Course Name - Operations and Revenue Analytics

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Week - 04

Lecture - 19

Welcome, friends. As we were discussing in our last session. There are a variety of situations where upstream supply chain partners need to do inventory management based on this dependent inventory concept, where we discussed that they need not forecast, rather they should not forecast for their own item requirements. The forecasting is done only at the final product level, which is done by the OEMs. Then, based on that forecasting, which is done at the OEM level, we do backward calculation, backflushing, which is going to help us in knowing the demand for our products and also when we are going to start production, when we are going to deliver the items to the subsequent stages of the production process. We discussed that for developing MRP-1, there are three very important inputs.

One is our master schedule, second is the bill of materials, and third is inventory records. With the help of one example, a simple example in our previous class, we discussed the case of product structure, and we also calculated how the bill of materials is prepared using that simple product structure. It is a graphical way. Through which we can understand that for making one A, how many B's and how many C's, and B's and C's are further made using D's and E's. So, for one A, how many D's, how many E's you need to finally produce, and then these D's and E's will make your B's and C's, and B's and C's will make your A. So, a complete backward planning is required, which is dependent on the number of how many A's you need. And therefore, if all these B, C, D, E manufacturers also start doing their own independent forecasting and independent

inventory management. It may create either a huge amount of inventory piling up in your system or there may be a continuous shortage of items in your system.

So, with this MRP kind of system, you are going to have very efficient inventory management, which is not only going to help you deliver the items at the promised dates but also keep the cost of inventory in check. Now, in this particular class, we will see how we are going to do this entire MRP development. Now, for that purpose, as we already discussed, there are two or three very important inputs: master schedule, bill of materials, etc., and then we are going to do the MRP processing with the help of some examples. Now, this is on your screen, a simple, let us say, table which gives you your master schedule. Here, you see that any end item when it is to be produced, when they are needed, and in what quantity.

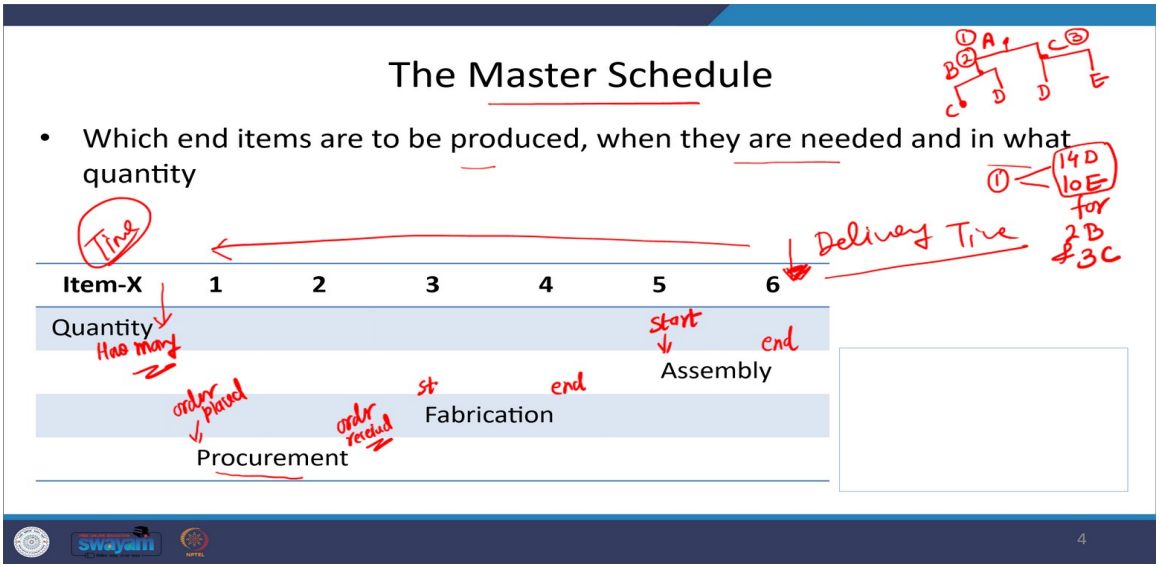
So, we are talking three very important things like item X when it is going to be started. So, if I am going to deliver in period number 6, this is the delivery time. So, assembly starting, start of assembly is happening in the fifth period. To start the assembly in the fifth period, the fabrication is starting in the third period and fabrication end in the fourth period so that in the fifth period assembly can start. And similarly the procurement of these items which is required for making this item X may be some kind of a raw material, the processing will start procurement will start let us say order placed in period one order is received in period two.

