Decision Support System for Managers
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Week - 11
Module - 04
Lecture - 53
Decision Support Systems for Inventory Management (Contd.)

Hi, welcome to this 4th module of the 11th week on our course on 'Decision Support Systems for Inventory Management'! Today we are going to start off from where we had left in the last module.

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We will be discussing about a case, where we had applied the concepts that we learnt in the last module. So, we will be discussing about a particular case of determination of buffer stock level in a manufacturing environment.

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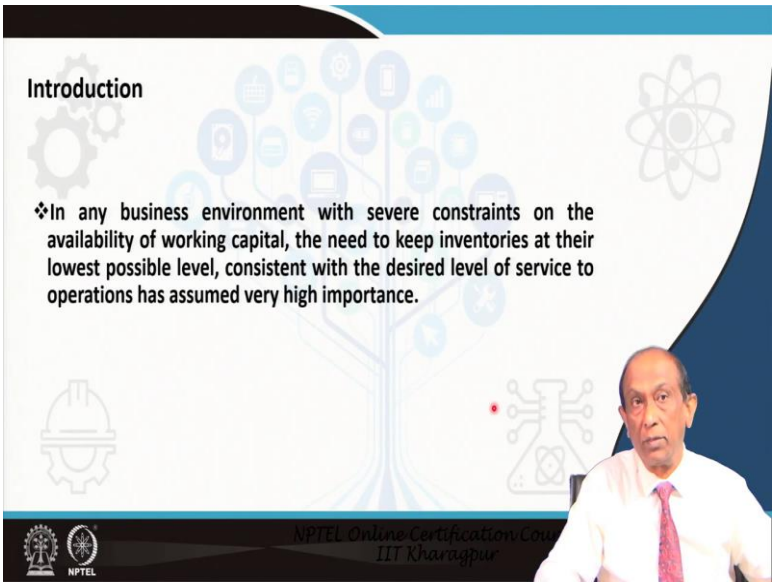

So, in the last module, we had discussed that, in any business environment, particularly in a manufacturing environment, with severe constraints on the availability of working capital, because to meet the working capital needs. Most of the manufacturing units they have to take loans from banks or financial institutions and they have to pay interest on that loan amount. And, the inventory expenses are made from that working capital.

And, hence there is a need to keep the stock level or inventory at their lowest possible level, but at the same time, we have to take care of the fact that the desired level of service to operations have to be maintained. And, that is why determination of the safety stock assumes lot of importance.

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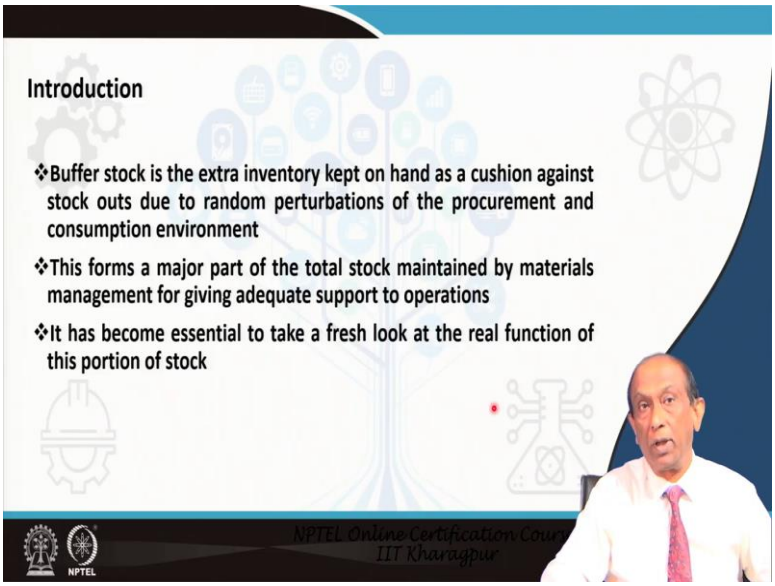

So, last module, we have mentioned that the safety stock or the buffer stock is the extra amount of stock or inventory, kept on hand as a cushion against stock outs; due to random perturbations of the procurement and consumption environment. That is what we said that, the lead time might vary the demand rate might vary or there can be fluctuations of lead time and demand rate at the same point in time.

So, this buffer stock or the safety stock forms a major part of a total stock maintained by materials management or even operations management; for giving adequate support to operations. And, hence it has become essential to take a fresh look at the real function of this portion of stock.

