Management of Inventory Systems
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Lecture - 03
Introduction to Inventory and Materials Management (Contd.)

Now, we are going to discuss the third topic under Introduction to Inventory and Materials Management.

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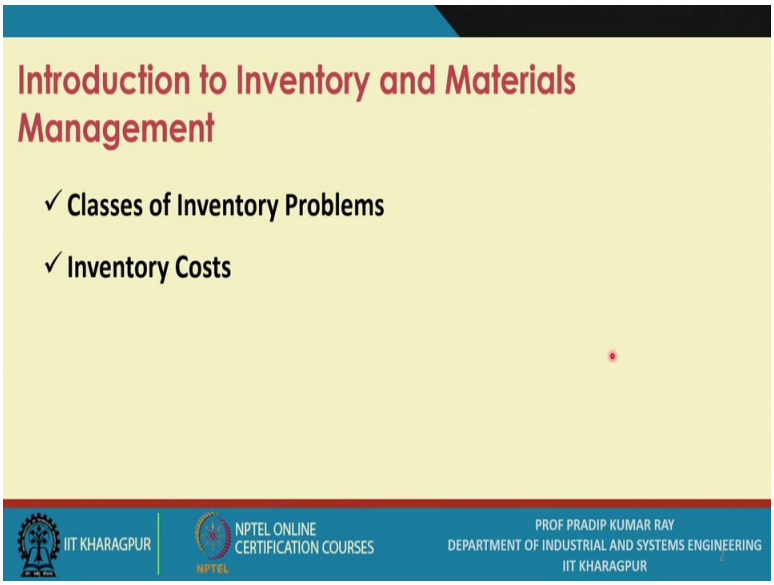

So, during in this topic, we will refereeing to 2 important issues. One is the classes of inventory problems; in the last interaction we have already identified the factors related to inventory problem the classification, and you have already come to know that how these classes are classes are made. And so, there are different types of inventory problems.

Now, what is important is that you must have a very clear cut idea, and you must start thinking simply about the inventory problems. So now, the classes of will we must conclude something solidly about the classes of inventory problems; so, the first thing we should do. And the second one that is the next issue we are going to discuss that is the inventory related costs.

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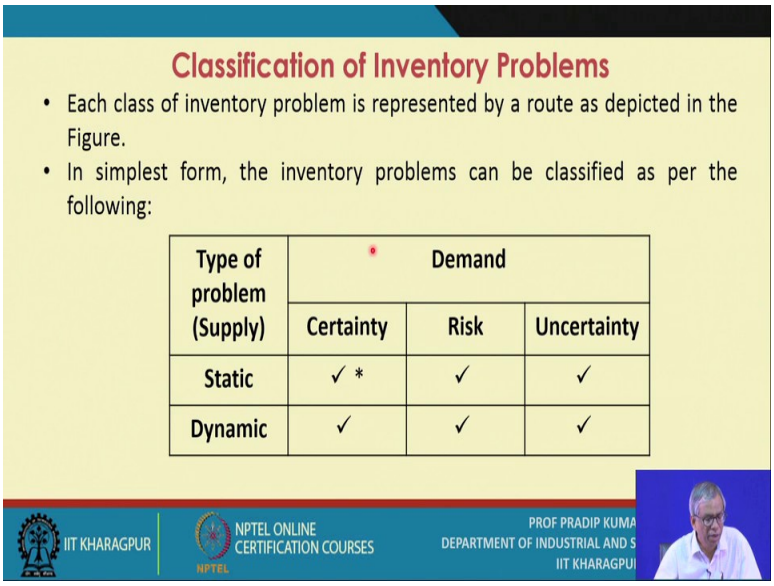

Usually what happens that any inventory related problem you formulate. And obviously, during the formulation you come to know what are the decision variables. And you need to determine the values of this decision variables; under constraints or under certain conditions, under certain assumptions jn such a way that you get the best possible performance. Now related to the inventory how do you associates inventory management systems any type of inventory management systems.

So, how do you associates the performance? That means, what are the; you know the performance related the criteria with which you judge the efficiency effectiveness or the quality of an inventory control systems. So, here your main objective is, you will learn an inventory control systems meeting all the objectives in such a way that the cost of running the inventory control system is minimum.

