**Management of Inventory Systems**
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Lecture - 02
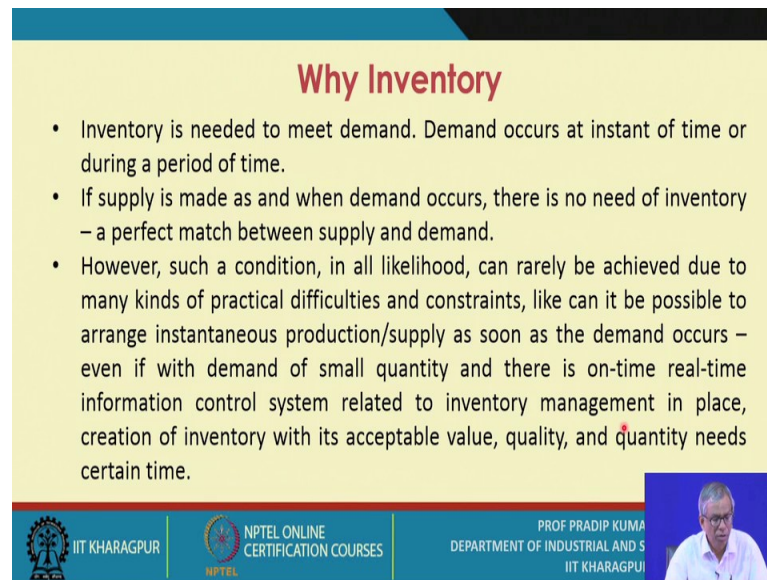**Introduction to Inventory and Materials Management (Contd.)**

So, against the topic 1 that is Introduction to Inventory and Materials Management, now I am now going to discuss the second topic.

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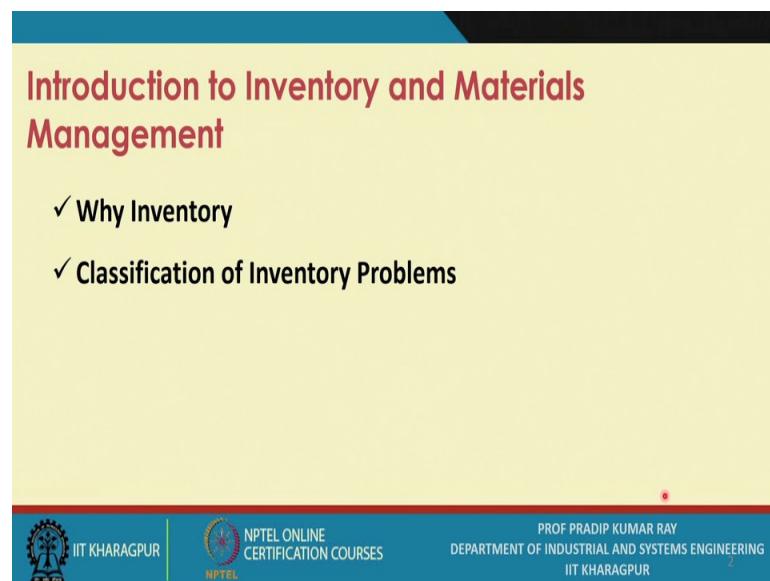
And this topic deals with the 2 aspects; one is the reasons of inventory, why do you need inventory? You should be very clearly understood, and the classification of the inventory problems. Already we have the classified the types of inventories the different types of inventories based on the state based on the utility, we have already the studied this one we have classified the inventories.

(Refer Slide Time: 01:06)

Now, in a given situation, you can come across different kinds of inventory related problems. So, the first thing you need to do is classification of the inventory problems. So, you need to know that what are the factors actually contributing to a specific kind of inventory problem.

And these factors are common to any kind of inventory problems. So, you need to identify the factors, and then you need to study each and every factor, and then you need to consider the different the combinations ofthese factors to identify the kind of problem you are facing right now or you may be facing later on.

So, the inventory is needed to meet demand. Right now we are discussing the issue that is why inventory. Why do you need inventory? Suppose inventory is not there what would happen? Demand occurs at instant of time or during a period of time; that means, what I am saying that at this point, in time the demand of 10 units as occurred at this point in time. So, if there is a demand and you need to meet the demand. How do you meet the demand? You need a supply, the supply of what? Supply of inventory that means, at any instant of time suppose there is a demand of 5 units.

