Project and Production Management
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Lecture - 38
Basic Inventory Principles

In today's lecture we are going to be talking about some basic inventory principles. If you recall in the last two lectures on aggregate production planning, we had seen that the major problem was concerned with fluctuations of demand and maintaining inventories. To meet that fluctuating demand was one of the important means of dealing with such fluctuations. In this lecture we will devote ourselves primarily to how inventories are handled, whether they are really relevant, what functions they perform and what would be a computerized inventory management system. These are the basic issues that we will be talking about in this particular lecture.

Basically inventories are idle resources maintained in various forms. The question that obviously arises is, if they are idle resources why do we keep idle resources, because in any situation you would not like to see your man power idle. You would not like to see your machines idle. You would therefore not like to see your machines and materials idle. What is the basic purpose of keeping inventories? We must also recognize that inventories are maintained at various levels throughout the manufacturing system, for instance we talk about inventories of raw materials. Whatever materials are received in the factory you often maintain stocks of these raw materials and quite often depending upon the nature of the factory you might find huge chunks of raw material lying there as inventory. It is not only occupying space but it is also at the same time blocking up capital which could have been put to productive use. In that sense it is there. Then inventory may be in the form of purchased and manufactured parts. Parts which have to be purchased from outside and parts which have to be manufactured within the plant, both of them constitute inventories and you inventories at that level. Then as you proceed among the manufacturing process, you find that there are subassemblies and these subassemblies are also nothing but work in progress inventory and finally when you talk about the finished products, those also are inventories. So what it really shows is that the presence of inventories is there at every stage of the manufacturing starting from raw materials to purchased parts to subassemblies to finished products. We also recognize the fact that since inventories represent a sizeable investment in a logistic system, we must be aware of the functions they perform.

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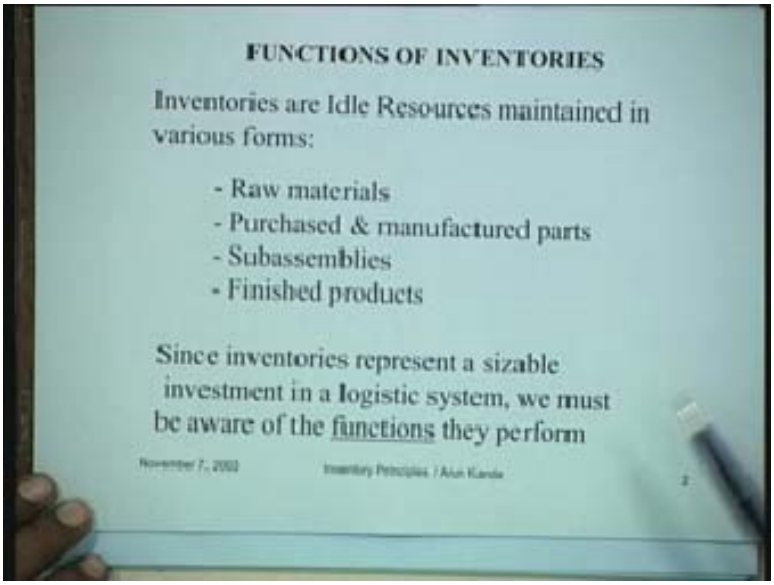

We must be clear in our mind as to what kind of functions inventories would perform. Why are we maintaining inventories, keeping idle resources with us at that particular point of time? I think it would be interesting to see that there are different categories of stock, for instance the first category of stock and one of the major purposes of inventories is what we call pipeline stocks. This is in process stock or in transit stock and therefore what we mean by this is that you take the analogy of a pipeline which is used to supply water for instance. You will never get water in the tap unless the pipeline is full. If there is no water in the pipeline you will never get water at the point where you need it. Something similar is required in the inventory design system because unless the assembly line is full you will never get a car at the end of the assembly line.

These kinds of inventories are actually called pipeline inventories or pipeline stocks and there is really very little you can do about them. The only way to minimize pipeline stocks would be to design a better method of distribution that means design a piping system which has lesser length, lesser diameter, may be and then you are able to use this for purposes of maintaining the amount of water stored in the pipe is minimized. It is equivalent to saying that the inventory stored would be smaller if the length of the assembly line is smaller. However if we have very large lengths of the assembly line you will have much greater stocks which are in process and therefore this is a major thing. Therefore basically pipeline stocks which make the inventory function properly are can be reduced only by design better design of the system. You cannot improve them by improving the operational performance of that particular system. This is the first function of inventories. They are actually pipeline stocks and therefore they are necessary in that sense. The second category of stocks which we often talk about is called cycle stocks. Cycle stocks occur for instance in batch production, owing to economies of scale or to technological requirement. What this means is that when you are producing instead of producing one item at a time, you often tend to produce in batches.

If you are producing a certain quantity, you might produce let us say in batches of 100. When you have batches of 100, you are not consuming at the same rate. The production rate is typically higher than the consumption rate. You have stocks accumulating and this accumulation of stocks is what we call cycle stocks and basically when you are talking about economic order quantity and its determination you are trying to actually minimize the costs associated with cycle stocks. That is the whole purpose.

The third category of stocks when we talk about inventories, are what we call seasonal stocks. These are like time varying requirements of an item. Whenever an item is produced, these stocks are in much greater demand or whenever raw materials are available, you stock them, for instance, agricultural products which are produced in various seasons. If you visit a sugar factory, you invariably find that sugarcane is stored in large quantities, just outside the sugar factory in certain seasons when the sugarcane crop matures and after that it is not available. That is an example of seasonal stock and there are time varying requirements of an item. So because of these you can have seasonal stocks, another reason for maintaining inventories is in the form of safety stocks. So safety stock is there generally because of the supply and demand uncertainties and also because of uncertainties in the lead time. If you are 100 percent sure that your demand during the month is 100, you will order 100 and be satisfied with it but if it happens that in some periods it is 80, another period it is 120. There are these kinds of uncertainties. So you have to maintain some kind of safety stock of these items, so that you do not run out of stock in that particular period. Similarly if there are uncertainties in the lead time, it means it takes time for the vendor to supply your requirements, and this time is variable.

If it were fixed there would be no problem. You can order at a certain time and get the supplies but when the lead times are uncertain then the time at which you place the order will also be uncertain. So you have to maintain safety stocks to deal with such uncertainties. There could be stocks held for other reasons. For instance one of the major purposes of holding stocks for other reasons is the decoupling function, as far as the inventory stages or the production stages are concerned. For instance if they are in a factory, the number of machines connected from one to the other and the production process is going on from one stage to the next stage. Then in order to decouple the individual stages what would be required is that you can hold stocks between the machines which are actually trying to decouple the various machines, so that even if one breaks down the other one can keep on working. That is the decoupling function of inventories and it could also mean that you have situations like quantity discounts and price discounts. Also there might another reason for holding inventories which might be under speculation. You expect for instance that the price of a certain good or a commodity is likely to rise and therefore you hold stocks of that inventory in the hope that whenever the prices rise, you will sell the commodity.