So, when I have to deliver in the sixth period, I have to deliver in the sixth period, but I have to start the work in the backward manner from period number one, when I am placing the raw materials, order the raw material is procured is delivered in the second period, in the third period I am starting the fabrication, fourth period the fabrication is over. Fifth period, we are starting the assembly. Assembly will be completed in the sixth period and then I will deliver the item in the sixth period. So, this is one you can say dimension of our which is the time dimension. And second important dimension, second important aspect will be quantity.

How many? because as you remember in our previous class we discussed that we need 1A and for 1A, we discussed that certain number of B's and C's are needed and for B and

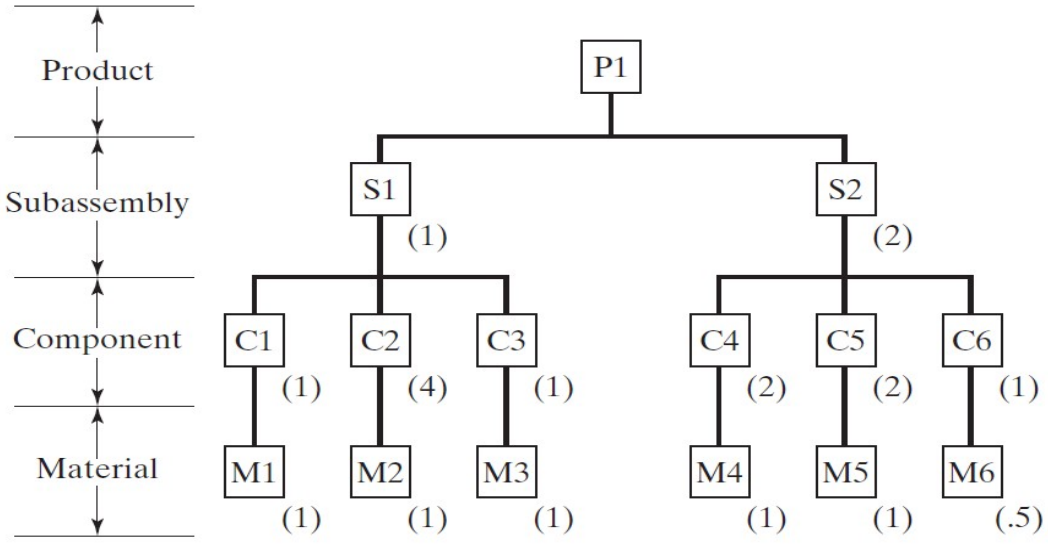
C also this B requires C and D and this C requires D and E. So, in fact the calculation if you remember for 1A you require 14D and 10E and these 14D and 10Es are making 14D and 10E for 2B and 3Cs because 2Bs and 3Cs are needed for making 1A.

So, this entire calculation we have already discussed in our previous class. So, after this master schedule based on this knowledge of product structure we are going to make a bill