So, at that is so, in order to meet the demand at the same point in time, you need a supply of 5 items or the 5 units of a particular item. So, this is are inventory. So, essentially when you talk about the inventory management system we are referring to the relationship between the supply and demand, and how best you can the create a condition

where you know the supply and the demand is having the best possible there having the best possible relationship between them.

So, inventory is needed to be demand occurs and instant of time or during a period of time. If supply is made as and when demand occurs, this is this is possible, in many a time in majority of the time this is not possible. There is no need of inventory; it is a perfect matching a perfect match between supply and demand, is it ok? So, this might happen and certain cases is a and if you a that is ultimate goal; that means, you say in many cases that can you create a condition where you know, but the supply and demand and matching exactly at any point in time.

So, obviously if you create such a condition there is no need of having inventory. However, such a condition in all likelihood in all likelihood, is it? Can rarely be achieved due to many kinds of practical difficulties and constants, is it? Like can it be possible to arrange instantaneous production or supply as soon as the demand occurs.

Is it possible? In majority of the cases in almost all cases it is not possible. Because you need to produce as a production takes time, you need to make the supply and the supply takes time. So, even if you with demand of small quantity, and there is on time on time or online real time information control system.
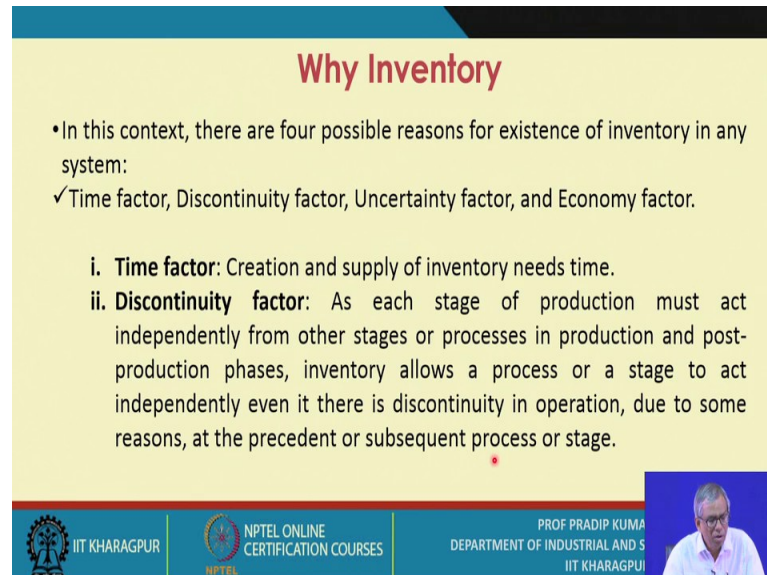
So, even if there is an online, real time, information control systems. So, this there is will come across the online real time control systems the information systems is constantly being updated. So, even if you have that kind of system related to inventory management so, in many cases many companies, they have you know the adopted computerized inventory management systems with several modules.

The several functional modules is very common practice this days among in in many organizations throughout the world. Creation of inventory with is acceptable value quality and quantity need certain time. You cannot you cannot create the inventory instantly.

So, the creation of inventory with it is acceptable value, that is most important, is it ok? If in a hurry you produce the inventory, but it does not have adequate value, and obviously, know do not call it an inventory and that will cannot meet the demand. So, the

quality of the inventory the quantity of inventory and ultimately the value of inventory you must you must ensure.

(Refer Slide Time: 06:34)

So, in this context there are 4 possible reasons for existence of inventory in any system. So, what are those? These factors are first is the time factor see in night you need to you need time to produce the inventory, and then only you can supply it, is it ok? So, first one is the time factor the second one is a discontinuity factor; that means, what do you do you keep inventory in sufficient quantity, in sufficient amount in advance. Right now you have as a production system.

Now, there could be a discontinuity in production system, there could be discontinuity in the supply there many are the factors are making the systems the uncertain. So, there could be many discontinuity factor. So, what you try to do? In order to take care of this factor what you do you keep some extra inventory.