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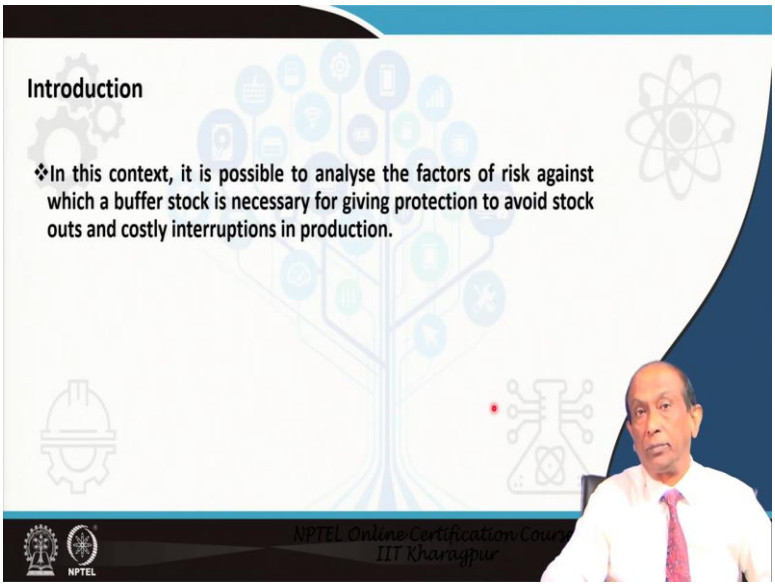

In this context, it is possible to analyze the factors of risk against which a buffer stock is necessary for giving protection to avoid stock outs and costly interruptions in production.

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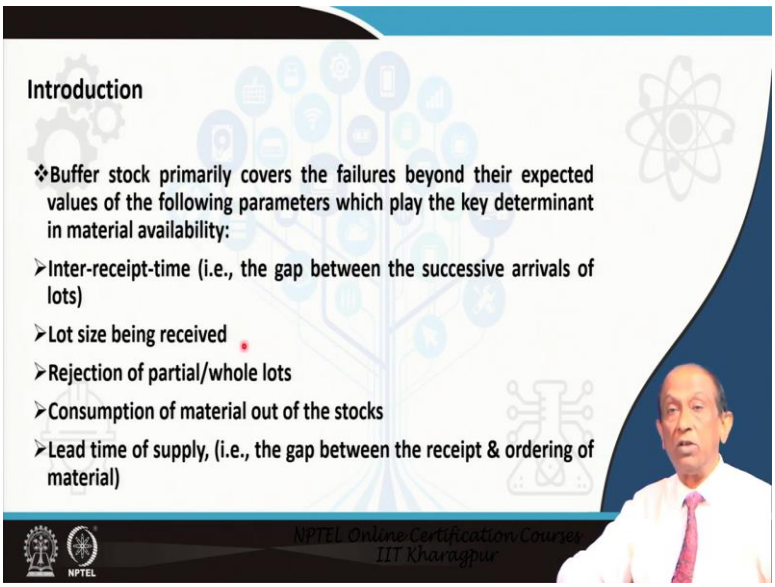

So, buffer stock primarily covers the failures beyond their expected values, that is the average values of the following parameters; which play the key determinant in the availability of materials.

So, what are those parameters? First of all, the inter receipt time, that is the gap between the successive arrivals of lots this is one. So, inter receipt time is very important, which

is almost equivalent to the lead time. The second parameter is the lot size being received, you have ordered 500 units, the supplier might have send you 300 units, you have ordered 500 units, the supplier might send you 700 units.

So, there will be a fluctuation in the size of the lots that you receive. Sometimes the quality of the lot may not be up to the mark. So, there can be rejection of partial or the whole lot. Then, you have to take care of the consumption of material out of the stocks and of course, if lead time data is available the lead time of supply is also a very important parameter. So, in a real life environment, these are the parameters, which determines the level of safety stock.

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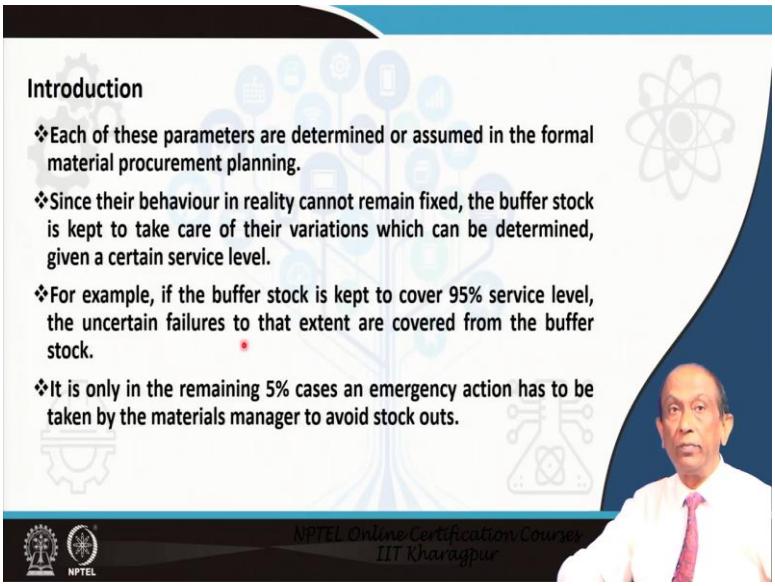

Each of these parameters need to be determined or assumed in a formal material procurement planning environment. Since, as I have already told you, the behavior of these parameters in reality cannot remain fixed; the buffer stock is kept to take care of their variations which can be determined, given a certain service level.