So, and when you try to determine the; the values of the decision variables in such a way that the total relevant cost of inventory or the running the inventory systems is held at minimum. Then we say that this is you know I have optimally determine the values of the decision variables, when to order and how much to order. So, these are the 2 important decision variables in any kind of inventory problem. So now, let us conclude about on so, the classification of inventory problem this is an important topic.

So, what we have what we have a concluded that each class of inventory problem is represented by a route as depicted in the figure, we have already seen the figures. In fact,

where all source of other routes are depicted, and the on the route you will find the you come across several types of factors. On that you know of the different levels on the different types. So, how many such routes you have come across.

So, that many inventory problems you have to deal with. So, at one extreme you have the most simple problem. at other extreme, you have the most complex problem. So, in the simplest form now there must be some extraction out of it.

So, what is it? That means, I am going to represent the; this the classification of inventory problems with a simple in a table format. So, the inventory problems can be classified as per the following. First what you say that the type of problem Forget about your the lead time. So, lead time also need to be considered, but here only the 2 factors are considered, ok.

These 2 factors actually there at the heart of the problem; first one is, the type of problems either it is could be the static problem,, one-time decision or the dynamic inventory problems; that means, is a multi decisions so, the multiple time periods you have to take so, multiple decisions. Then this supply is must meet the demand that is the condition you have to create.

So now the demand may be known with certainty, that is one case the demand may be known with risk; that means, related to the demand, you have you know what is this demand distribution, but exact demand is not known. And where as in this is the demand; that means, the problem under uncertainty; that means, demand is known with uncertainty.

That means, even the demand distribution is not known. So, obviously, you know no demand distribution known does not mean there is no information related to the demand. If it is a no information case nothing is known about the demand; obviously, that cannot be any problem formulation. So, in majorities I mean the rarest of the rare cases, right What you will find that I am not getting any idea about the demand level

But, but in those the few cases, this is really that you happen we will find it majority of the cases, even if you do not know the distribution of the demand at least some information you have. So, sometimes what we say the this problem is referred to as the distribution free analysis, ok.

So, even if the distribution is not known in the in the probability theory, there are certain you know the inequality expressions you may use, even if for the given decision the variable or say decision variable; where for the demand particularly in this case or say the random variable. So, even those particular the expressions in equality expressions are valid and for any type of distribution.

So, you can conveniently use those inequality expressions to formulate the problem, and then you get other expressions of the decision variable. So, it cannot be the no information case, no information means no problem formulation and no solution. So, it is a partial information along with you know and whenever you have the partial information about the demand, you must opt for the techniques those are referred to as the distribution free analysis.

So now these combinations are commonly you come across. First one is the demand is known with certainty, and you know the problem is static inventory problem. So, this is this problem is absolutely this there is no problem at all everything is known. So, this particular sell is not coming under the inventory control domain. If at all it is a problem, now this problem means demand is not in certainty, and it is an static inventory problem; that means, just one order you have to place.

So, the number of orders that is known as well as the order quantity also will be known. And when to place the order that is also known. So, if at all it is a problem, this is coming under actually the scheduling problem, and when you deal with multiple items, is it ok?.

Now, this is this problem will be telling with; that means, the demand is known with risk demand distribution is known. Whereas the order quantity just the number of orders is just one. Or the number of orders could be greater than one demand is known with risk. Similarly, when the demand is known with uncertainty, both the static as well as the dynamic cases we must be dealing with.