So, this is the second reason third reason is; obviously, the uncertainty factor, right? So many of these problems will find coming under inventory, these are basically the problems under uncertainty; that means, even the demand is known not known. So, sometimes the demand is low sometimes demand is high, is it ok? So, so when the demand is low and you knowing fully well that it could be high in the next season.

So, why do you have you know, you must have a capacity and the at this point in time when you produce to capacity, you may have some extra stock. But this extra stock you can use in the next season when the demand is more than the capacity. So, this also one of the reasons uncertainty factors, and the last one is the economy factor.

So, let us elaborate briefly about all these factors. So, time factor is the creation and supply of inventory in it is time, is it ok? That is why you need inventory. The second one is the discontinuity factor. As each stage of production must act independently from other stages or process in production and post production phases, this have already mentioned like say we mention about the you know the decoupling inventory.

Inventory allows a process or a stage to act independently even if there is discontinuity in operation, is it ok? Due to some reasons at the precedent or the subsequent process of stage so, this is unavoidable.

(Refer Slide Time: 09:36)

So, discontinuity factor because of the discontinue factor you must have inventory. What is uncertainty factor inventory offers? Protection against unplanned or on anticipated occurrence of events that may affect supply system. Such factor may be of many types including acts of God; so, this is uncertainty.

So, sometimes you know you have a condition where you can produce to capacity, but if suppose there is a sudden the breakdown of the machineries of the production systems.

So, shut down, what do you do? You cannot produce as per the capacity. So, it is better that when end of the system runs at it is capacity. So, why do not we utilize it is capacity fully, even if the demand is less let the production quantity be more than the demand.

So, that if this is an occurrence of you know, but the shutdown or the breakdown you have the extra stock. And because of this extra stock you can fulfill the demand occurring at that point in time.

Economy factor inventory offers cost reduction advantages, when bulk purchases with quantity discounts is allowed, this is a common practice everywhere. If you produce if you if you demand if you know demand more, or if your requirement is more so, you are you are allowed you know the quantity discounts.

So, there is some advantages in reducing the total purchase cost. So, when the quantity discounts offered so; obviously, the quantity discount of is offered at a particular the level of or at a particular quantity. So, maybe if you make a supply of a if you if you have a so, a demand for 10000 and you want to purchase 10000 units ah. So, the unit price quoted maybe if 10 rupees per unit. Whereas, if it crosses 10000 suppose you are demand is 15000, you make it a reduction of say 20 percent so, that is the price discount you offered.

So, because of this quantity discount of the price discount ah, there will be overall gain in your the total purchase the cost. So, that is why the discount is accepted. So, the economy factor becomes prominent when procurement at lowest price in condition of seasonal price fluctuation is justified.

(Refer Slide Time: 12:29)

Now so, we know that why we must have inventory, and ah, but this inventory amount or the amount of inventory is to be the determinant logically scientifically. And following certain principles so, those details will come to know in course of time.

Now, how do you classify the inventory problems? That is the code issue so, before we attempt to classify inventory problems, as they exist in manufacturing or service organizations. It is pertinent to know what is to be determinant related to inventory management, for an item or for specific questions need to be answered against an item, is it ok?

So, that means, you know what uses inventory problem; that means, related to a particular inventory item what do you need to do? That means, the 2 questions are to be answered. The first one is when to order for this item it must be known, whether at any point in time, or at a particular point in time, is it?

So, this time so related to time there will be this question and you have to answer. The second one is how much to order for this item. If you at any point in time suppose you decide to there must be certain rules, you will come to know all these rules. So, suppose you decide at any point in time t equals to p that you have 2 places an order.

So, the next question is asked that what will be the quantity what will be the order quantity. So, how much to order for this item? So, the remember at any point in time

whatever may be the inventory problem, related to a particular item whatever may be the constant. So, whatever may be the conditions these 2 questions have to answer, right? And these 2 questions are answered in the in various ways. So, there are 2 parameters related to above questions.