For example, if the buffer stock is kept to take care of 95 percent service level, the uncertain failures to that extent are covered from the buffer stock. It is only in the remaining 5 percent cases, an emergency action has to be taken by the operations manager or the materials manager to avoid stock outs.

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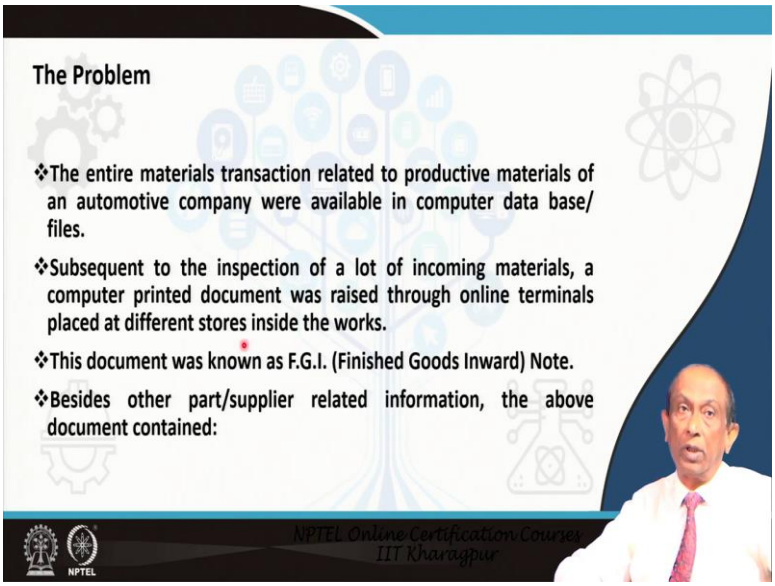

See, what we did, that we looked into the database of an automotive company to determine the safety stock. How we can get some of these parameter values? So, what we found that entire materials transactions, related to the productive materials were available in their computer database. And, then when we looked into this data items, we found that, one important data item is related to these Finished Goods Inward note, which is termed as F.G.I.

Now, what is F.G.I? We looked into that environment and we observed that, subsequent to the inspection of a lot of incoming materials, incoming materials are coming a lot is received, it is inspected and after inspection a computer printed document was raised through online terminals placed at different stores in the works environment. So, we looked into the data items of these finished goods inward note.

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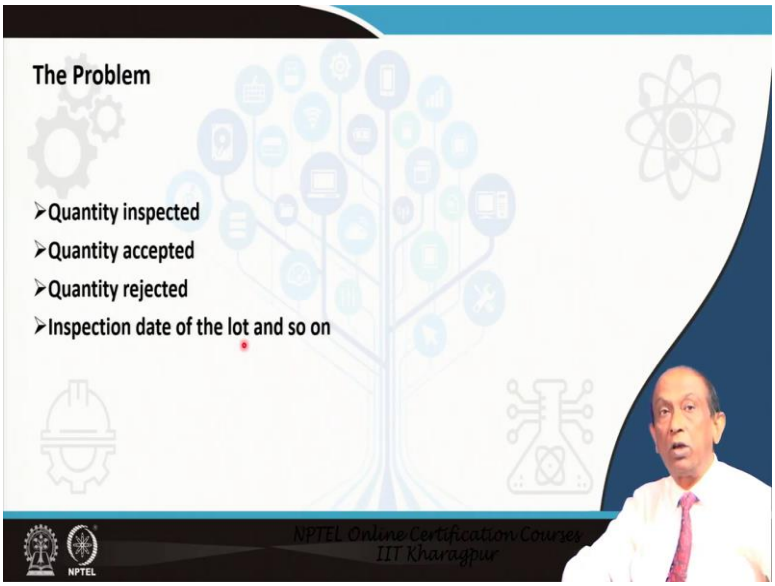

So, what we found that besides other part supplier related information this F.G.I document contained the quantity inspected, quantity accepted, quantity rejected, inspection date of the lot and so on other variables.

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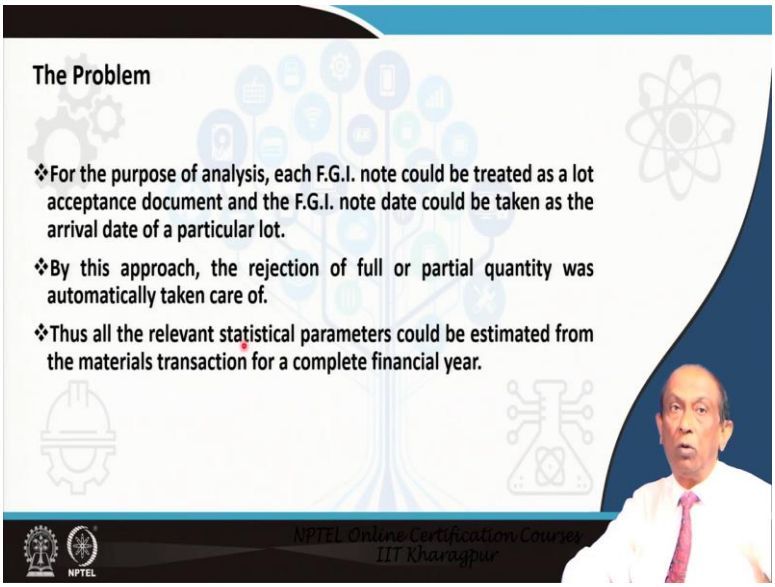

So, what we did? We assumed for the purpose of analysis that, each of these finished goods inward note could be treated. As a lot acceptance document and the F.G.I note date could be taken as the arrival date of a particular lot. F.G.I note date is the date when

that F.G.I is getting prepared that can be you know considered as the arrival date for a particular note.