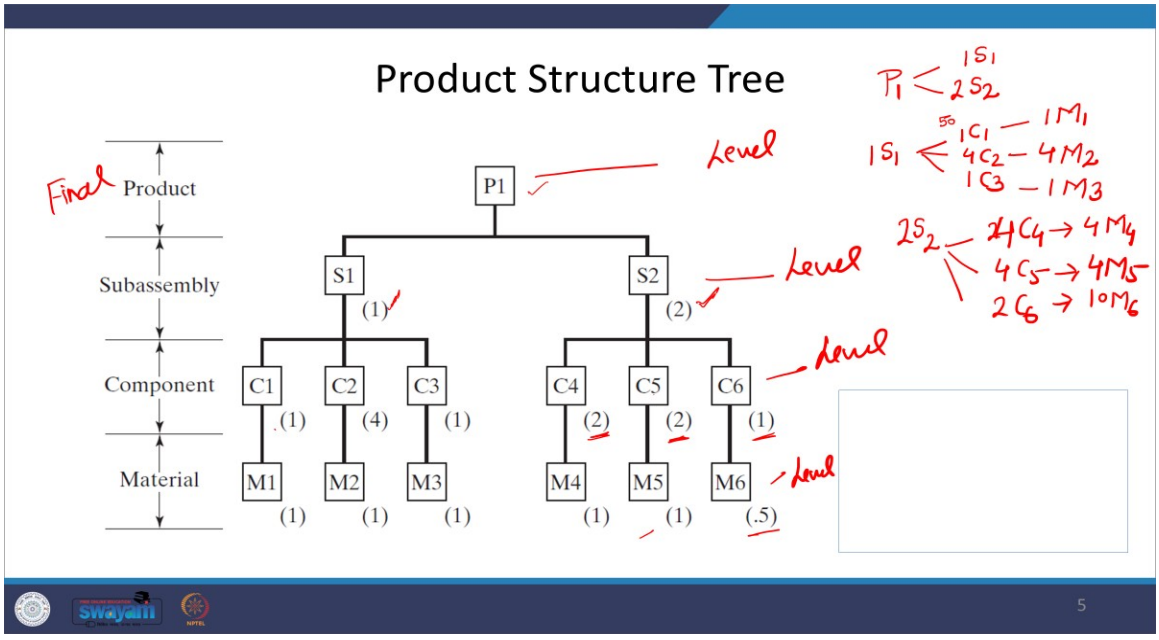
of material, this product structure tree PST is like this which we have already discussed here we have a slightly more longer product structure, where you have four labels this is one label, second label, three label, fourth label. In our standard language, these are levels which is the final product, then these are subassemblies, components and the materials like this.

Product Structure Tree



And you see that for making one final product you require two subassemblies S1 and S2. S1 is one unit and you require 2 units of S2. For 1 unit of S1, you require 1 unit of C1, 4 units of C2 and 3 units of C1. Similarly, for 1 unit of S2, you require 2 units of C4, 2 units of C5 and 1 unit of C6. And for 1 unit of C6, you require 5 units of M6, 1 units of C5 we require 1 unit of M5 and so on.

Now, you can easily make these calculations based on what we have discussed in our previous class that 1 unit of P1 requires 1S1 and 2S2, 1S1 requires 1C1, 4C2 and 1C3. Now, you see that 1C1 requires 1M1, 4C2 will requires 4M2, 1C3 will require 1M3, 1S2 sorry 2S2 requires 2C4, 1C2 requires 2C4. So, 2S2 will require 4C4, it will require 4C5 and 2C6. Now, 1C4 requires, 1C4 requires 1M4, so 4C4 will require 4M4, 1C5 requires 1M5. So, 2C5 sorry 4C5 will require 4M5 and 10C6, 10M6.