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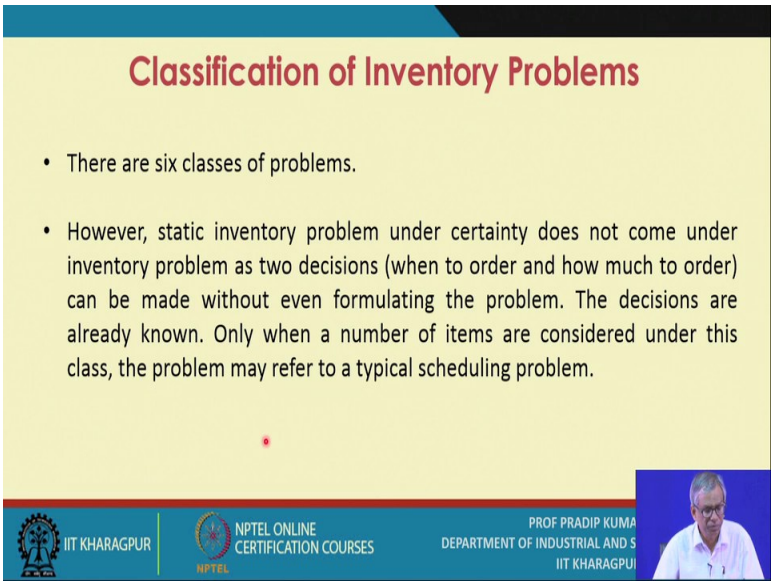

So, there are 6 classes of problems, we refer to this table; however, the static inventory problem under certainty this point already I have elaborated does not come under inventory problem as 2 decisions went to order. And how much to order? How much to order can be made ?.

Without even formulating the problems so, that point is to be noted. The decisions are already known only when a number of items are considered under this class is more number of items. So, more than one items you consider the problem may refer to a typical scheduling problem. So, this point already I have mentioned.

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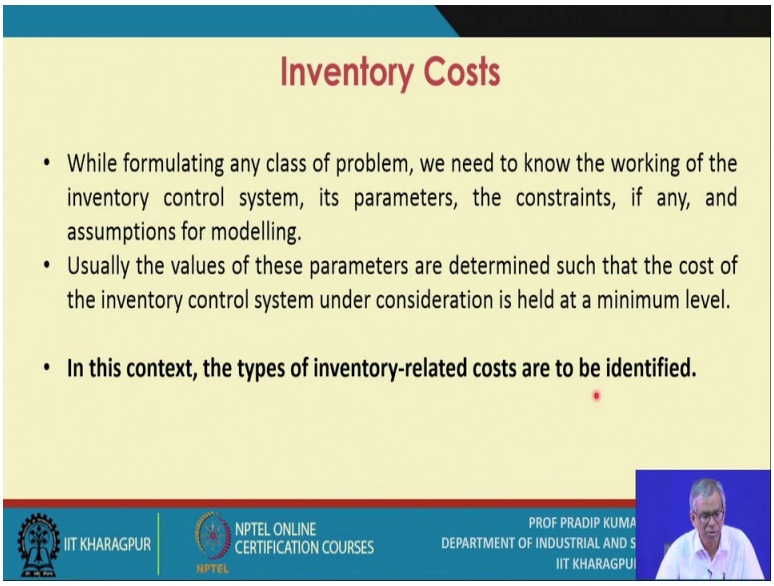

Now, let us the talk about the inventory related cost this is a very important the issue. Because while you formulate the problem while you try to determine the optimal values of the decision variables. So, your objective is to in majority of the cases, the minimization of the total relevant cost.

And this when you write down the total relevant cost expression, you need to know actually the what are the different types of costs applicable in a typical inventory control system.

So, while formulating any class of problem, we need to know the working of the inventory control systems, how does it work? Suppose I say there is a perpetual inventory system, so the first thing you must know that how does it work ? And a many a time we are one more thing; that is, I need to explain my inventory control problem related to a particular item.

So, the first thing I must do that I must be able to draw an inventory profile the diagram. And when I and I will draw this diagram the inventory profile, as per a particular inventory control problem.

So, when I look at the inventory profile so, I will get an idea that what kind of the problem I must deal with, is it ok? So, this is this way we should proceed; that means, you have to explain the problem in a systematic manner. So, that you know the problem

quality as well as the intricacies involved in getting a solution of a problem whether it is a simple problem or complex problems are you should be aware of is it ok? How difficult the problem is by just looking at the inventory or the profile you should come to know.

So, then only we will conclude that you have sufficient expertise and knowledge in this particular area. So, we need to know the working of the inventory control system, this is a must this is a necessary condition, it is parameters the constraints if any and assumptions for modelling, ok. So, this these are the issues you please note them down, and later on while you go for modelling you will be referring to different kinds of parameters different kinds of control systems different kinds of constraints etcetera, etcetera. Usually the values of these parameters are determined such that the cost of the inventory control system under consideration is held at a minimum level, is it ok?