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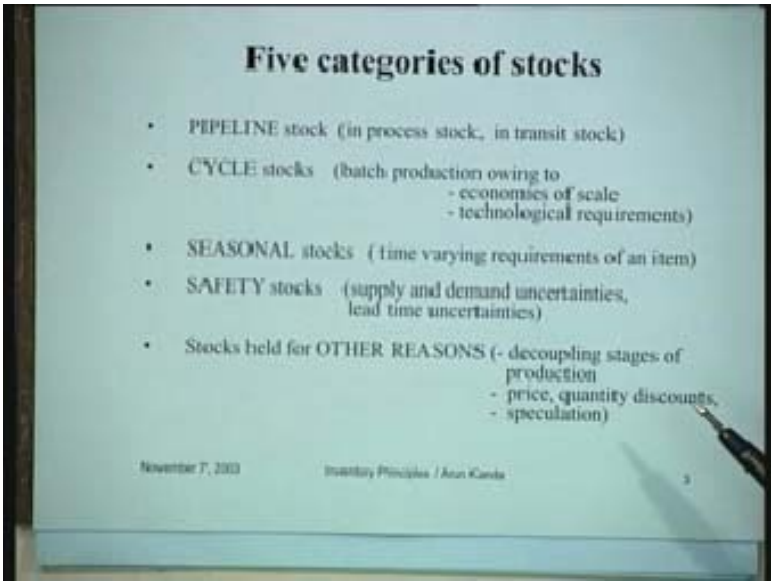

In fact trading in shares is basically an example of this kind of a situation. These are the basic purposes or functions of maintaining inventories in this particular situation. Now let us see the costs that are incurred as a consequence of retaining inventories. By and large we can say that inventory related costs can be of three different kinds. The first kind of inventory related cost is what we call a procurement cost and generally when you are talking about procurement cost, we can talk about various types of costs here. You can talk about the cost of goods but generally the cost of placing the order is fixed and generally not dependent upon the ordered quantity, that means the cost per order therefore is generally a fixed quantity and it does not depend upon how much you order, whether you order 20 items or whether you order 100 items from a person who comes to you.

Let us suppose you are shopkeeper and you maintain a shop where you have stocked different kinds of items. Then the supplier who comes to replenish your stocks, the cost per order would be the same no matter what is the order quantity for him. That is why generally the cost per order is not dependent upon the order quantity as far as the procurement cost is concerned. These are two very important types of costs. One cost is associated with existence of inventories and number two cost is associated with non existence of inventories. We have costs of holding inventories and costs of stock outs, if you do not hold out inventories. So normally costs associated with existence of inventories generally occur when the supply tends to exceed the demand. When the supply exceeds the demand then typically we have items in stock and the cost per unit per unit time is generally written as i into C where i is the inventory carrying cost rate and C is the unit cost of the item. What we are trying to say is that quite often it is common to express the cost of holding inventories in terms of a percentage of the unit cost of the item and small i here refer to what we call the inventory carrying cost rate. The other type of cost that we are talking about is the cost associated with stock outs that means a stock out is a situation where there is demand for something but you have no supplies available. It is the opposite of the situation. That means the demand now exceeds the supply. You

do not have the supply available. The typical way of handling these costs could be in the nature of either cost per unit or in terms of cost per unit per unit time. This would typically depend upon whether you are dealing with a lost sales or whether you are dealing with a back ordering situation.

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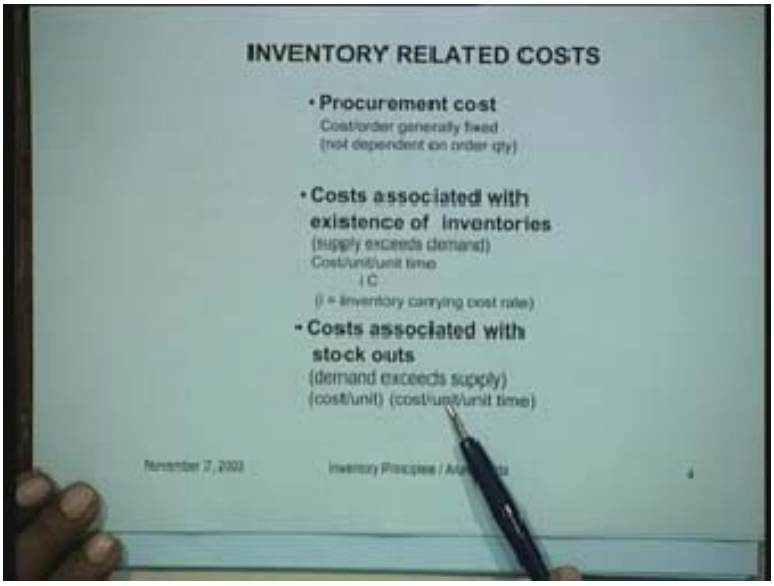

When you deal with a back ordering situation, the cost associated is a function of the cost per unit per unit time, that is after how much time can you satisfy the customer. Generally backordering cost would have these units but when it comes to lost sales, if a customer walks into a store and he does not find a particular shampoo of his choice he just walks away from it. So that sales is lost as far as the stores is concerned and the lost sales can be therefore expressed in terms of cost per unit, because it is not backordered. These are generally the major types of costs which are involved when you are dealing with inventory decisions. However in order to estimate these costs in real life what you need is a thorough understanding of which type of cost will go into a particular component in the inventory. Let us look at that, for instance when you look at the costs of procurement, the procurement cost generally is composed of these two components. One is the cost of goods; the second is the ordering cost.

