Production and Operation Management
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Lecture 27
Material Requirements Planning (MRP) Examples-I

Welcome friends in our last session, we started discussions about material requirement planning which is done for managing the inventory of those items which have dependent demand. And we discussed various examples where dependent demands are possible because the end item, the final product requires various kinds of sub-assemblies components etc. And for that purpose, we discussed that the basic EOQ model which we discussed in our independent inventory management or the fixed time interval models are not used.

Here, we are using the orders, we are placing order for managing the inventory of these dependent items based on the requirement that when do we require these items for the final product. So, the time fencing and then the second was the issue of how much quantity we will order. So, we have discussed that in a material requirement planning, 3 important inputs are there, 1 is the master schedule, master production schedule.

The second is your bill of material, how many quantities of each type of sub products are required and third is the inventory records. These 3 important inputs are required for processing the material algorithm and then your output is available in the form of primary reports and secondary reports. Now, in this particular session, we are going to discuss some numerical examples for the use of theory, which we have discussed in our last 2 sessions for material requirement planning.

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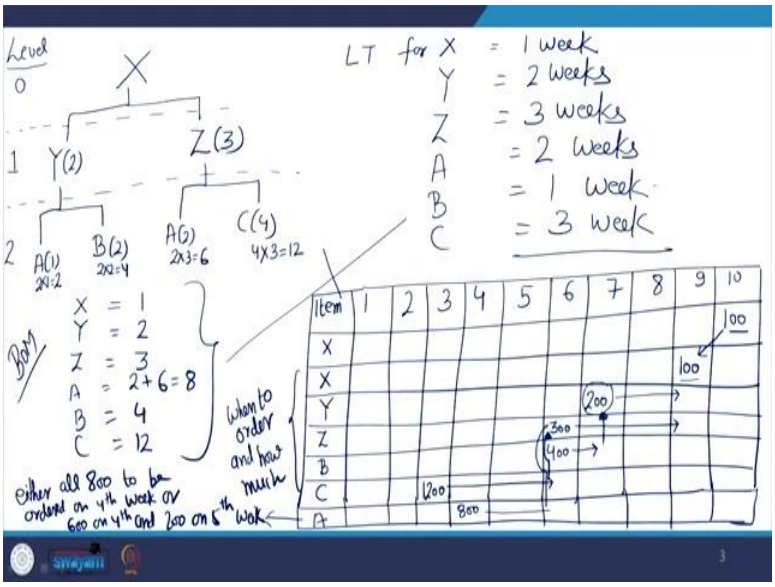

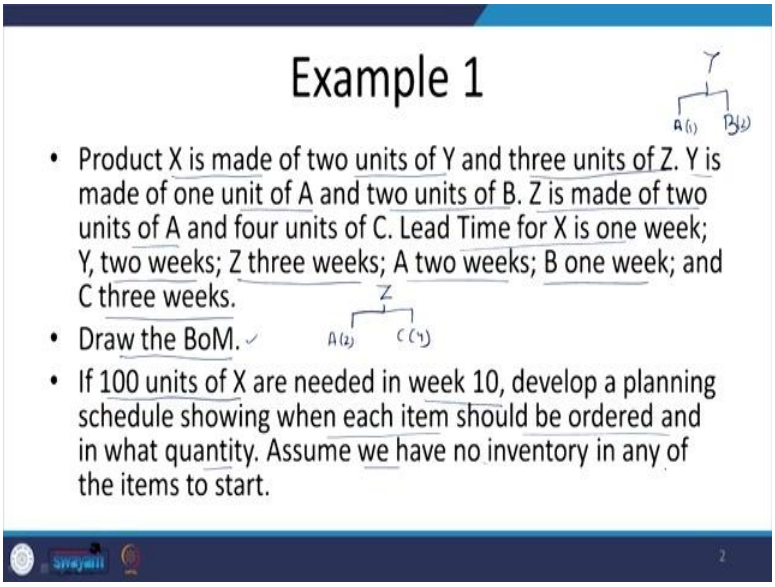

Now, 1 example which we have taken this is about the development of bill of material. Now, here the question is that there is a product X there is a product X. Now, to make this first let us make the product structure this is product X. Now, this product X is made up of 2 units of Y and 3 units of Z. So, it requires 2 sub components. Y and Z and it says that 2 units of Y and 3 units of Z are required for making 1 unit of X.

So, you can write in bracket 2 and 3. This is if you remember, we can also mention the levels of productive structure. So, this is level 0, this is level 1. Now, going further, Y is made up of 1 unit of A and 2 units of B. Now, Y is having A and B 1 unit of A and 2 units of B. So, let us add this leg A and 2 units of B like this and this is the second level of the product structure.