So, usually the parameters of an inventory control. So, please note it down where suppose you know any inventory control system I explain against a particular item. Immediately you must be able to identify that what are the parameters of this inventory control systems.

Like, like one example when you referred to you know the perpetual inventory control system for a single item, there are 2 parameters we have. One is the reorder point and the second one is the order quantity. When you refer to periodic inventory control systems, we refer we have again 2 parameters, what is the maximum inventory ? And what is you know the order period, is it ok? So, the order period remains fixed, ok. So, in other periodic review control systems.

So, similarly for all other you know inventory control systems. So, we refer to their parameters. Usually the values of this parameters are determined such that the cost of the inventory control systems under consideration is held at a minimum level. So, everything in determined in such a way that total cost of running the system is held at a minimum. So, in this context the types of inventory related costs are to be identified.

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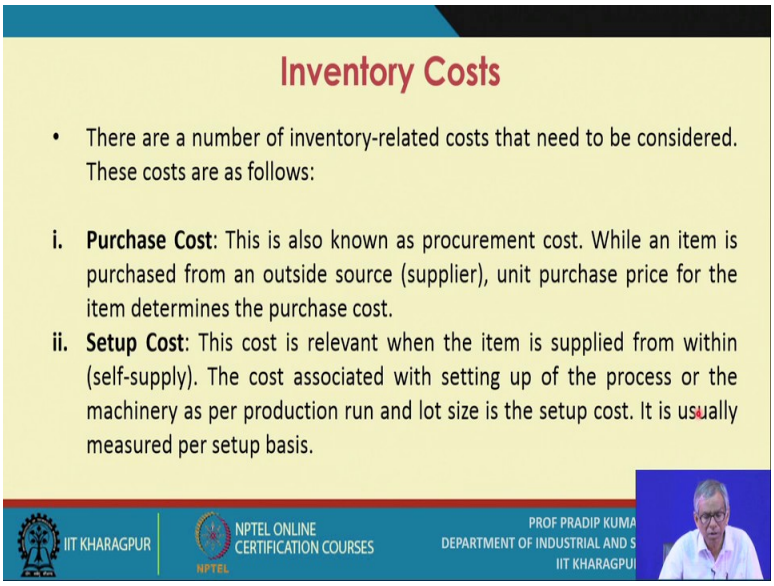

So, this is so, you will come to know what are the relevant you know the cost of elements or the types of cost. There are a number of inventory related cost that need to be considered, ok.

Now, I will just explain briefly that what are these costs. Now these cost are as follows, the first one is the purchase cost. Now what is this purchase cost ? This is also known as the procurement cost. So, when you try to procure say certain one item from a supplier. So, a deal is made the order is released and the to the supplier. And in course of time is item will be supplied. So, this when the agreement is made when the purchase order is placed; that means, the purchase prices will be known, is it ok? And at that purchase price that purchase price will be charged against say such for the agreement and all.

So, this is basically a procurement cost. While an item is purchase from an outside source of the supplier has have been telling you. You need purchase price for the item determines the purchase cost; that means, the total purchase cost will be the unit purchase price multiplied by the number of units purchased, for a given period of time. Then the next one is the set of cost; that means, many time you go for self-supplying you need this item at the fabrication shop.

Now what do? You do you place an work order not the purchase work order to the machine shop. And as per the your requirements, there will be producing that particular

item or the part. And subsequently when the part is manufactured the finished part will be sent to you at the fabrication shop.

So, this is the typical self-supply or the inside supply case. So, this cost is relevant; that means, the set of cost when the item is supplied from within the plant. The cost associated with setting up of the process or the machinery. So, there is a set of time you need to produce say 500 units at a particular machine, and this 500 units I will be producing at a particular machine, and I will be sending it to the fabrication shop.

Now, this 500 to in order to produce 500 units. I need to have just one setup. And that means, I have to I have to have the setup for that certain activities you have to carry out. And any activity you carry out there is a cost associated with it. So, related to set up there must be a cost associated with it, your setup is an activity. So, that is why it is referred as a set of cost. So, the cost associated with setting up of the process of the machinery as per production run that is very important and the lot size is the setup cost. So, you need to estimate the set up cost which is usually measured per setup basis.