Cost of goods is the price of the item that you pay and therefore this is the cost that you incur anyway and the ordering cost is in fact the cost that you incur in placing the order and here of course we had said that cost per order is generally fixed and is not dependent upon the order of quantity. I hope you are convinced of this, let us again take a small example and say for instance that there is a shop keeper who has to replenish his stock every week. What he probably does is that he engages every week a three wheeler or a taxi depending upon his financial position. Suppose he engages a three wheeler and then he goes to the main market, he goes to the bazaar buys all the items and keeps them in the three wheeler and brings them back. The cost of the order is the cost of ordering the three- wheeler from home to the main market and then coming back so that cost is

constant; irrespective of whatever he buys there, provided of course the total amount that he buys can be accommodated within the three- wheeler. That is what we are trying to say, so that is the reason why we say that cost per order is generally constant. However this cost per order that we are talking about generally contains these components in an industry. It talks about an administrative component. So the administrative component is the cost of preparing the purchase order, doing all the paper work and so on. So there is a cost for making all the enquiries which are required and things of that kind on telephones and faxing and other things. That is the administrative component. Then there would be a handling component. When you buy the goods, you have to handle them from that place to you premises. So there are always costs of handling. You might have professional packers to do this job for you or you might do it yourself. So the nature of the handling nature of the product determines how much handling costs you have. Then there is a cost of transportation and then there is typically the cost of inspection of arrivals. Once the items are received within your premises, you inspect them to find out the nature of the arrival. Are they okay? Good? Bad? How many breakages have taken place etc? These types of costs are involved in here. So all these costs go into the ordering cost component of the procurement cost and the cost of goods is basically what you pay to the vendor as the cost of the goods.

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After the procurement cost we talk about the inventory holding cost. This is the major inventory cost that we are talking about here and the inventory holding cost as we had said are costs associated with the existence of inventories. This would happen if supply exceeds demand so that you have a stock of goods and typically the unit is cost per unit per unit time which is expressed as the inventory carrying cost rate multiplied with the cost of the item. The typical components which are included here is if you were to estimate these costs in a realistic situation, the cost of storage and handling would be the interest on tied up capital. This is generally one of the most important components of the inventory holding cost. Quite often people tend to say that interest on tied capital is in

fact the major holding cost. Property taxes, insurance, spoilage of items, you see if you stock items in a store then on an average if you stock 100 items, whatever they are some would get spoiled as you go. So that spoilage cost is also a part of holding. Obsolescence cost is also a part of inventory holding cost. If there is a store which stocks certain kind of item or a certain type of shop taking cell phones for instance the obsolescence rates in such items is pretty high. All the older models would in fact become obsolete very soon and these obsolescence costs could be carried over to inventory holding costs. Pilferage is another important thing. I mean most stores would have data available on, let us say if they have stocked 1000 items at the end of day may be 20 are pilfered. The additional cost is in fact a cost of pilferage when items are being stored typically.

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How are storage and handling costs? Storage and handling costs are the amount of cost you require to let us say hire a storage space and to employed people and equipment to transfer the goods from that place put it in the various stacks. So that is storage and handling cost. It is entirely your cost; property taxes are the taxes you pay on the building. It is like saying that property taxes are like I stay in a house, I pay a property tax and storage and handling is whatever I store inside the house is not a part of property tax. It is I have decoration pieces; I have other things on the wall and so on. So that is the storage and handling of those pieces. These are the typical components in the inventory holding costs and basically you have to consider all these components. Now what really happens is that you might say for instance that, of the total inventory holding cost you might estimate these independently and then find out what is the inventory holding cost. Therefore what is normally done is that this inventory holding cost is generally estimated by estimating the value of i, the inventory carrying cost rate. Suppose an item is cost 1000 rupees, you want to find out what is the cost of holding is. First you say the interest on tied up capital is the main thing which means that if I hold an item where the interest rate is 10 percent. What does it mean? An item of 100 rupees I would be paying an interest of 10 rupees on that particular item, so on 1000 rupees I pay let us say 100 rupees

in that sense, plus there are these things which may be 5 rupees for this and 10 rupees for this. What you can possibly say is at the end of the whole show, instead of taking this as 10 percent you might take it as 12 percent or 15 percent as the cost of handling inventory to account for the various factors. This is the manner in which the inventory holding costs are typically determined. We may then talk about shortage costs. These are costs associated with stock outs. That is we are talking about, a situation where the demand exceeds the supply and therefore if it is a loss sale it would be in the nature of cost per unit and if it is a back order then it would be in the nature of cost per unit time and typically these costs would consist of components like additional costs of a special order because if something is not available on stock and if you have a special customer for whom you have to make it, then the additional costs of making the special order is a shortage cost. Back order if possible of course then there is loss of customer good will and there are lost sales both.

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These are the kinds of components associated with shortages costs. Shortage costs incidentally are generally more difficult to estimate than the inventory holding costs. The reason for this is they are intangible, for instance loss of customer goodwill is intangible. Some company says if I lose a customer it is equivalent to 50 rupees to me. Some other company says no it is equivalent to 100 rupees for me. How do you assess? What is the loss of a customer to you? It depends upon the company's policy towards its customers in that sense. So depending upon the kind of policy that it has, it would then assign appropriate shortage costs for that particular situation. I think a very important principle in dealing with inventories is what is known as selective inventory control and many of you may have heard of this term that if you have a large number of items or if you have a large number of people, there are always a significant few and insignificant many among them. In fact this law is known as Pareto's law. Pareto's law applies very well to inventory situations and what typically happens is that if you look at organizations, they deal with a very large number of stocked items. The number of items could be 10,000 to

100,000 or even more. For instance if you are talking about company like Maruti udyog, the number of components might easily go into something like 30-40,000 or even more that they stock. If you talk about a company boeing which stocks spares for aircraft the number of aircraft spares might even run into millions. It could be a very large number. The number 10,000 to 100,000 is not uncommon. What we are trying to say is that you have a larger number/ variety of these stocked items. In this particular classification into selective inventory control, we talk of classification on three different terms. We can talk about classifications and rankings of the inventory on the basis of value, on the basis of criticality and on the basis of the usage frequency. When we talk about classification of inventory on the basis of value, we actually say that for each item we calculate the annual demand.

We multiply it with the unit price and then we sort of decrease. We put these items in the descending order of their value. Value is the annual demand and the unit price and take the cumulative value. So what would always happen is that this would result in what is called ABC analysis. A class items are the ones which are most important. B class are the ones which are less important and C class items are the ones which are least important and this importance is determined to a very large extent on the annual value of the item. You find that a few A class items would generally be responsible for something like 60 to 70 percent of the total sales revenue of the company and then B class would be slightly lower and C class would be a bulk of the items would be responsible for all the small contributions to the inventory to the value. This particular thing is known as ABC analysis. Many firms tends to use the term “always better control” for ABC because this helps them in the sense that out of 10,000 items you can identify 10 or may be 50 items which are A class items and which need to be monitored very closely and the other items B and C class items need not be monitored that closely and can setup a general policy for them and so this makes inventory control for so many items much easier. That is the importance of ABC analysis based on value.