(Refer Slide Time: 14:51)

So, these are the 2 questions we have related to time and related to quantity for any inventory control system. A number of factors affect this inventory problem. Each of these factors may have different levels, is it ok? So, the first will identify the factors which actually determine and inventory problem. And then will look into each and every factor, and the details of this factors under you know how many different ways have these the factors can be leveled.

So, this also will understand, will identify those levels against 3 factor, and then will be able to classify the problem. So, this the classification process we are going to discuss in a systematic manner. Combinations of the types and levels of these factors determine classes of inventory problems; that means, each combinations will identify when all the factors and when levels are known when you can established different combinations so, will count how many different combinations.

So, you may find that one combination is the simplest problem, and the another combination is the most complex problem. So, you also must understand that why it is a simple problem, why is another combination is treated as a complex problems in the real

world ah, what will find that almost all sorts of the problem types you come across a starting from the most the complex or say the most simple to most complex problems.

And you must have the reason means you must have the tools techniques approaches to the formulate all kinds of problems I need to get a solution and the solution the will lead to a answering to speech to specific questions that is going to order how much to order.

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So, the first factor so, all the factors we need to briefly describe at this stage you please note them down all the important points. The following factors need to be considered for classification. The first one is the knowledge of demand; first factor is the knowledge of demand, demand for the item. We must have this knowledge this is the starting point because you are creating an inventory system essentially to meet the demand.

So, the demand maybe of 2 types the first one we call it independent demand, like the demand of finished goods. So, is basically this demand depends on to market conditions. So, the market ask for a particular so, the finished goods are the final product, ok. So, it does not bother about the materials, it does not bother about the demand of the w I p, is it ok or m r o items.

So, this is this is referred to as the independent demand, is it ok? So, the demand of the finished goods are the demand of the final product or there could be dependent demand.

So, what is dependent demand? That means, demand of raw materials, is it ok? Amount or raw materials you required to produce one unit of finished goods or the final product.

So, this the demand of raw materials just for an example depends on demand of finished goods as per bill of material of the finished goods. So, for the finished goods are say the final product; obviously, you know there is a bill of material; that means, to produce one unit of output, how many different types of how many the different types of ah.

So, the components parts or the sub assembly is you required. So, that is very clearly you know the mentioned in the bill of material document. So, for one unit of so the output that means, the finished goods if you refer to the bill of materials, you will be will be coming to know that how much raw materials you require. How many parts in the which quantity you required to produce one unit of output?

So, accordingly you determine when the when the demand the quantity is known for the finished goods. So, obviously, for each part for each raw material you will be will be able to know, what is the actual quantity required.

(Refer Slide Time: 19:51)

So, this is the dependent demand then the demand could be constant; that means, the demand is under certainty. That means, what do we say the problem under uncertain. So, under certainty; that means, demand is known with certainty demand known with certainty. Demand level is known exactly, we say that my next which demands for this

item is 10 units. So, an exactly 10 units so, such cases the do happen even if really, but sometimes know this is there is there are cases ah, when the demand is known with certainty, will refer to this cases latter on, ok? And you will come to know, it is not that rare.

Now, the next the type of demand yes; obviously, the variable demand. This may be defined in 2 ways, the demand under risk when the probability distribution of demand is known. So, this is one case and the second case is more complex the demand there will be demand, but the exact the level of demand is not known.

So, this is refer to as the demand under uncertainty, even the probability distribution of demand is not known; that means, either you do not have any the first data. This is the first time the demand has occurred that could be the case, where the situation is such that you cannot make any conclusions about the demand pattern, is it ok? So, how can there be any you know the demand distribution.

So, when even probability distribution of demand is not known, only partial information related to demand is made available. So, this case also will be dealing with there are approaches there are techniques with which you can solve this problem. And particularly you know what extent just make a note that particularly for the partial information in many a time, we can you know explain or in terms of the moments of the distributions.

Even if the distribution the type is not known, but you can calculate the moments of the distribution first moment, second moment, third movement, forth movement and if you calculate if you for a given item with the data, if you can calculate up to the 4th moment, ok. You will have sufficient information and obviously, you there are the approaches with which you can determine the order quantity as always the ring interval.

