groups or the materials into three groups, that is – Vital, Essential and Desirable. Now, just we will try to understand what are, what type of materials will fall under vital category, what type of materials will fall under essential as well as the desirable.

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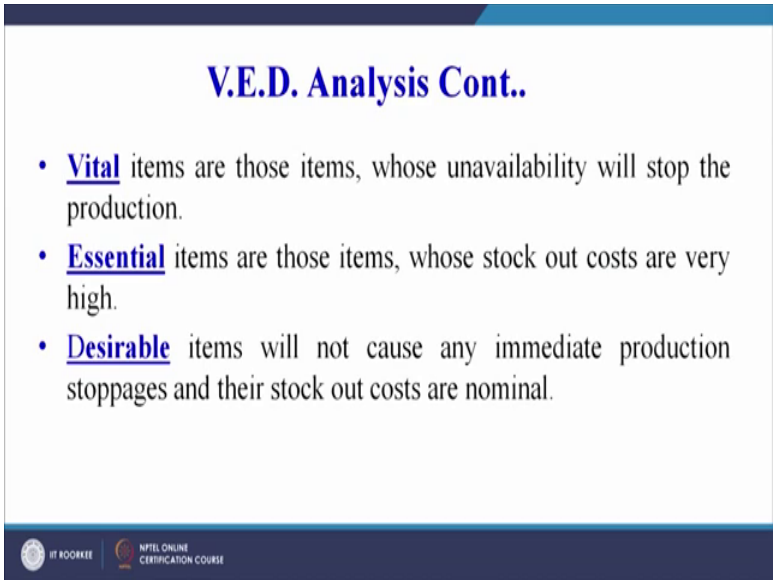

Now, what are vital items? Vital items are those items whose unavailability will stop the production. So, they are the lifeline of the production process. So, if you cut the lifeline, the process will stop. So, vital items are those items whose unavailability will stop the production. Essential items are those items to provide maybe, provide that material the stock out cost will be very very high. Desirable items will not cause an immediate production stoppages and their stock out costs are minimal or nominal. So, based on this also, this classification also, we can classify the materials.

So, maybe the most important are the vital, because if you do not have a vital or if you have a stock out of the vital materials, the overall production process may stop. So, in today's session we have seen two different methods of classifying the materials in the organization that is the ABC analysis and the VED analysis. In ABC, we classify the materials as class A, class B and class C. Class A high value, may be low usage. On the other hand, class C low value, high usage and in vital, essential and desirable; vital components are very important because their unavailability will lead to the stoppage of the production process. Prior to that, we have tried to understand that what is the role of inventory control and more specifically why do we need to keep an inventory.

Now, in the next session we will try to answer our questions like how much to order, that is economic order quantity and we will try to see that when to put our reorder, what is the lead time, what is the reorder level; all those things we will try to understand in our next session.

Thank you.