The other thing is criticality. What do we understand by criticality of an item? You see an item might be worth 10 rupees but it might be very vital in the engine assembly of a particular brand of cars. So it is not a very expensive item but is a vital item because if it does not function properly then it could lead to a catastrophe as far as the product is concerned. Such items are called vital items. Then we have essential items and then we have the desirable item so VED analysis is another way of looking at the criticality. This is the most critical item, less critical item and the least critical item and then the third thing that is normally talked about in selective inventory control is the notion of a usage frequency. In the usage frequency you talk about fat moving items, slow moving items and non moving items. This is known as FSN analysis, Fast, Slow and non moving analysis. Based on the product characteristics suitable policies can be chosen for these kinds of items. So you can imagine that each one is on each analysis. It could be ABCVED and FSN. Basically this could result in 27 categories of items. You could talk about it in AFV item and so on.

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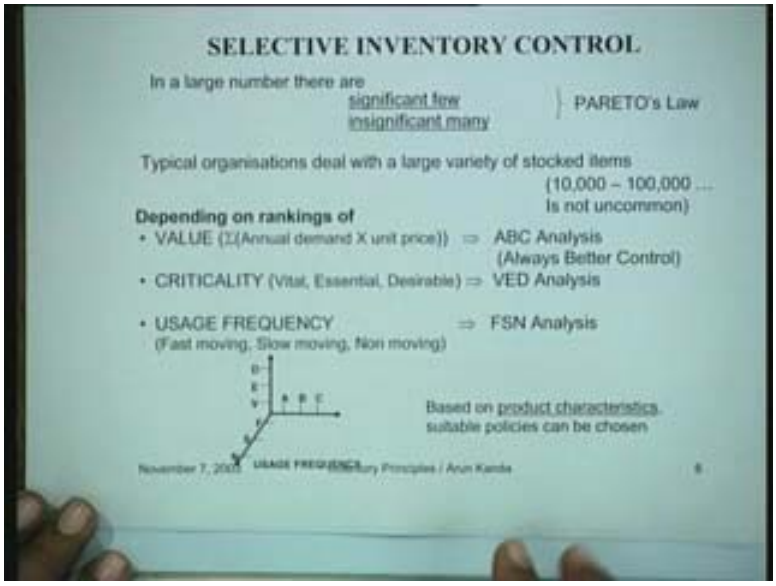

Depending upon the category of each item you could choose a suitable policy and this is how one can actually come to this analysis. A non moving item is one which does not move from the stores. You have many items stocked in your stores and you find that a particular bearing that you have got, there is no demand for that item in the entire factory and you have stocked it for the last 5 years and nobody has asked for that bearing. So it is a non moving item. So there could be slow moving items if the usage frequency is less and it could be a fast moving item if everyday there are requisitions for that item. It is a fast moving item. Normally when you are dealing with non moving items the problem is not of inventory control. The problem is of designing the optimal stock, disposal policies for such items because you should not be stocking them. That is the idea. So, items which have become obsolete, for instance could become nonmoving, a typical ABC analysis. So if you plot the values as we said, the value of the item is the product of the cost of the item multiplied with the demand of the item. But you would find invariably that of the items, less than 10 percent of the items may be responsible for something like 70-75 percent of the cost. These items are called a class items. Subsequently the next 15 percent up to 25 percent items are responsible for 75 to about 90 percent of the cost. Thereafter if you see beyond these items, they have accounted for roughly 90 percent of the cost and the remaining 75 percent of the items are responsible for only 10 percent of the remaining cost in that sense. This is one way of classifying items. Another way of classifying items into ABC is in fact that A class items are those which are 6 times average annual usage,
C class items are those which are less than 0.5 times average annual usage and B class items are in between.

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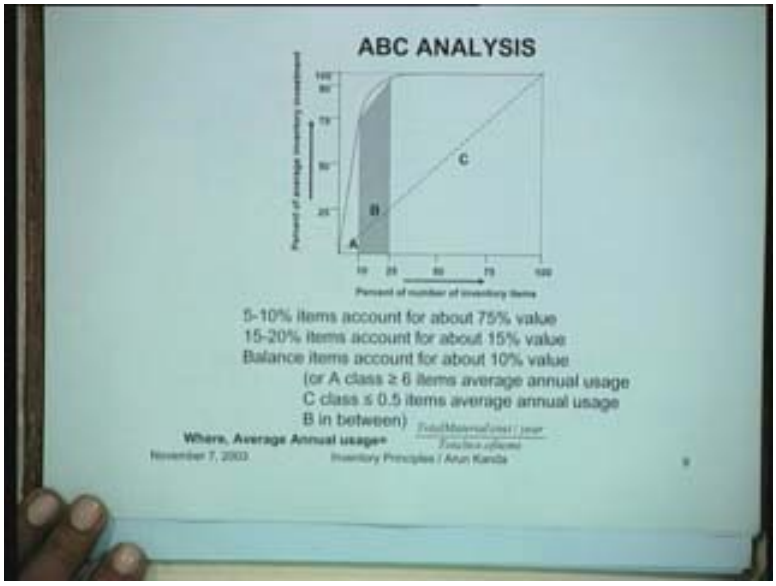

This is another way of looking at the average annual usage of different types of items. Let us look at the objective of ABC analysis and let us try to rationalize ordering policies based on this kind of analysis. What you find is suppose we have three items which are to be stocked in a factory and let us say the annual consumption value of these items are of this nature, so this is arranged in descending order and let us say we give equal treatment to all of them. Equal treatment meaning we place four orders per year for each one of them. If we do that then the value of each order will be 15,000 here, 1000 here and 2250 here and the average inventory therefore is going to be of this nature. It will be half of this because the average inventory will be fluctuating from zero to this maximum value. These are the average inventory figures and the total inventory will work out to something like 8125. On the other hand if you give a preferential treatment on the basis of ABC analysis, you are talking about the basic utility of the ABC analysis, this is an A class item, this is a B class item, this is a C class item let us say and suppose we place for a class items 8 orders per year. For B class items we place 3 orders per year and for C class we place one order per year only that means we stock it in bulk. These are like small items nuts and bolts. What will happen is that these are also 12 orders, these are also 3 orders but these are a preferential treatment on the basis of ABC. What you find is that the value of this with 8 orders now works out to only 7500, for 3 it is 1333. For 1 it is 1000 here and the average inventory is half of these, so that the total inventory falls to 4917. This is a very significant result. What it shows is that by simple procedure of giving a more preferential treatment to A class items ordering them more frequently increasing the number of orders and giving a less preferential treatment to C class items ordering them less frequently you are able to cut down on the total inventory that you are holding. In fact this is the basis of the typical EOQ formula with which you are already familiar. For instance you know that in the EOQ formula for a certain item, we place the order. The stock level goes up, and then you consume this at a certain rate and so on so that the pattern of variation of inventory is a saw tooth curve. Then we can find out the carrying cost, we can find out the ordering cost and we can do an expression for the total

cost and at this particular point which is called the EOQ whose formula, q star is equal to 2 into demand into ordering cost divided by i into c under the root. This particular value therefore gives you the point where the total inventory cost is minimum.