So, since we considered the accepted quantity in F.G.I. We had taken care of the rejection of full or partial quantity. Thus, all the relevant statistical parameters could be estimated from the materials transactions for a complete financial year.

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These parameters adequately described the global pattern of receipts and consumption behavior of materials in any of the areas that we were going to study. Another thing that if you go to this work environment and just ask anybody that, what is the lead time nobody will give you? Ok.

Nobody will tell you what the lead time is. Because, nobody knows nobody keeps track of that. So, we had to compute it in a different manner by considering this F.G.I note dates. Because, what we did that we defined one particular variable called inter receipt time, as the difference in days between two successive lot arrival dates.

We found out we assumed the distribution of that inter receipt time, computed the mean and standard deviation of that inter receipt time, which could be considered a surrogate measure of the lead time. And, we found that the receipts and consumption environment, in that automotive company varied with the nature of operations associated with a particular area.

That means, for regular production items the environment is different from say items which are used for foundry operations, or forging operations. In that particular company all these forging, foundry, all related engine shop, all these things were there inside the plant.

Today, you know you such kind of plants normally do not exist, because most of these automotive companies they are more bothered about the assembly operations. They keep that, assembly operations in house and the rest of the things they outsource. Today one in this particular exercise we are talking about a particular company, where all these units were there inside that premises.

So, since the nature of operations used to vary area wise, the determination of buffer stock levels for the same required separate analytical treatment for each of these areas and consequently different methodologies were evolved for each of these respective areas. So, we will not go into the details of each and every area, we will be discussing only about one or two areas in this particular lecture.

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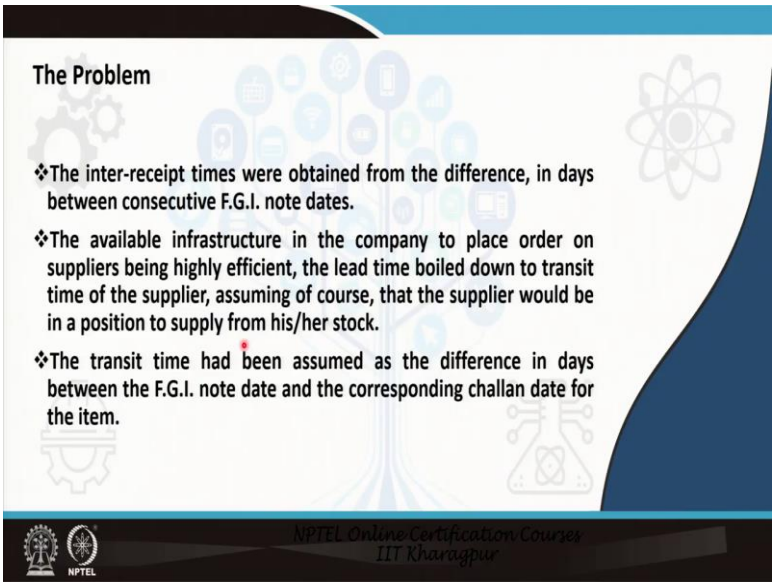

So, what we said that, since lead time data was not directly available. The inter receipt times, were considered as a surrogate measure of lead time. And, the inter receipt times were obtained from the difference in days between consecutive F.G.I note dates; that means, for a particular item irrespective of the supplier from which the item is been obtained.

We considered all the materials transactions over a year and sorted those transactions in the ascending order of the F.G.I. note dates. In that case the difference between two successive F.G.I note dates, we will give a measure of the inter receipt time. That means, if 50 F.G.I transactions were captured, then there would be 49 such measures of inter receipt time over that period.

And, since the arrival of lots ok, could be easily you know considered and we could find we plotted this you know distribution of this inter receipt time and we found that, it almost approximates normal distribution. Again in some cases we found that, the available infrastructure in the company to place order on suppliers was highly efficient.

In many cases the lead time boiled down to transit time of the supplier. Assuming of course, that, the supplier is in a position to supply from his or her stock. So, the transit time is another parameter, which was assumed as the difference in days between the F.G.I. note date and the corresponding challan date for the item.