Then comes Z, Z is made of 2 units of a Z is like this 2 units of A and 4 units of C. Now, let us add this to the diagram A 2 C 4, A 2 C 4, this is also at D. So, you can have D is different labels and then the lead times are also given to us that lead time for X is 1 week lead times for X 1 week for Y it is 2 weeks then come into Z 3 weeks, then for A it is 2 then further for B it is 1 week and then for C it is 3 week.

Now, this is the complete information which is given to us for 1 unit of X. Now, you can see that for 1 unit of X, your bill of material says that for 1 unit of X you require Y equals to 2 a Z equals to 3 and then for 1 unit of Y you require 1 unit of A so far 2 units of Y, you require 2 into 1 that is 2 and for 2 units of Y, you require 2 into 2 that is 4, for 3 units of Z, you require 2 into 3, 6 units of A, add 4 units of C that means 12 units of final C.

So, A requirements are 2 plus 6, that is 8 and B's requirement is 4 and C's requirement is 12. So, that is the total requirement for making 1 unit of X. For 1 unit of X you require 2 y's, 3 Z, 8 A's 4 B's and 12 C's and these are the lead times available to us. So, now the questions says draw the bill of material. So, this is your bill of material the quantities required for different material that is now available to you.

Now, when you add this quantity with lead time when you use these 2 information, now we are able to make our MRP. So, what is says that we want hundred units of X in week 10 and develop a planning schedule showing when each item should be ordered and in what quantity assume we have no inventory in any of the items to start. So, there is 0 inventory available in the beginning of the problem and we want 100 units of X in week 10.

For that purpose, you can prepare a chart like this and were these are the weeks. So, this is 10, 9, 8, 7, 6, 5, 4, 3, 2, 1 and item. So, item is X, which is required in 100 quantities in period 10. So now, you will release the order we are requiring.

So, I am just giving you when to order and how much? So, for X, we will order because the lead time of X is 1 week. So, when my final requirement is in week 10, so I will place the order in week 9 for 100 units, then only I will get the order in week 10. So, you can say that this is planned order receipts, and this is planned order release for X.

Now, come Y, now Y and Z are required for making our X. I want to make the X in period number 9 and X can only start making in period number 9 when Y is available to me and Y will only be available I want how many Y's because for 1 X 2 Y is required, so for 100 X 200 Y's will be required and I want 200 Y's here on this particular date.

So, when I am placing order on 7th week then you will get these wise here because 2 weeks it is going to take similarly Z. I require 3 Z for 1 X, so I need to place the order of 300 Z in week 6 and it is going to take 3 weeks time, then only I can make 100 X in ninth week. Now, for making X, Y and Z we require different types of components. So, let us see B first let us see B first for B, you require only 1 B and B is required for making Y, Y we are starting in the week 7, Y we are starting in the week 7.

So, how many B's are required, we require 4 B's. So, 4 into 100 that makes 400 and it is having a lead time of 1 week. So, our 7th week we are starting Y. So, in the 6 week, we will place the order for Y so that B so that it is available, when this is going to start. So, this way you can remember that, this is for this particular cycle.

Then comes C, C is required for Z. C is required for Z and C has a lead time of 3 weeks. So, Z is starting in the 6th week see Z is starting in the 6 week. So, I have to place order 3 weeks before means in third week and how many C's 12 C is required for 1 X. So, for 100 we require 1200 and it is having a 3 week lead time. So, for by this quantity, I am going to use these number of C's. And then finally, let me also think of A's, A's are required for both Y and Z.

Now, you see your Z is starting in the period 6. So, you should place the order of A, so that you can get enough number of A so that you can fulfill the requirement of this. So, there are 2 possibilities, there are 2 possibilities that you can give the order of all A's in the period here, so that these can be used for this particular process and then you can have remaining A for the use of Y or you can do another thing also that you can divide these A in 2 parts that 600 A you give order on 4th week and 200 A you give order on fifth week. So, both these possibilities are there. It depends upon what type of capacities you have.

So, accordingly either you can give the entire a on 4th week or you can give order of 600 A on 4th week and 200 A on 5th week. So, 2 possibilities are there. So, here we can note that either all 800 to be ordered on 4th week or 600 on 4th and 200 on 5th because A is to be used for Y as well as for Z. So, if you are keeping all 800 on the 4th week, you need to pay inventory carrying costs 2 for 200 units for 1 week.