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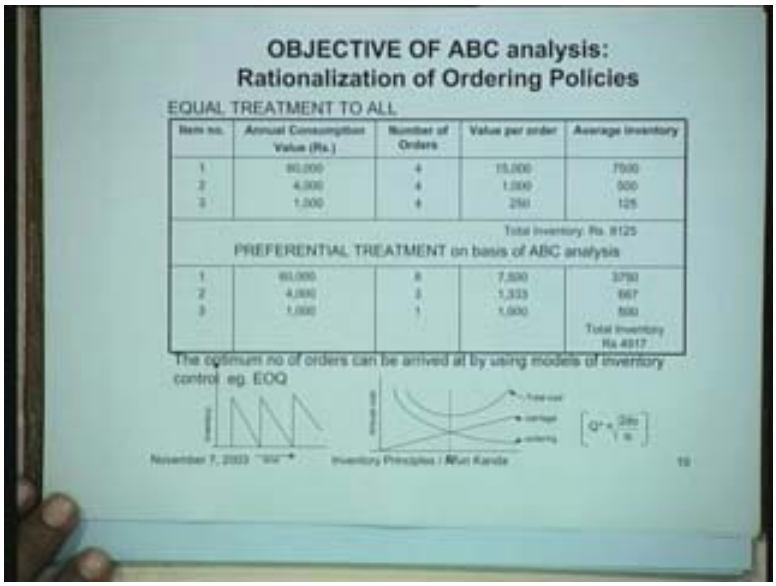

That is another aspect of how you can rationalize your ordering policies. Another important thing is the determination of the reorder point. What is the reorder point? When you have a certain stock when your stock level falls to a certain level you place an order, you must have noted that in the normal household in the kitchen, when your stock is running out. For instance, when your mother finds that the stock of wheat flour is coming down, they do not wait for the wheat flour stock to go down to zero generally. They do not and therefore they place the order a little before the bin is empty. It is called a two bin policy for placing orders. Two bin means is basically trying to say that you are having two bins. You keep consuming from the first bin, when the first bin is exhausted and you come to the second bin that is the time you place your order. So this is a two bin policy in that sense. So question here that we are talking about is how to determine the reorder point.

That is the point at which you will place the order. Reorder point is the maximum reasonable demand during lead time which is the expected demand during lead time plus the safety stock. So if you assume for instance that the demand is normally distributed and this is the average lead time value that you typically have, then k times this particular standard deviation will give you this particular value and the area which is shown shaded here is in fact the probability of stock out. Normally what you can do is for different values of k the risk of shortage that you have could be 50 percent if the risk of shortage could be 50 percent then the service level is then taken at 15 percent. If the risk of shortage is now 15.87 percent which is this area, then the service level is the remaining area which is 84.13 percent, if the risk of shortage is 2.28 percent then the service level will be 97.72 percent. If the risk of shortage is smaller, then the service level is much

higher. Now what we are therefore trying to say is that this (Refer Slide Time: 41:55) would be the region in which you will be keeping higher safety stocks. If you want to have a smaller and smaller risk of shortage which means a higher level of service level then you will have to keep higher safety stocks. So normally what is the policy for A, B and C class items? For A class items they have relatively low service levels, 0.8 or so. Now why do they have low service levels? A class items are important but A class items are being handled very closely and you are monitoring the performance very frequently. So what it means is that they will have relatively low service levels because you would be adding to them very often to reduce the cost. They would have lower safety stocks consequently for a class items.

Why would they have lower safety stocks? For an A class item you would generally tend to keep a lower safety stock. Why, because you would be coming back to the item very soon. You do not want to keep a large stock of this. If you start keeping large stock of a class items, your inventory related costs will become very high because the cost of these items is very high. You want to cut down on their inventories, that is the reason and you want to have a tighter control and efficient expediting. B class items would be handled routinely with service levels of 0.95 or so in this scale here and C class items should be present in ample supply minimum record controls. Procedure should be that we should have very high service levels, very high service level mean the probability of stock out of a C class item should not be low. The probability of risk of shortage should be very low. The probability of keeping the service level high should be there, the reason being that you will probably place orders for these items very infrequently. So you do not want that during this period. The demand should arise for these items and you should not have the item, and since these items are less costly anyway you can always afford to have high service levels for these items. Normally a service levels are around 0.8 or so. For B they are 0.95 or so and for C class items service levels generally vary from 0.95 to 0.98.

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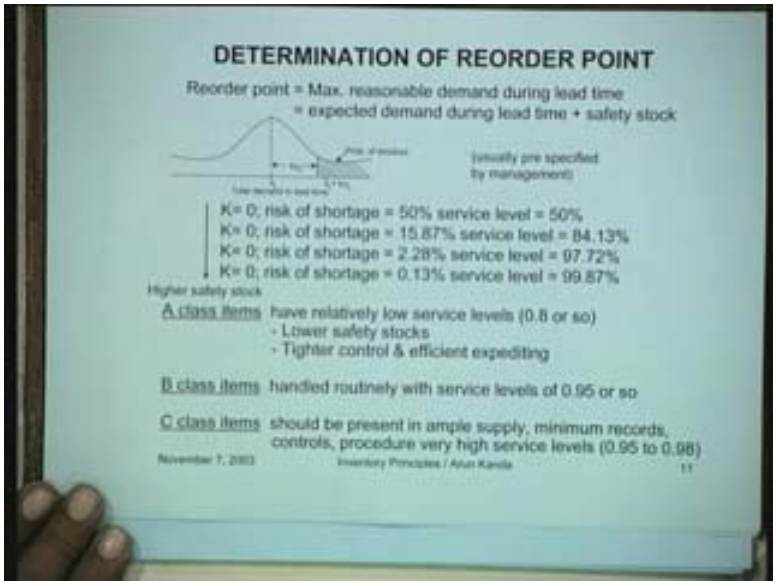

I think this is an important aspect of how control is exercised when you are designing a policy for handling these various kinds of activities. What are the policy implications of selective inventory control? ABC analysis, what does it mean? It means simply that a class items need continuous rigorous control. So use of mathematical models is justified for these items. B class items are generally relaxed control. So you need a typically a periodic review for these controls for these items. For C class items even simple rules of thumb will do, that is how you handle the various items. As far as VED analysis is concerned, v class items call for a high level of service because they are vital, therefore you should have stock when they are needed. So the probability of a stock out should be small, that means you need high level of service for these items and E class items call for medium level of service and D class items call for a tolerable level of service and therefore what we are basically trying to say is that the service levels are determined jointly by whether an item is ABC or VED. So whether it is, VED or AEC depending on that you will choose a service level and as far as FSN analysis is concerned, fast moving items most inventory models apply to this category. Most of the research which has been done in inventory models like economic order quantity determination and so on belongs to this category. Then we have slow items which are spare parts. Non moving items or dead stock which is optimal stock disposal rules are necessary for these kinds of items.