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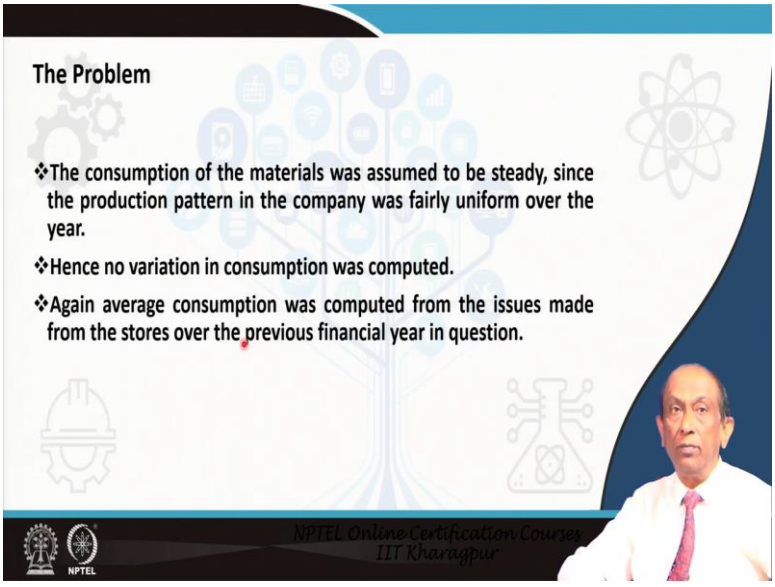

The consumption of the materials was assumed to be steady since, the production pattern in the company was fairly uniform over the year. Actually, you know products were of very high quality and there was a steady demand for that. Hence, we did not consider the fluctuation in consumption pattern. So; that means, the demand is constant, the demand rate. Hence, no variation in consumption was computed.

But, we have to know the average value of demand rate. So, average consumption was computed from the issue transactions from the computer we got all the issue transactions data for an item over the period, say 1 year, 2 year, whatever data was available and we have computed the average. So, that is why we said that average consumption was computed from the issues made from the stores, over the previous financial year in question.

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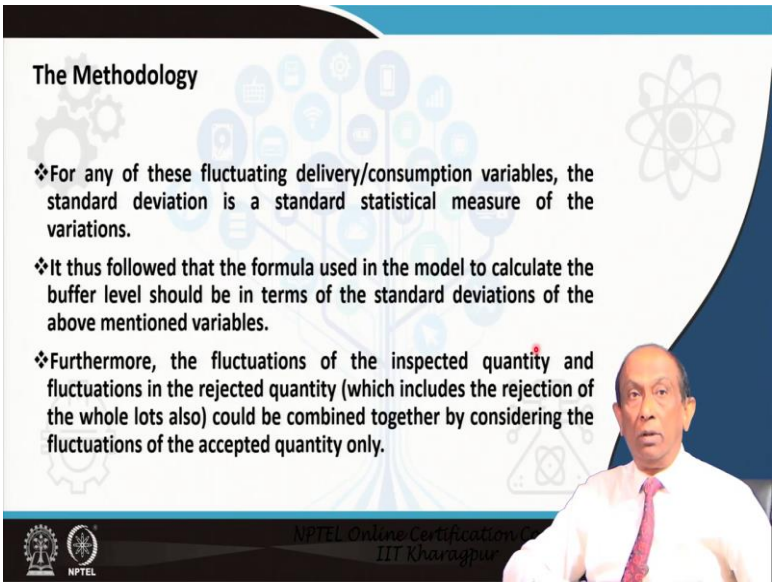

So, for any of these fluctuating delivery or consumption variables, as we know that, the standard deviation is the standard statistical measure of the variations. So, the formula used in the model to calculate the buffer level was in terms of standard deviations of the above mentioned variables.

And I have already said that the fluctuations of the inspected quantity and fluctuations in the rejected quantity could be combined together by considering the fluctuations of the accepted quantity only; ok.

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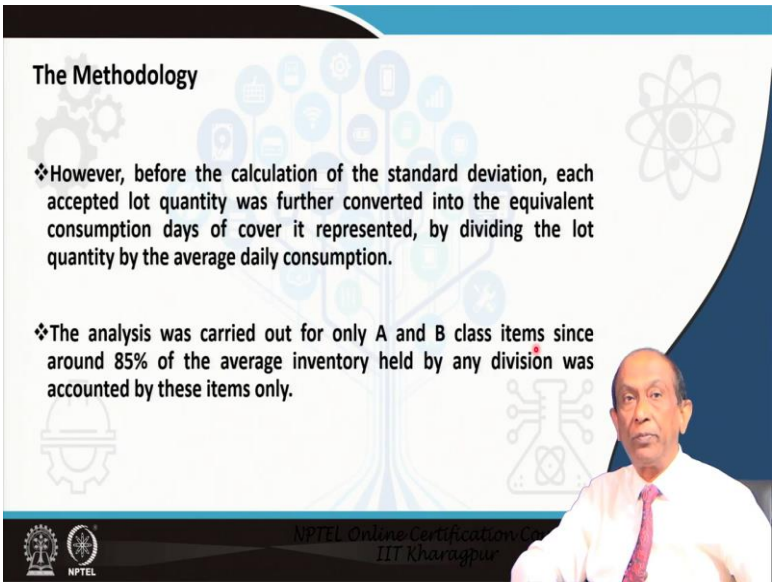

So, what we did that, before the calculation of the standard deviation, each accepted lot quantity; we converted into equivalent consumption days of cover, by dividing the lot quantity, by the average daily consumption.