So, if carrying cost is not very high and the setup cost is high in that case it is good to make all 800 together if the carrying cost is high and setup cost is not very high in that case, you can make 600 on 4th week and 200 on 5th week. So, it depends that what is the cost

parameters and based on that you can develop this kind of material requirement plan. So, this is 1 example we understood for material requirement planning.

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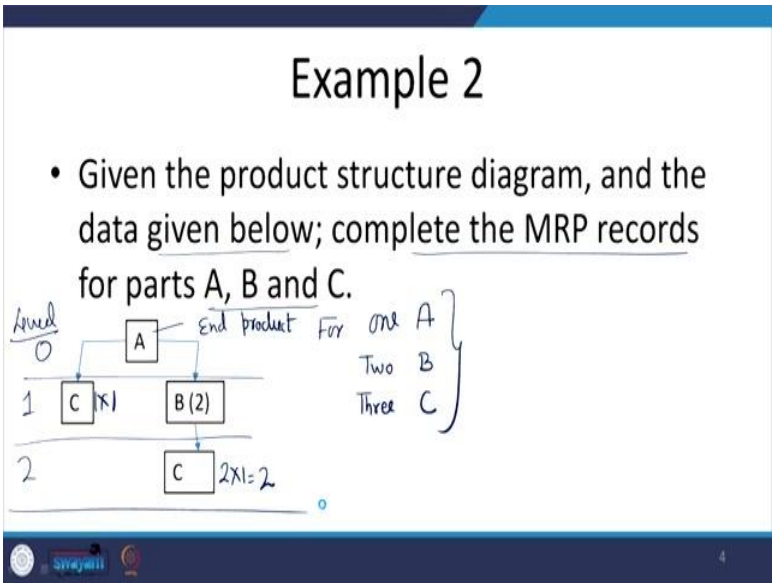

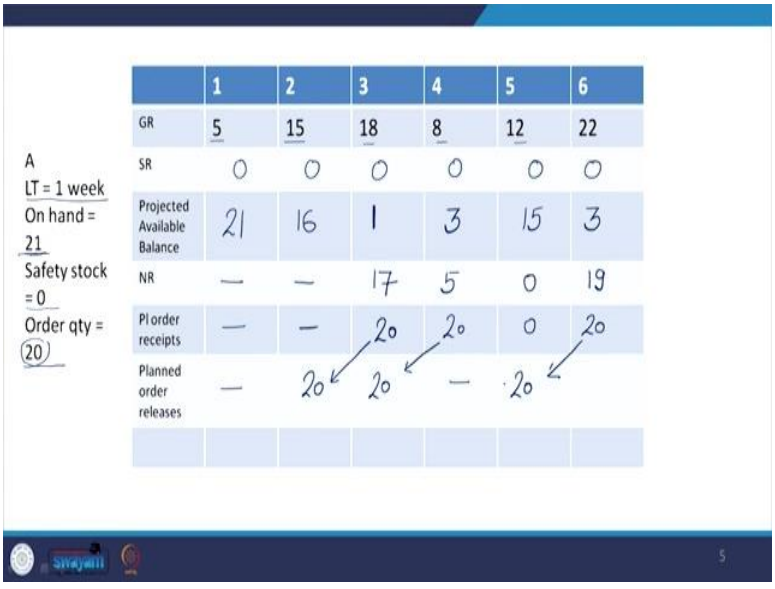

Now, let us do 1 more example. Here we have a product structure available to us. And in this we have some kind of data available to us where we need to see that how to complete the MRP records for production ABC. Here the structure says that for 1 A you require 2 B and for 1 B, 1 C is required for 2 B 2 C's are required 2 into 1, 2 and 1 into 1 1. So, for making 1 A, this is theses. So, this is your bill of material for this simple diagram that for making 1 A 2 B's are required and 3 C's are required. Now, let us see this table which we need to complete for this diagram.

So, the diagram says the requirement and now, this is our material requirement planning. Now, the gross requirement is given the end product is this is the end product and here also you see, though it is a very simple diagram, but it also has 3 levels, this is level division. So, this is 0 level, this is level 1 and this is level 2. Now, it is important thing to understand that same component C is available in level 1 and C is also part of level 2. So, it is quite possible that the same component may be required at different levels.

So, as you can see in this diagram, no here some information is available for A we will use this means to understand that there are only 3 components in this product 1 is final A and there are 2 sub components B and C. So, for making MRP we need to make the complete table of this type for all ABC.

So, this is for A, I have made a bigger table and then you see B we can have tables for B as well as for C. Now, let us see how to full that table for A. Here we see that these are the gross requirements in different periods 5, 15, 18, 8, 12, 22 and now, you see the lead time for A is 1 week.