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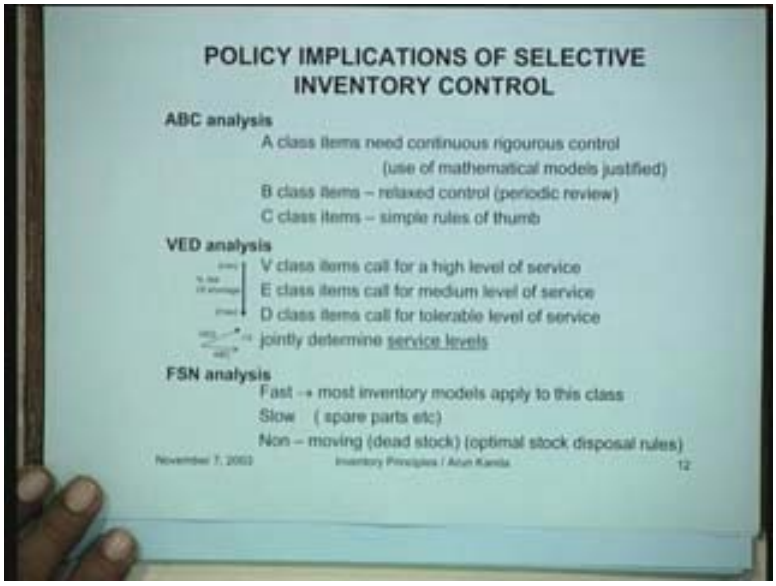

Here is a typical illustration of what would happen if you are talking of a high cost of stock out and a low cost of stock out. If you are talking about a high cost of stock out and you have ABC item and a VED item, then typically what will happen is, it is at this point of the matrix that this particular service level would be highest, say 0.95. Rather it will be the highest here. This is increasing in this direction, 0.99 here, 0.97 and 0.95 and then in this direction they are decreasing. As far as a class items are concerned, you require about 0.8. This is how the typical high cost of stock out would behave. If you have an item with a low cost of stock out what will happen is that these values might be modified, so something like this value comes down to 0.7 and this value comes down to about 0.85 and this is now 0.95 and 0.9 and these values would also come down to figures like 0.6 and 0.5.

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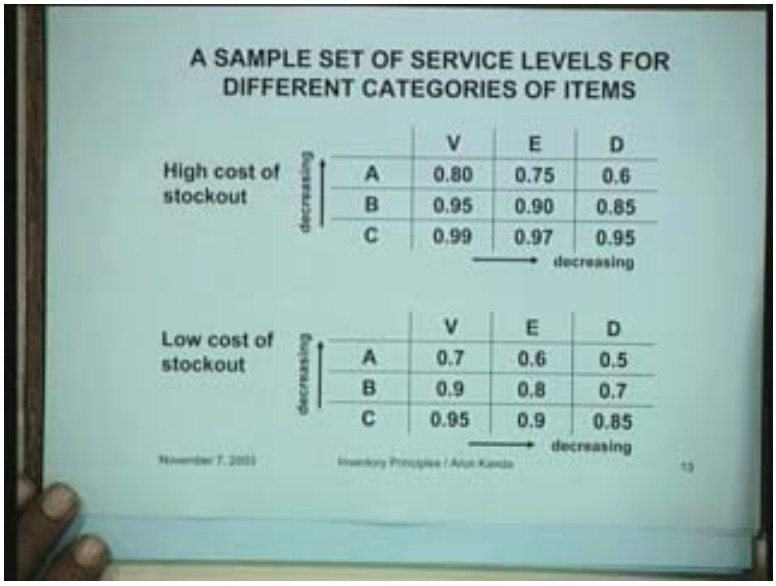

This gives you some idea of how service levels can be kept for different categories of items that means it is dependent upon ABC as well as VED analysis. What is the objective of an inventory management system? First to manage inventories in an organization we require an inventory management system, so basically an inventory system consists of a set of rules and procedures that allow number one for routine decisions on when and how much to order of each item needed in the manufacturing or procurement process. Two which call attention to the non routine situations, the rules do not cover. So that is another thing that you want. If it is a non routine situation it should call attention to that and number three which provide mangers with necessary information to make these decisions effective. This is an objective and the objective of a well designed procedure should be the minimization of the costs incurred in the inventory system attaining at the same time. The customer service level is specified by the company policies.

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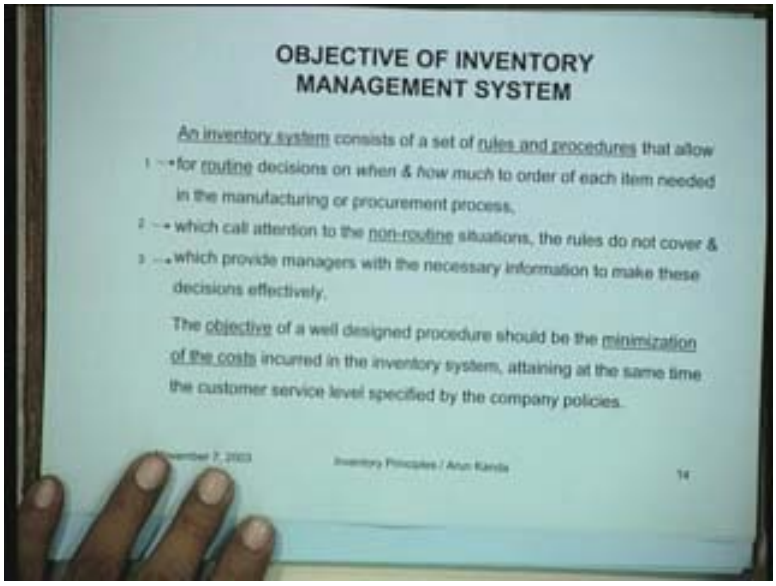

That is how the basic objective of the inventory management system is, in terms of looking at this. Let us now try to look at a typical structure of a computerized inventory management system. What does it do? Any inventory management system typically has these four modules or components. One is called a transactions and file maintenance module, two is called a decision rules module, the third is called a system integrated module and the fourth is called a system management interaction and evaluation module.