And, that analysis was carried out for only A and B class items; because those are the most important items. Because 85 percent of the average inventory held by any particular division was accounted by these items only; which were maybe 20 percent in number among the total number of items.

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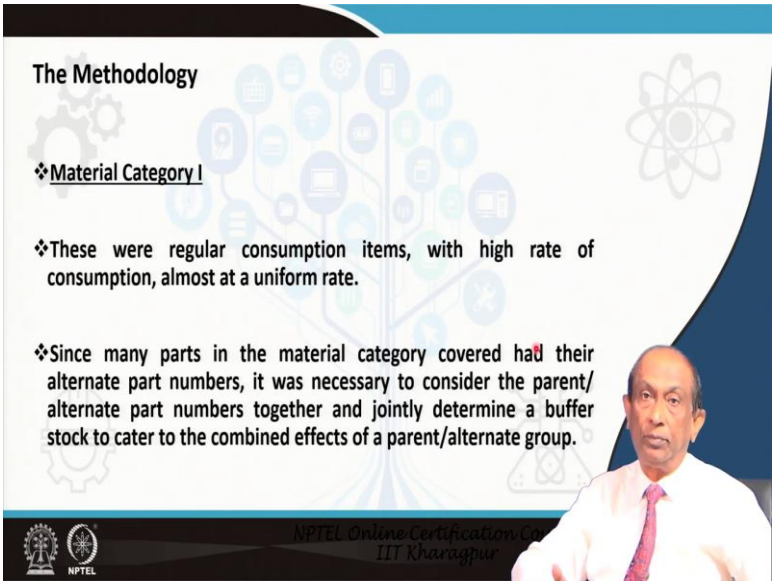

So, we looked into different category of items. For material category I, which were regular consumption items with high rate of consumption almost at a uniform rate, what we did that, we found out that many parts in that material category had some alternate part number; because if the parent part or the original part was not available then the substitute part or the alternate part was being supplied by the supplier.

So, it was necessary to consider this parent and alternate part numbers together and jointly determine a buffer stock to cater to the combined effects of a parent alternate group. Because, in their computer database for the purpose of delivery scheduling and ordering purpose, the requirement was that the buffer stock should be mentioned against the parent alternate group.

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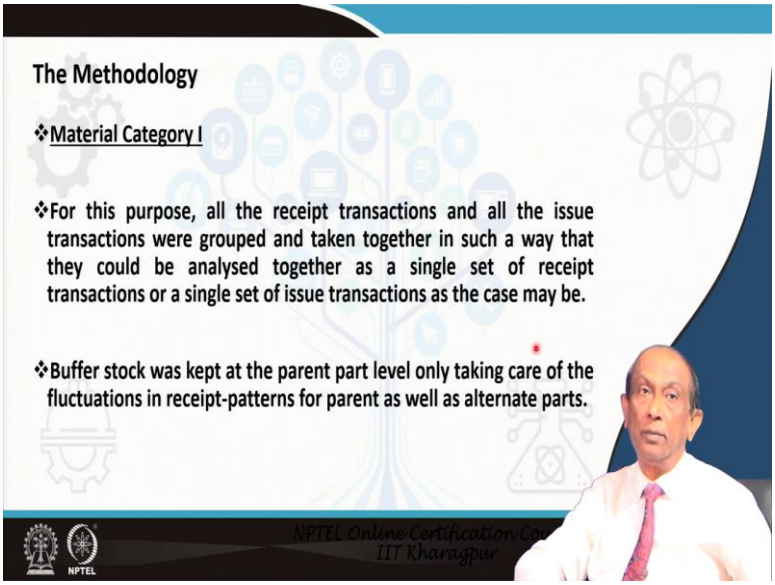

For this purpose, all the receipt transactions and all the issue transactions for the parent alternate parts were grouped and taken together in such a way, that they could be analyzed together as a single set of receipt transactions or a single set of issue transactions as the case may be. The buffer stock in that company was kept at the parent part level only taking care of the fluctuations, in the receipt patterns or consumption patterns for parent as well as alternate parts together.