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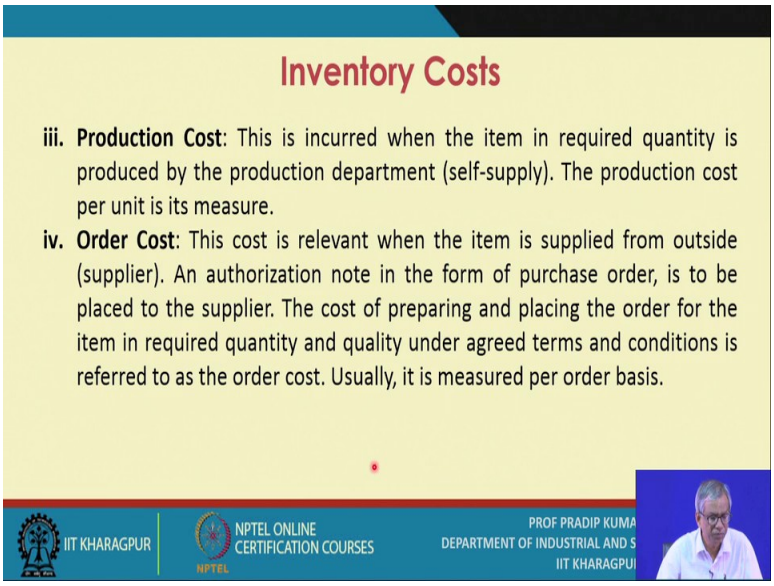

Now, there is also a cost you must be you should be bothering about, that is the production cost. This is incurred when the item in required quantity is produced by the production department, is it ok? So, that is basically the self-supply case. First you get the setup and then you start producing it, is it ok?.

The production cost per unit is it is measures. So many time while you formulate that you know your problem and the total cost expression should be is to be known so, you need to refer to the production cost. Then you have the ordering cost or the order cost. So, what is this cost is relevant when the item is supplied from outside, ok.

So, outside supply case and authorization note in the form of purchase order, is it ok? It is a, it is a it is a legal document in fact, the purchase order is to be placed to the supplier. The cost of preparing and placing the order for the item in required quantity and quality under agreed terms and conditions is referred to as the ordering cost like. So, you need to know what are the activities you carry out while you place the order while you make the order while you prepared the order you know what you can say the purchase order the many source of activities you carry out. And then when you get the order supplied, then also many source of activities you carry out.

So, all the activities is to be noted down, and then the corresponding the cost estimates you must have, and this exercise you follow rigorously, and you will get an estimate with minimum error of the ordering cost. And usually it is measured on ordered basis, that means, ordering cost per order.

So, one particular order, that means, the purchase order. It may just considered one item or multiple items; that means, the there are cases where one item for each item you need to have one supplier, for many items you can have one supplier; that means, the same supplier is supplying not only one item, but several items.

So, obviously, if for such a supplier it is most likely that you will include not only say the one item in the purchase order, but the multiple items. And these multiple item have this with respect to all these items you must have the same terms and conditions has agreed upon, ok.

So, these are the final details later on when we will refer to you know the purchasing procedures purchasing systems, many of such issues will be discussing.

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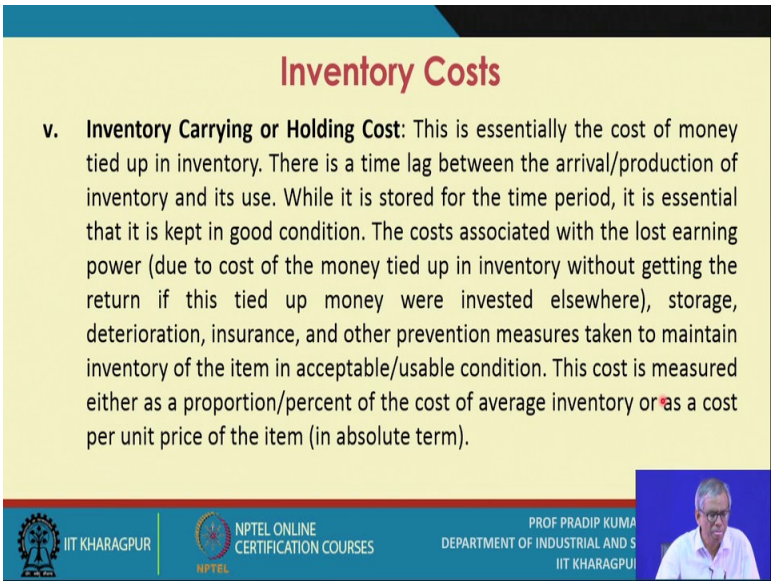