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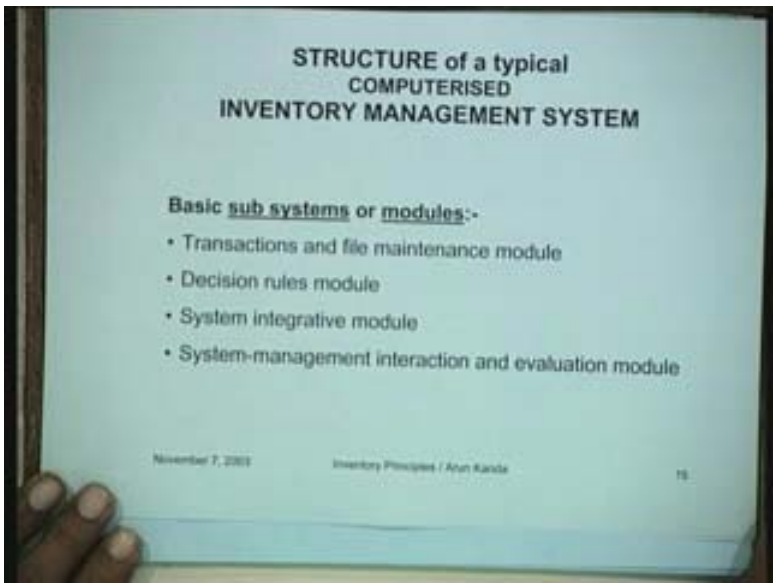

Let us see what these modules typically consist of. Transactions and file maintenance module is basically book keeping of inventory control. If some item is issued and some

other items are received, you must know exactly what the transactions that have taken place are and what is the status of inventories. So that can be done in a computerized system very easily. This is like maintenance of your bank account typically, entry auditing control and processing of inventory transactions and what is required is continuous updating to provide accurate information on available stock, customer order status, cost of items, delivery time, delivery lead times, sources of acquisition and ordering restrictions and mainly the area of processing and would be required in the area of data processing.

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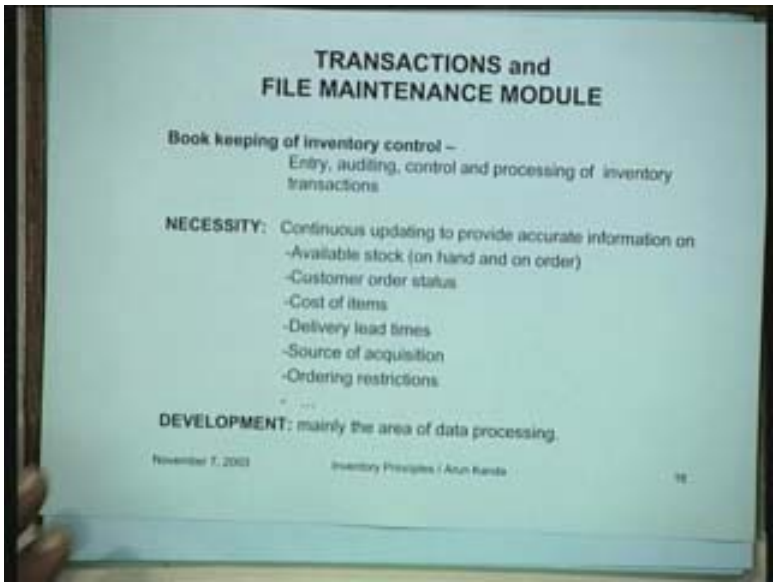

You have any situation where transactions are involved, so basically this is that component of inventory where you are updating the transactions. Then the second major component is a decision rules module which will provide the kind of information, decisions that have to be taken on various kinds of items. For instance what may happen is that suppose you have an item depending upon whether it is A class item or a B class item or a C class item where information is available in your inventory system, then if it is an A class item you can use EOQ and continuous monitoring and use a formula like this. If it is a B class item you might have a policy of ordering in lots of three months. If stock at hand is less than the ROP and then similarly if a C class item, this order is in lots of six months demand if the stock on hand is less than the reorder point.

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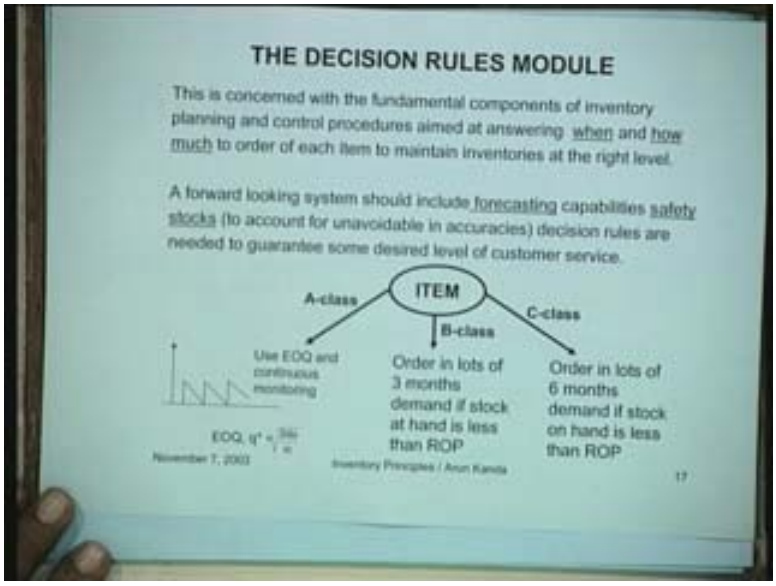

That means depending upon the nature of the item when the track is available you have a set of rules which is defined in the policy which will take care of this. So optimization of rules of thumb or whatever you have, then we have a system integrative module. The system integrative module will talk about the decision rules and the distinct inventory policies the interaction between the two. So the various items being controlled depending on their inherent characteristics require specific degree of management attention and service levels that can be achieved by using some appropriate stock policy.