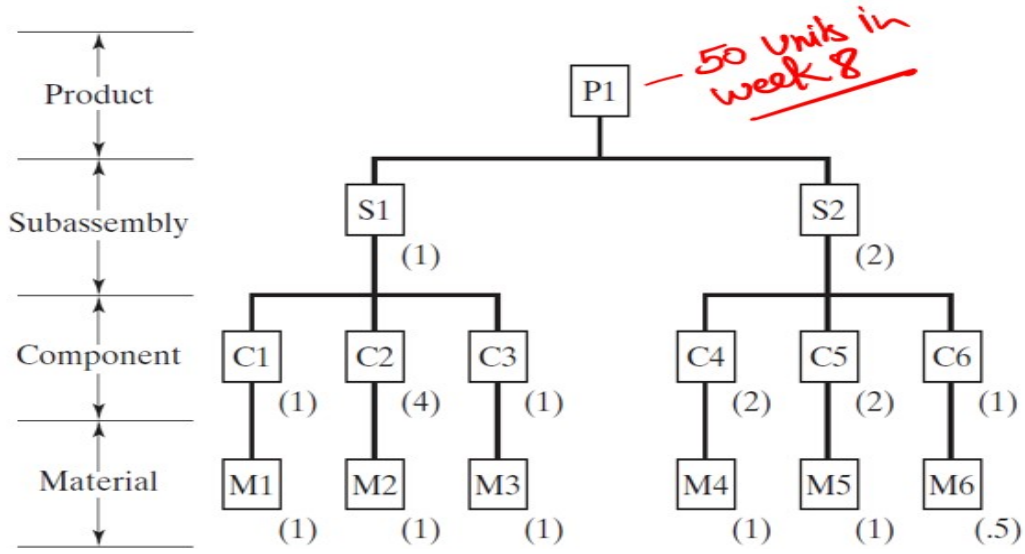


So, in this way you understand for making 1P1, 1P1 you require 1M1, 4M2, 1M3, 4M4, 4M5 and 10M6, that is the total product requirements or material requirement for making one unit of product final end product that is P1. So, this is a bill of material that how many different types of sub-assemblies, components, materials you require for making your final product and accordingly this product structure tree is a very useful way direct way visual way of determining this quantity. Now, the third important thing in this the processing of MRP, Now for processing of MRP we need to see the time phasing and we need to spread this over a sequence of spreadsheet sections. For example, we need to see what is the gross requirement of each component like I just calculated the gross requirement of each component. Now, if I say that I want to make 100 P1, if I want to make 100 P1.

You will see the gross requirements will change and will be multiplied by 100 for all of these different sub-assemblies, components, and material parts. So, gross requirements, then timing of order release—timing of order release is basically based on lead time and available inventory. And then we also need to decide what the quantity should be, which we will discuss in our next class—what the order quantity should be whenever you are releasing an order. There may be different types of systems. In this class today, I am going to consider the simplest system, where you order the exact quantity required, but that may not be economical. So, we will discuss in detail the determination of the best size for ordering purposes because there is a cost element associated with this, and that will be discussed in our next class.

Now, we have gross requirements. How many are in the pipeline? And based on that—whatever you have in-house plus in the pipeline—you will get your net requirements. Your gross requirement minus your projected on-hand, and then, based on that, you will have your planned order release and their appropriate receipts on a particular day. Now, consider this example again, which we were discussing a few minutes back—we have this product structure diagram, and 50 units are to be completed in week 8. 50 units in week 8—that is our commitment. Now, for this purpose, we have to decide how many

orders we need to release and when. As I said, I am assuming a few things at this moment.



And what I am assuming is that there is no inventory—no inventory of P1 or any sub-assembly in stock. There is no inventory of P1 or any sub-assembly in stock. 50 P1s to deliver in week 8—50 P1s we need to deliver in week 8—and let us assume there are S1 and S2. Then we have C1 to C6, and then we have M1, M2, M3, M4, M5, and M6. Now, we need to make some assumptions. In reality, you will have actual data, but here, I am assuming some lead times.

Let us say the lead time for these items is one week. Every item requires one week, one, one. So, for simplification, I am considering a one-week lead time for all these different assemblies, subcomponents, etc. And as I said, we will have this requirement for 1P1; you require 1M1. So, for 50, you require 50; for 50, you require how many M2? 50 multiplied by 4—200 M2.

50 M3, then let us see how many M4: 4, 4, 10, 200, 200, and 500. These are the number of units we require for M1 to M6 because you want to deliver these items in the 8th period for P1. So, here you want the eighth period; then, you can only deliver in the eighth period when the items are ready with you, and the assembly of P1 takes one week.