Now there is an important or very, very important cost element we have that is referred to the inventory carrying out the holding cost. That this is essentially the cost of money tied up in inventory as I already mentioned. That the inventory means basically the tied of capital, is it ok?.

So, your inventory system should be such that the minimum amount of the capital is tied up in inventory, that is to be ensured. And if suppose in certain cases, suppose you find that is too high you know; that means, the amount of money, or the amounts of capital tied up in inventory as a idle resource is very high.

So, what you need to do it will directly affect your operational performance; that means, the right point in time will not yet the right quantity of materials. This is going to happen; that means, the flow will be disturbed. So, what you need to do ?.

You need to improve an inventory control systems in such a way that you know a the enough amount of capital is released for other purposes from the inventory; that means, in the in plane and simple terms it means that inventory investment to be assessed at any point in time, and you must use with it means to release capital from this idle resources in such a way that in next planning what I assume the inventory investment is substantially reduced. There is a time lag between the arrival or the production of inventory and it is use.

While it is stored for the time period, it is essential that it is kept in good condition is clearly understood. The cost associated with the lost earning power due to cost of money tied up in inventory. Without getting the return if this tied of money were invested elsewhere; obviously, this is the inventory use amount of inventory idle resource.

So, the capital is tied up, money is tied up. So, unless you realize it how can you use this money for some other purposes for productive purposes. So, what do you need to do? That means, you keep the item, till it is used in in acceptable good condition. Same into look into the storage cost, you need to look into the deterioration cost, what should have insurance the premium you provide or you need to bear ? And other prevention measures taken to maintain inventory of the item in acceptable and usable condition.

I keep the item, it will be used to after say one month, the make sure that you make sure that it is kept in such a way condition that the value of the item; that means, the economic value of the inventory is not lost.

So, for that certain the cost of we have to bear. So, this cost elements you need to identify these activities which you carry out to for up keep and maintenance of the items when your stores. So, these activities are to be identified corresponding cost estimates you must be aware of, and then you get an idea about get an idea about the estimate of inventory carrying or the holding cost. So, this is an important cost.

So, this cost is measured either as a proportional percent of the cost of average inventory, later on you will come to know that how to compute the average inventory cost, ok. So, normally the practice has been that I will estimate the inventory carrying cost as a percent or the proportion of the average inventory held, likes say 15 present 20 percent or say you know the 10 percent or 8 percent.

So, this way you specify the inventory carrying out the holding cost. Or in absolute term you say that the price of the item is 10 rupees. Now I am just sending say 1 rupee for in relation to is carrying or holding in good condition, is it ok? Per unit time, per year or per month. So, that means, essentially in absolute terms you are spending 1 rupee, against against the unit price of the item for inventory carrying or inventory holding, ok; so, this is the idea.

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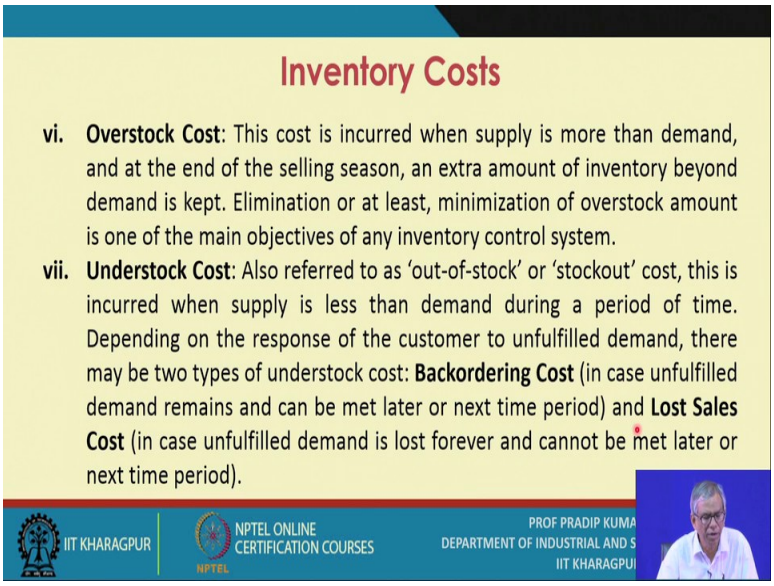