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The next important factor is the source of supply. So, this may be of 2 types, first one is outside supply case; that means, the item is procured from outside supplier. So, most of the cases almost the 40 to 70 percent of the items the listed in bill of material for a discrete type you know discrete type manufacturing systems. Or say the typical you know, the batch type production systems will find there all procured from outside whereas, there are cases where you need to have self-supply. So, this is refer to the inside supply.

So, of the both the cases will consider the modeling will be done for both the cases. Item is supplied from inside is called the self-supplying case decision process, repetitiveness that is the next factor. This may be of 2 types one period decision; that means, only for a specific time period the demand occurs. So, it is a onetime decision, the next time period. The demand does not exist, there many such cases, you come across where you know you need to take a decision just for once; that means, it is referred to as a one period decision.

So, this is referred to as the static inventory problem. So, we need to have a single order in all likelihood because usually such cases the selling season or you know say by the period when the time period is maybe few weeks or say maybe one month, is it ok? So, you decide to have just one order, for meeting one month's demand.

Specific time period during which only the demand exists, is it ok? Just for one week or each day a particular newspaper is sold in specific quantity. So, the next day you know you place a different order quantity, is it ok, so it varies. So, obviously, say one period decision so, this type of problem is referred to as static inventory problem. But there are there are cases there items inventory items are these items regularly used mainly for the production purposes.

So, for which you know you have to take a multi period decision dynamic. So, whenever you have you come across or you have to take a decision, not only today everyday every month every year, ok? Decision maybe the different kinds of decisions, you might have for different time period. So, this problem is refer to the dynamic inventory problem.

Repeat orders we have to do demand exists for countably infinite time period, is it ok? So, the company's product is being produced for the last 50 60 years. And I am sure that the next 30 years ofthese products will be made available in quantities.

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So, this is a typical dynamic inventory problem case, item produced regularly knowledge of lead time or lag time, so, what is the lead time or the lag time. The time between placement of an order and the receipt of supply; I repeat the time of placement of an order and the repeat and the receipt of the supply. So, this the time difference is referred to as the lead time or the lag time.

So, this is an important factor to be considered in inventory you know problem classification. Knowledge of lead time or the lag time lag in receiving order, that is it. Time between placement of an order and the receipt of it supply have already mentioned, this may be have 2 types constant lead time you assume it to be constant and or it could be variable lead time.

So, in the majority of the cases say at least 60 to 70 percent of the cases will find the lead time is variable. Probability distribution of lead time is known are specified, is it ok? So, that is related to the lead time related factor.

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Now, there could be different inventory control systems. That you can impose on the system write. So, the practitioners over the years, they have been the recommending different kinds of inventory control systems, right? If is it any factory, you come across different types of items.

And so, also different kinds of inventory control systems you may come across. And for a specific item one particular type of inventory control system maybe recommended. So, for any item it is inventory control systems can be decided independently? A large number of such control systems have been developed by researchers and practitioners throughout the world.

And many of the such control systems they find a place in text books on inventory management. And they are in use in different companies, you visit different kinds of inventory control systems you come across, is it ok? And all are useful; among a large number of such systems the following control systems are widely used. And while we while we discuss the inventory control. So, the models in subsequent lecture sessions will be referring to all these 5 types of you know the control systems.

So, these systems all the systems will be learnt in depth in course of time. So, the first system is called perpetual just please noted down, later on will discuss in detail. Perpetual or continuous review system this is one kind of system. Next one is the periodic review system for many kinds of items this periodic review system is followed.

Then we have the material requirements planning on MRP system there are many versions of MRP system. And you will come to know later on that mainly the MRP system is recommended specifically for w I p type of inventory, is it ok? Then you have the distribution requirements planning this is the very much there in the materials management systems. So, this is very, very important in fact, the distribution requirements planning. And you must have you know the good quality distribution requirements planning system.

So, that you know for the entire supply chain; that means, from the inbound logistics to the factory system to the outbound logistic ah. You can have a balance flow of materials in different forms. So, you must have that means, entire inventory management systems of a factory of a manufacturing system must be supported by an adequate and the quality distribution requirements planning systems. And of course, that the last type of systems inventory control systems also will be discussing, that is the single order quantity systems.