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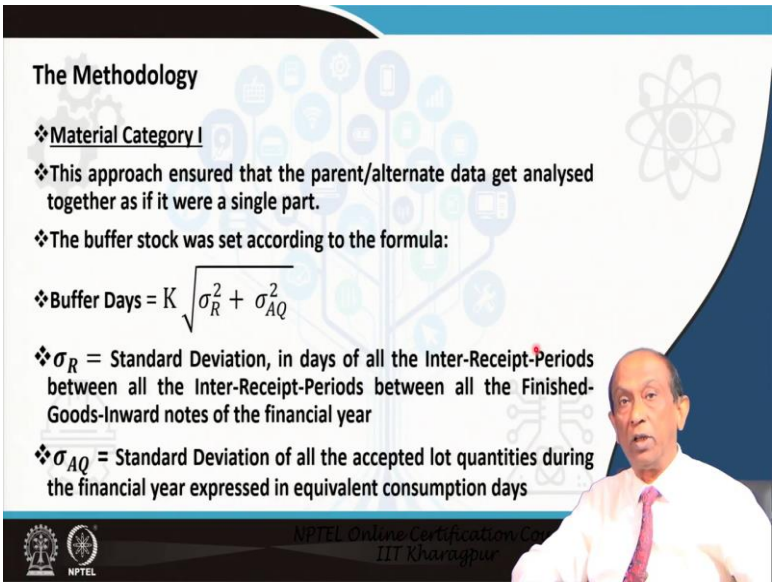

What we do did that, the buffer stock was set using a formula of K times root over of sigma R square plus sigma A Q square where, K is that factor corresponding to that service level what we had talked in the last module. Sigma R is the standard deviation in days of all the inter receipt periods between all the finished goods inward notes of the financial year. And, sigma AQ is the standard deviation of all the accepted lot quantities during the financial year expressed in equivalent consumption days.

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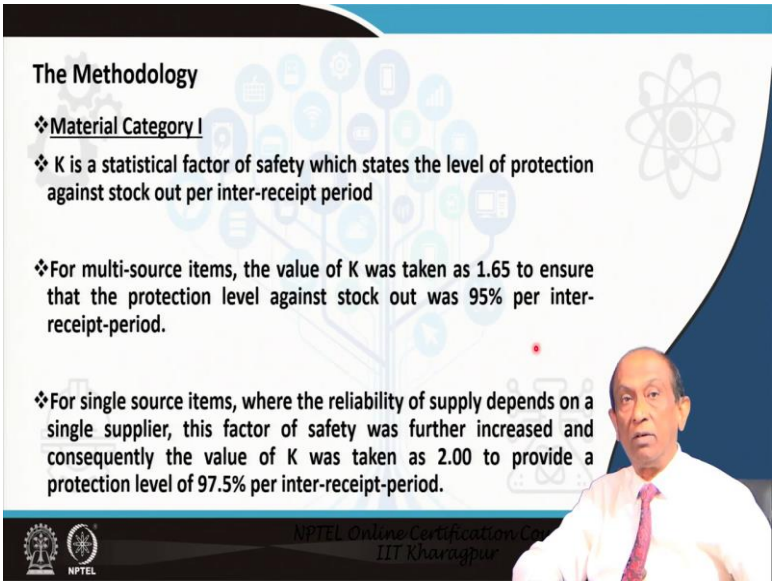

K represents a statistical factor of safety, which all of you know that for 95 percent level of service level K was taken as 1.65. Now, for single source items where the reliability of supply depends on a single supplier, this factor of safety was further increased in consultation with the, you know top management group. And the value of this safety factor K was taken as 2 to provide a production level of 97.5 percent per inter receipt period.

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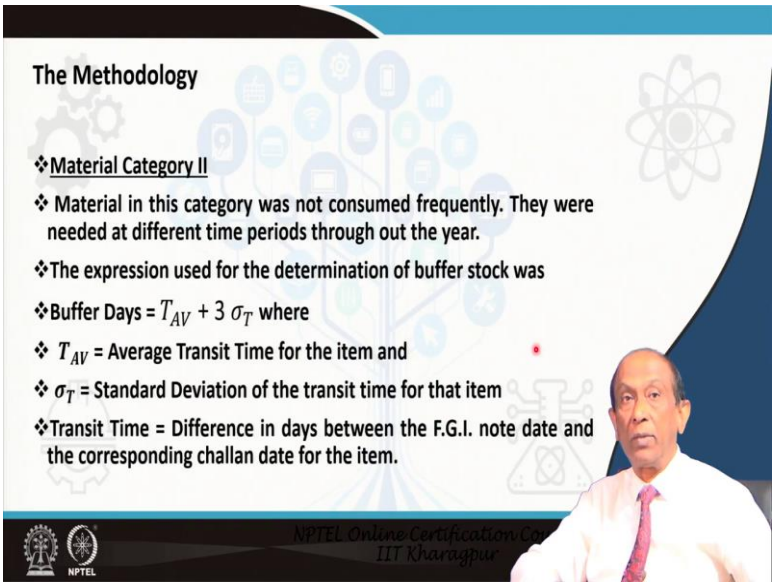

For material category II, these are particularly items like sand and all used for foundry and all. The buffer days were computed as T average plus 3 sigma T, where T average was average transit time for the item and sigma T is the standard deviation of the transit time for the same item. The transit time is nothing, but the difference in days between the F.G.I. note date and the corresponding challan date for the item.