Then you have 2 important cost elements overstock cost this cost is incurred when the supply is more than demand. And at the end of the selling season and extra amount of inventory beyond demand is kept. It is very clearly you know explained, elimination or at least minimization of overstock amount is one of the main objectives of any inventory control system.

Now, this if there is an overstock, there could be situations which is referred to as basically the under stock cost situation under stock situation. So, corresponding to occurrence of under stock, there must be a some under stock cost. Also referred to as out of stock or the stock out cost. This is incurred when supply is less than demand during a period of time, ok.

So, depending on the response of the customers to unfulfilled demand, is it ok? There may be 2 types of under stock cost either it is a back ordering cost or the lost sales cost. Now what is the back ordering cost, in case unfulfilled demand remains and can be made later or the next time period there are cases; that means, the customers right now is not getting the item, but it can wait is this not that, it is a waiting for the medicine or waiting for the food, is it ok? It is a may be any other items. So, we can wait for next 15 days or one month even or even 6 months.

So, you are unable to supply definitely a these item on time, but the customer is ready to wait. So, obviously, there is a cost you cannot avoid this cost, maybe the customer is not

that happy, that is not leaving you. So, if you face these sort of situation, this is referred to as the back ordering cost. In certain cases, the backordering is well planned, is it ok?.

For certain cases later on will deal with this case. But otherwise in many cases the risk is the lost sales; that means, in case unfulfilled demand is lost forever is asking for food is asking for medicine and right now you do not have any stock. So, can you holding there can you say that why do not you come after 7 days.

So, obviously immediately you know he will go elsewhere. So, for you know the demand is lost, isn't it forever ?.

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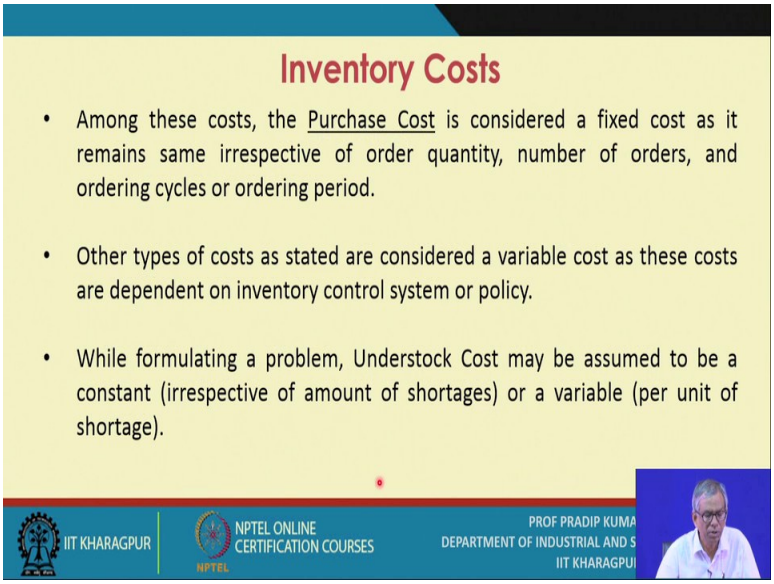

In many cases so, this is the lost sales cost. So, the depending on the problem you faced both the types of costs you need to consider. So, among these costs the purchase cost is considered a fixed cost; obviously, as it remains same irrespective to the order quantity. And other types of cost of stated are considered a variable cost as these costs are dependent on inventory control systems are policy, is it ok? So, while you write down the total cost expression, the first one is a the fixed cost at the next one is the variable cost.