So, whatever we need in second period, we need to give order for that 1 period before on hand inventory is 21, safety stock requirement is 0 and order quantity is 20 units. Now, what is it meaning that scheduled receipts are 0 there is no scheduled receipts. You do not have any order which is pending.

So, all head inventory projected available balance is 21 on hand stock is 21. So, net requirement is not there, there is no plan order receipts and no planned order release. Now, coming to the second period you have used 5 units out of here. So, 16 are available to you, your demand is 15 and therefore, there will be no requirement and you will go ahead.

Now, you will consume 15 and only 1 unit is available. So, 17 becomes the net requirement 17 becomes the net requirement and for that purpose you have to make some arrangement so that you can receive 17 here. Now, the order quantity which you can order that is 20 so to get 17 you have to place an order of 21 period before so that you can get 20 here.

So, out of 20 17 you will consume. So, 3 will be available to you in the next period, then 8 is the requirement 3 is available. So, 5 becomes the net requirement. Now, for 5 to be fulfilled, you will place again an order of 20 units in third period, which will come to you in the 4th period. Now, out of these 5 you will consume, so remaining is 15 and the requirement is 12.

So, there will not be any net requirement and therefore, you will not receive anything in this particular period and there is no planned order release, next period out of that 12 you have consumed. So, you are left with the 3 units your demand is 22. So, the net acquirement is 19 units. So, you want 19 but you can only get in multiples of 20 and therefore, you will place an order of 20. So, this becomes this becomes the material requirement plan for A, this is you will place 3 orders in week 2 in week 3 and in week 5 and that will help you in fulfilling the gross requirements for period 1 to 6. No going further in this calculation.

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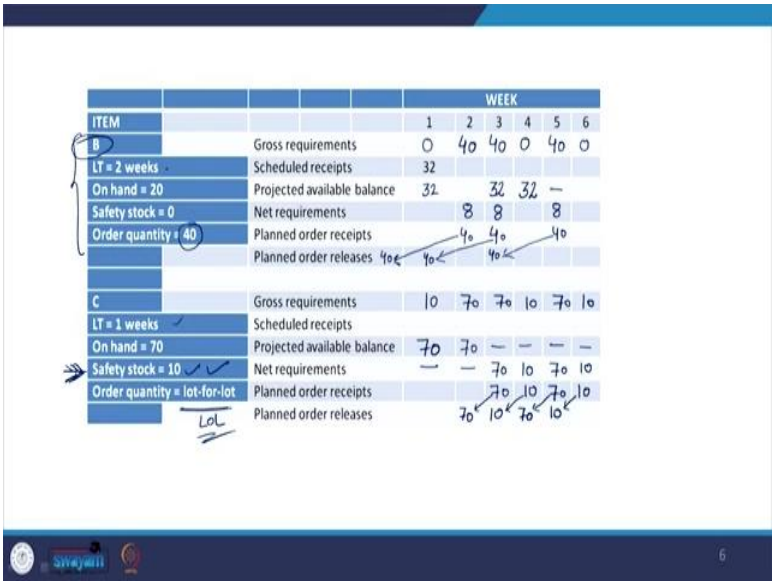

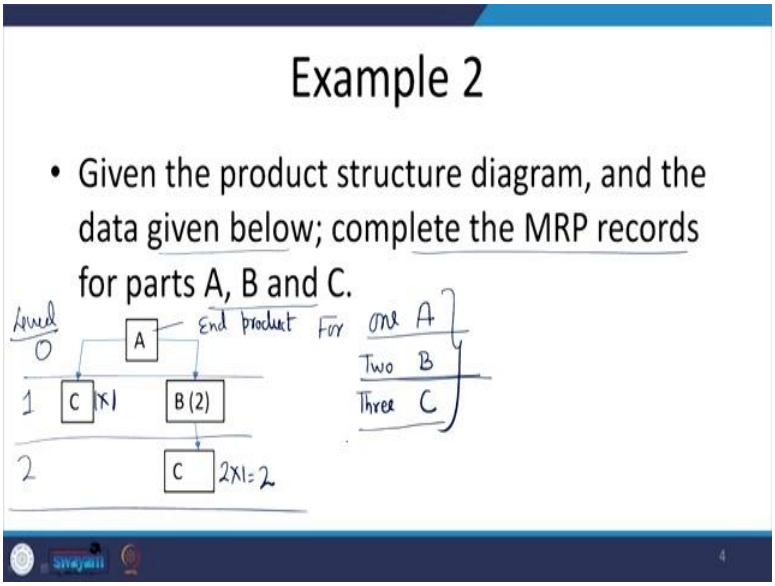

Let us discuss for item B now, in the item B you will first require you will translate the requirement from your previous discussion and here you see that for 1 A 2 B's are required for 1 A 2 B's are required. So, you see that for first period, you have the requirement of 5 A, but already 21 as 1 available to you and therefore, there is a net requirement is 0.