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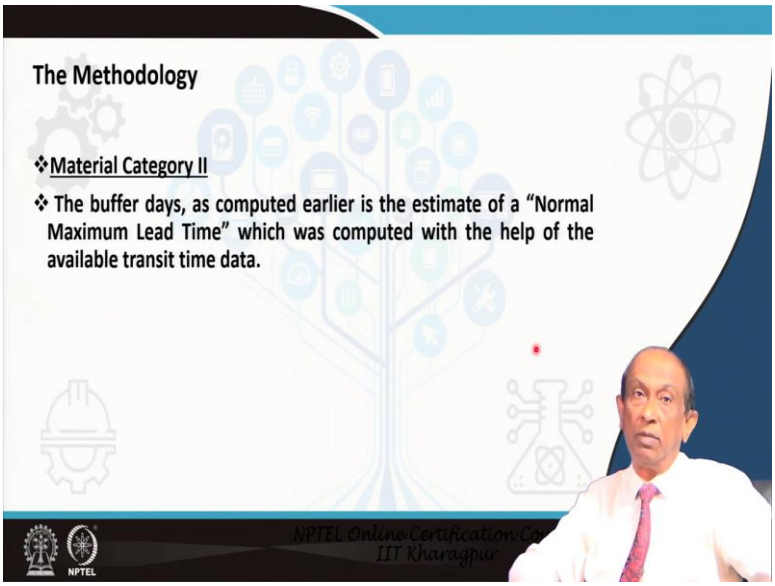

So, the buffer days as computed earlier is the estimate of a normal maximum lead time, which was computed with the help of the available transit time data for material category II.

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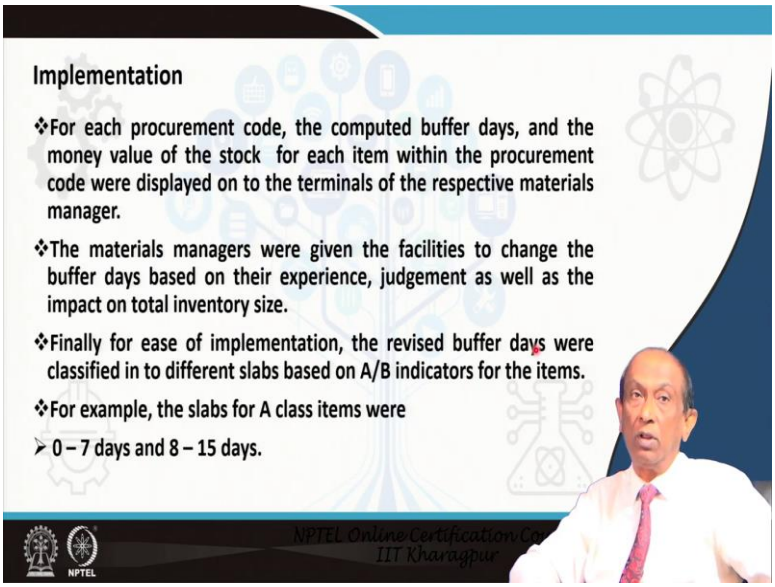

Then, for each procurement code, the computed buffer days and the money value of the stock for each item within the procurement code were displayed on to the terminals of the respective materials managers. The materials managers were given the facilities to

change the buffer days; based on their experience, judgment as well as the impact on total inventory size, which was also getting reflected on the screens.

Finally, you know after they have made all the changes and other things, the materials managers based on their, you know feeling, experience, they changed some of those buffer days.

But for ease of implementation the decision support systems recommended that, the buffer days need to be classified into different slabs based on A or B indicators for the items. For example, the slabs for the A class items were say, 0 to 7 days and 8 to 15 days for B class also similarly other slabs were recommended.

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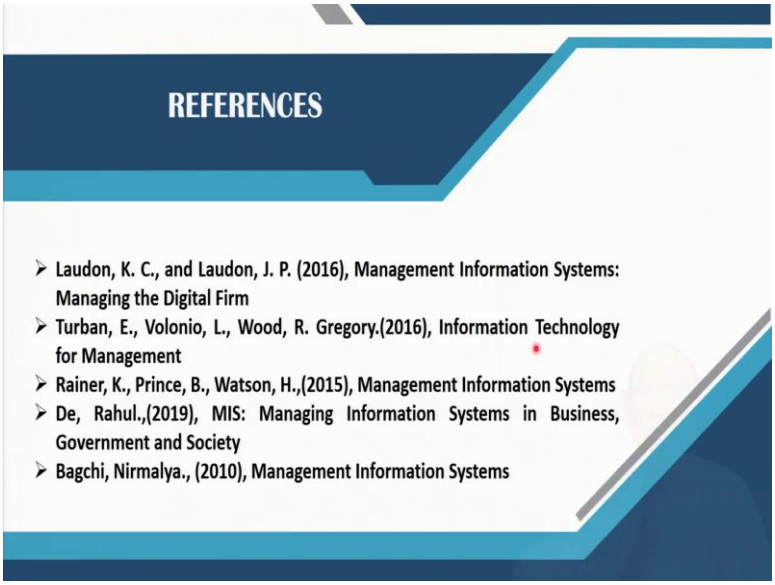

So, this is the way decision support systems in real life gets implemented. These are the references that we have used for this lecture.

And thank you all for your patience!