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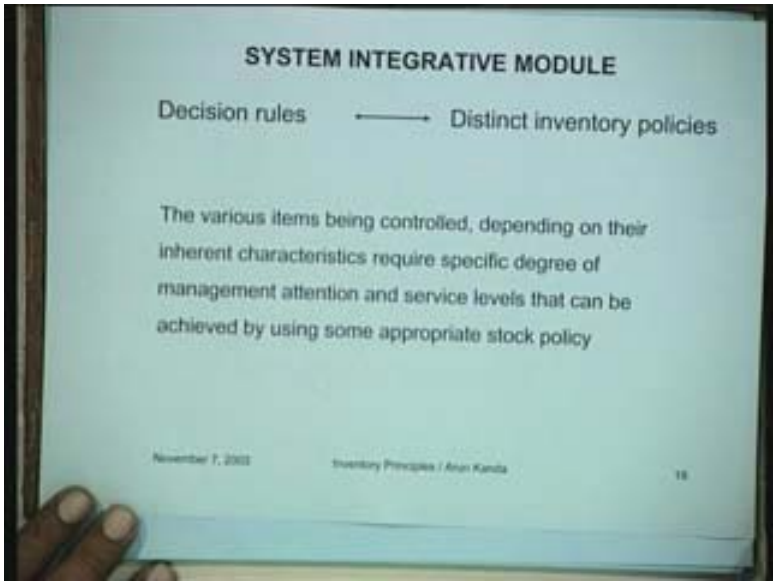

What particular inventory policy to use for a particular situation? What should be the service levels? These would require some kind of integration or interaction with the management to find out, so here is the module which does that and finally the management self system management interaction and evaluation module. What do we mean by this? This is actually intended to provide management with such information as to permit evaluation of operating performance, identify problem areas, and allow for management selection of policy variables or system variables system parameters.

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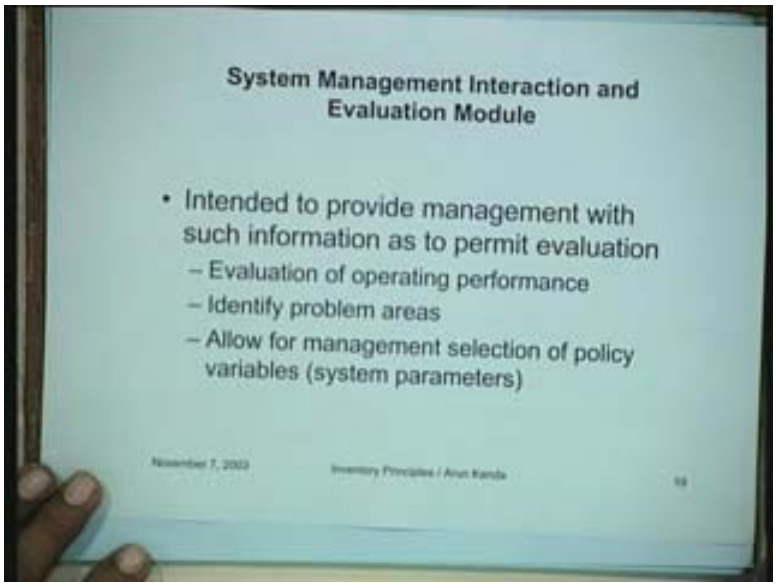

It is basically an evaluation module which can keep on evaluating your policies if you keep on applying them for over a year. Then at the end of it you will probably find out what the costs are and then maybe you come up with a better policy which should be able to reduce it. Next time you can incorporate this in this whole analysis. Therefore, something can always be done. Finally let us basically put forward some of the major conclusions and a brief summary of what we have tried to talk about today. I think the first issue that came out was that inventories are a necessary evil. You need them for some reasons despite what the Japanese might say of eliminating inventories and just in time system and no inventories in a situation where there are uncertainties. Typically the way that we have in our country, you need inventories to overcome some of those problems so that they are omnipresent and therefore you have to deal with them. We also saw the various functions that inventories were performing in terms of pipeline stocks, cycle stocks and seasonal inventory and safety stocks and other speculative reasons. Then we examined the nature of inventory related costs. We talked about how the costs of procurement the cost of holding inventories and the cost of shortages are to be computed and what are the components which go into this.

Then we talked about his very important principle of selective inventory management which applies to classification on different fronts. Classification on the basis of value which is the ABC analysis, Classification on the basis of criticality which is the VED analysis, Classification on the basis of whether items are fast moving or slow moving and that is actually FSN analysis because depending upon this analysis you have different ways of dealing with those kinds of inventories. Then we talked about various ordering rules and reorder point determination, for instance we saw that by giving a preferential treatment to certain items rather than democratic treatment to all items is always preferable because you tend to lower your costs. Policy implications of selective inventory management were discussed. Some of the features of computerized inventory management systems were the rudiments in terms of the basic four modules which are there in a typical computerized inventory management system which were discussed and then of course we are talking about the relevance and we did not specifically talk about independent and dependent demand systems because if we are dealing with dependent demand systems what we are dealing with is the domain of MRP and when we are dealing with independent demand systems of the kind that we were talking about today, we deal with basically conventional inventory control. So we will talk about MRP and we will also talk about mathematical modeling in inventory systems next time.

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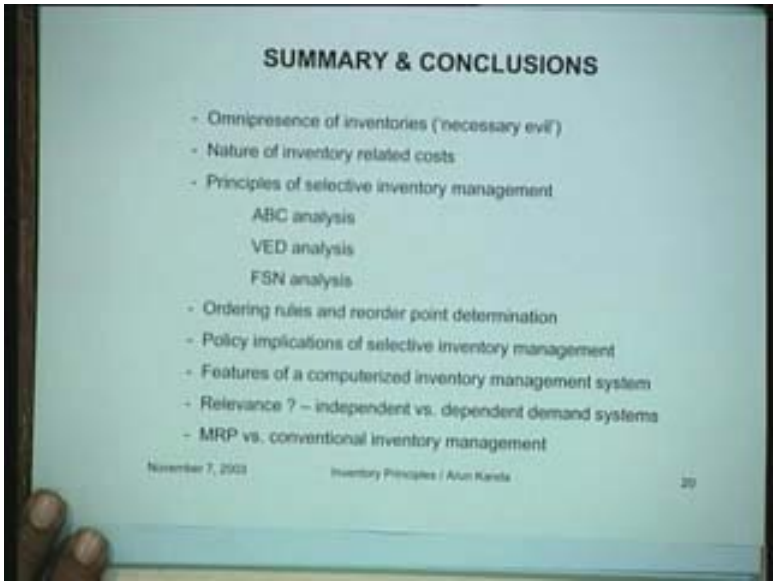

Also, we will also compare MRP versus conventional inventory management. In terms of the nature of the demand pattern, we have this. So I think with this, we conclude today's lecture.

Thank you very much!