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So, the over and above this factors as stated, the demand distribution over time may be assumed to be fixed that is the stationary demand or it might vary over time period.

So, initially we assume that what about the distribution will assume for the demand as well as for the lead time ah. These distributions so, the remain constant there is not going to change. Whether there could be situations there could be you know, this the some since regarding a particular type of distribution they might change.

And then if you assume different types of distributions over the time period, then it is a non-stationary demand or the non-stationary are the system. So, so either the demand distribution may be assumed to be fixed constant or it may be assumed to be a variable. So, the both the cases you come across while you modeling.

So, stationary as well as the non-stationary, another stationary system when you refer to when directly we assume that the inventory system as become a steady state system, is it ok? So, in many cases suppose the inventory system as such as when running for a long long time we may assume this hypothesis we may have that is the system has become stable other steady state condition. So, inventory control classifications may be depicted with the following figure.
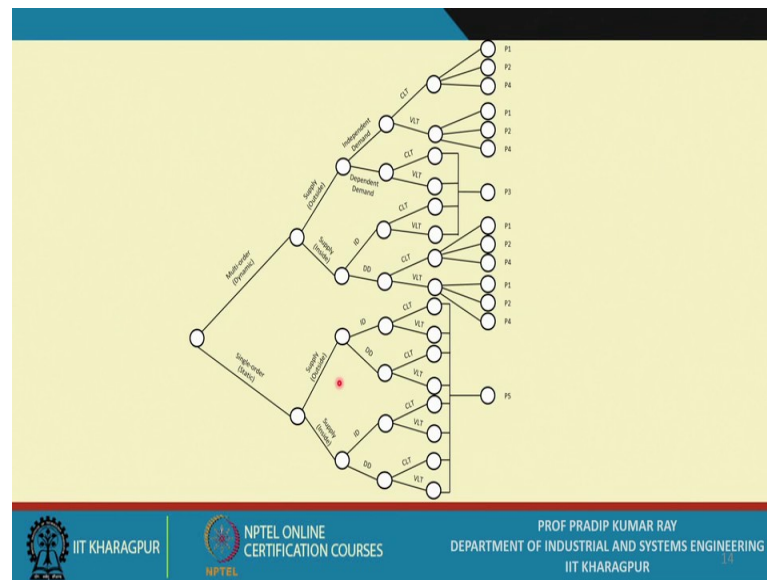
So, this is the figure you refer to like so, the multi order dynamic single order static. Then you have the supply outside supply or it could be inside supply. Then there could be independent demand, there could be dependent demand, then there could be constantly time there could be where will you time.

So, you reach to this note these are the notes you have, is it ok? And against a particular note; that means, in this combination with a particular combination, you can either adopt P 3 control systems, P 1 control systems, p 2 control systems or p 4 control system; that means, distribution requirements planning systems.

Similarly, there could be other routes, is it ok? So, you have these routes; that means, this is independent demand this is also independent demand, this is a constant. So, this is a dependent demand this is independent demand. So, for the dependent demand, you have the constant lead time variable lead time, is it ok? And for the dependent demand over here and independent demand over here; that means, this 2, 1, 2, 4, 1, 2, 3, 4, this 4 notes are essentially for the dependent demand for both the cases. And you have just material requirements planning. Whereas, this one is independent, and this one is independent.

So, you have these notes, and you have you can have either P 1 or p 2 or p 4 inventory control systems. So, similarly we have all these routes, is it ok? And this is the all these routes are exclusively for the single order modeling, is it ok? This is a single order modeling the static inventory problem under risk.

So, there could be outside supply or the self-supply. There could be independent demand, there could be dependent demand, there could be independent demand, there could be dependent demand, is it ok? So, here actually this is a constant demand this is a constant, this is a constant demand and the constant I know the variable demand, this is a constant demand variable demand, and this is a constant lead time variable lead time.

So, this is either the demand could be constant or the variable, right. So, ultimately we will have this single order modeling that this is referred to as the P 5. So, we have covered this important topic called the classification of inventory. So, who will be going for? You know, the formulating all most all types of manual inventory problems, is it ok? So, there are many combinations.

Thank you.