So, if you change the inventory control system usually the variable cost part may change. While formulating a problem under stock cost maybe assumed to be a constant, with respective of amount of shortages there are cases; that means, the fixed out of stock cost; that means, for all practical purposes whether this is shortage is of a 10 units or 100 units

the cost or the under stock cost you bear that remains same. But alternatively it may be considered as a variable; that means, per unit basis.

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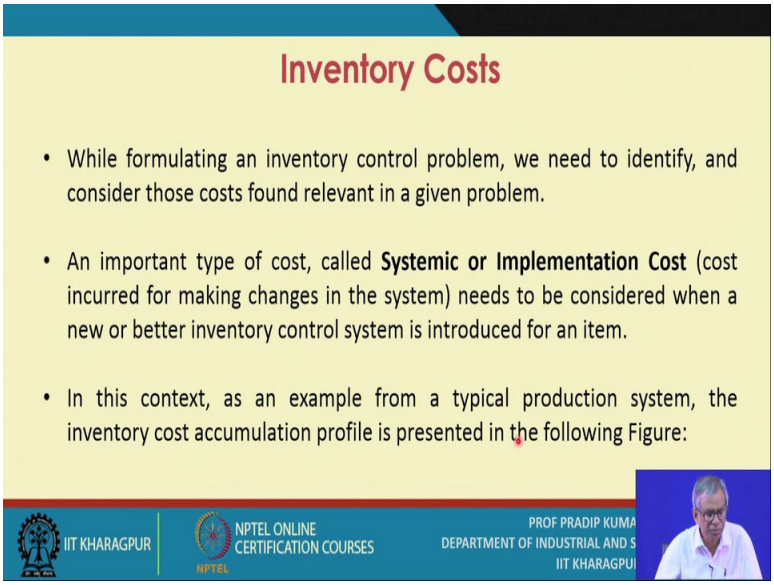

. So, there is one very important cost element you should consider this is called systemic or implementation cost systemic cost. So, an important type of cost called systemic cost incurred for making changes in the system needs to be considered when a new or better inventory control system is introduced for an item.

So, this part also we will be taking up when you talk about the implementation cost of a new inventory control systems. So, there must be some estimates of this, and then only you can compare between different alternatives for inventory control systems.

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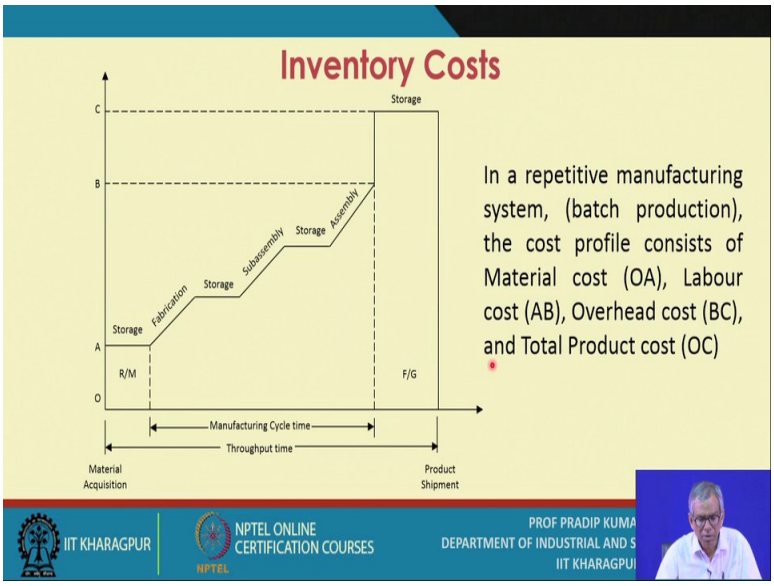

So, this is this is an example. So, this is an inventory carrying cost. So, here we can explain it later on also. So, the inventory cost profile is like this; that means, this is the cost y axis is the cost, and this is your raw material cost, this part is essentially you know it is the direct labour cost, and the B C is basically the factory overhead, is it ok?

So, this is the throughput time from martial acquisition to product shipment. And this is from so, the raw materials to the finished goods; that means, this is this part is the w I p ok. So, as the process you know as you have more number of processes. So, this the labour cost increases, and this is the manufacturing cycle time from this point to this point.

Thank you so much.