So, this net requirement data will go to this particular column. So, the gross requirement of B in the first period is 0. Then again you see in the second period, the net requirement of A is 0 that will again go to you in the second period. Now, coming to the third period the net requirement is 17 but since you are placing order in quantities of 20.

So, you have the requirement of 20 in the second week, here you are placing the order in the second week, the order which is coming to you for A in third week you have placed the order in the second week so, that will go here. So, that is and for 1 A, you require 2 B's. So, in the second v in fact, we need to correct ourselves for that this is not 0, it is going to be 40 because, in week 2, you are making 28 so, therefore, in week 2 you require 40 B. Similarly, if you see in week 3, you are making 28 and that means in week 3 also you will make 40 B.

Then week 4, you are not making any A so week 4 is 0, then week 5, you are making 28 that is again 40 and finally for this we have no idea. Schedule receipts are 32. So, projected available balance is 32 because you are going to receipt these 32 here and there is no consumption so it will remain 32.

Out of this 40 you are going to consume in the second week and 8 is available with you. So, you require 0 you have no balance with you. So, in fact your requirement is 8, 32 you already had that you will consume 40 is the gross requirement. So, finally the net requirement

becomes 8 units, now you will place order for these 8 units 2 weeks before because the lead time is 2 weeks.

So, here you want 8 units, but the order quantity is 40. So, you will place order somewhere here even before starting this first period, you have to order then only you will be able to make these 40 units. Then these 40 units you will have and 8 you have already consumed. So, the available stalk is 32 and 8 again you will require here but for 8 you will place order of 40 on first week.

That 32 is going to be available you here also then in the fifth week, you will consume these 32 and projected available balance will become 0 and 8 will be the requirement here. Again 40 will be coming to you by placing an order of 40 in the 3rd week so, this becomes the MRP for item B.

Now, we come to the third item in this particular category, where you see there are some interesting change. One interesting change is about we have introduced the concept of safety stock. And if you remember, in our last session, we discussed various types of lot sizing techniques. So here we are going to use lot for lot, lot sizing technique here we have the fixed quantities here it was 40, here it was 20 these may be either because of economic order quantity or because of our resource constraints, but here we are going for LOL.

Now, here you see the gross requirements, gross requirements will again come from this table for 1 A 3 C's are required for 1 A 3 C's are required. And you see that because in the first period, you do not have any requirement. In the second period you are making 20 A so 60 C's in third period you are making 20 against 60 in 4th, you are not making any in 5th you are making 20 so it will require 60 and 0 so this is the gross requirement.

Now, in this gross requires you need to see that safety stock is also to be added, you also need to maintain the safety stock. So, all the time you need to add safety is stock, we need to have whatever is required plus safety stock. So, in fact, if I write it clearly, so you can understand that these values will change and 70, 70, 10, 70, 10.

So, this will take care of my safety stock discussion. Now, initially on hand inventory is 70 initially the on hand inventory is 70 so that is already available with me 70 items and lead time is given 1 week. So, here I have a requirement of 10, 70 is always available. So, there is no net requirement and there is no further calculation required. In the second period, the requirement is 70 I already have 70 with me. So, finally, the net requirement is 0, in third

period, the requirement is 70 I do not have anything available with me. So, net requirement becomes 70.

So, for that LOL I am following and the lead time is 1 week. So, I will place an order of 70 units in the second period. Then, in the third period, this quantity will come and I will be fulfilling the requirement. In the 4th period I required 10 units the plan order receipts for 10 and here I will place the order of 10 units, then in this period the net requirement will be 70 I will place the order of 70 in the period of 4th week. Here, again the requirement is of 10 units, the planned order receipts will be 10 unit and it is like this.

So, this is how we are going to fulfill the requirement of ABC and this gives us a good idea that how do we handle the various types of MRP issues. We will also like to discuss in detail the comparison of different type of lot sizing decisions with the help of a single example. So, in our next session, we will do that example that how we can use the calculation of same data for determining the lot size issues. So, with this, we come to end of this session and in our next session, we will discuss the lot sizing calculation. Thank you very much.