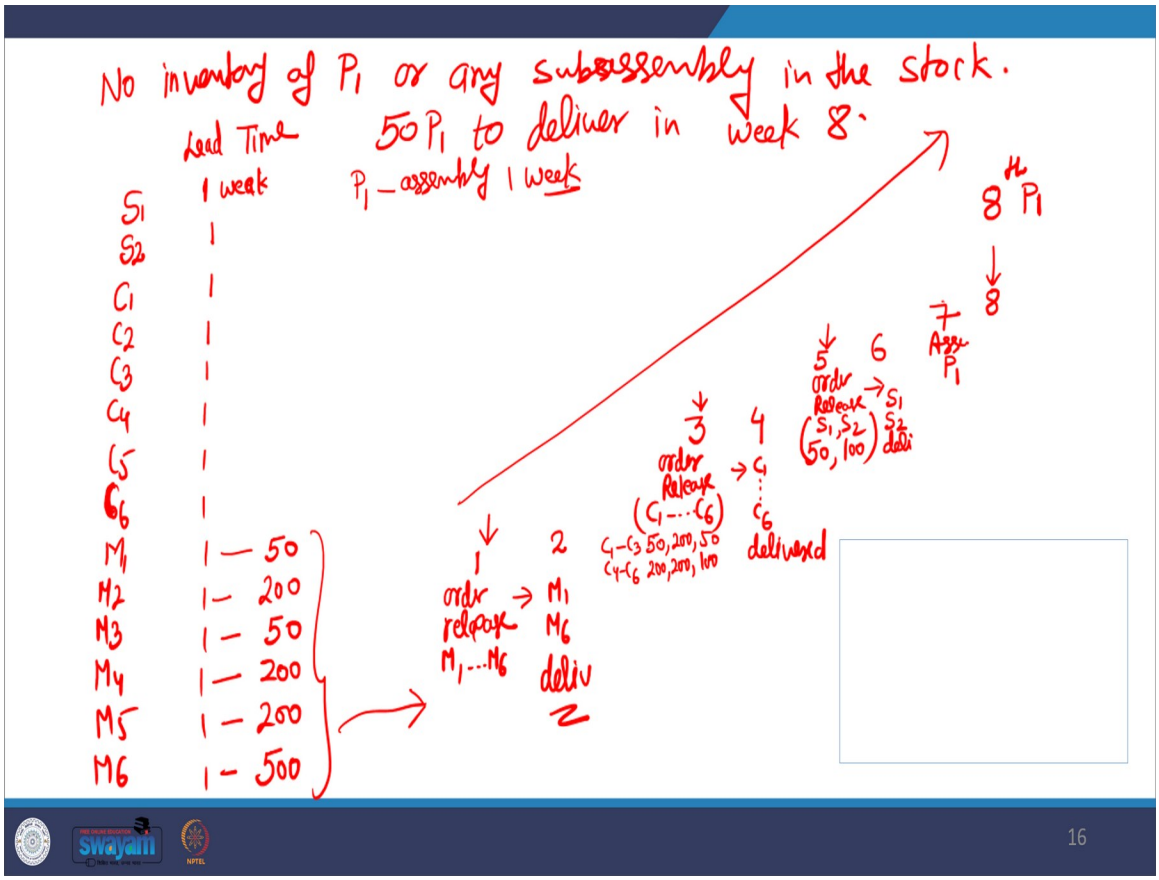
So, to deliver in the eighth period, you have to complete the assembly by the seventh period. So, seventh-period assembly P1: to get the assembly done in the seventh period, you need to get S1 and S2 delivered to you in the sixth period.

So, you will get the delivery of S1 and S2 in the sixth period when you have released the order in the fifth period. Order release for S1 and S2, then S1 and S2 delivered; then, you will use S1 and S2 in the seventh period for the assembly, and the quantity of S1 and S2 you need is 50 S1 and 100 S2—50 S1 and 100 S2. Now, S1 and S2 will only come when they have their components, and so, fourth period—rather, third period: order release C1 to C6; fourth period: C1 to C6 delivered. C1 to C6 also take one week, and C1 to C6, we know in how many quantities we need: you have 50 C1, 200 C2, 50 C3, 50, 200, 50. Then, C1 to C3 and C4 to C6 will also come: 200, 200, and 100.

So, these number of C1 to C6 you have to release in the third week. Now, for getting C1 to C6 readily available for using in the third week, they will only come when you have M1 to M6 available with you. And M1 to M6 you need to release in the first week. So, that in the second week you can have M1 to M2, M1 to M6 order release M1 to M6 and the quantities are like this and M1 to M6 delivered. So, in this sequential manner, when I

am releasing the order for M1 to M6 in period 1, then M1 to M6 are delivered in period 2 and then the order for C1 to C6 is placed in period 3, so that C1 to C6 are delivered in period 4, order for S1 to S2 is released in period 5.

So that these orders are delivered to us in period 6 and then in the 7th period we will assemble S1, S2 to make P1 and finally in the period 8th in the beginning of the period 8th we will be able to deliver 50 P1.



So, this is the way my material requirement planning is happening. We have time dimension that how systematically we are we if we release all the orders in the beginning, it will create huge problem because it will create the problem that they will not be able to understand and they will create extra inventory in the system. And at the same time and at the same time, it will become difficult for the timelines to achieve if we are not releasing the order at the appropriate time. If any of the order is delayed by one week, one period, it will ultimately have the detrimental effect on my final supplies that final supply will not be possible on eighth period.

It will delay the supply according to delay in placing the order in earlier periods. So, this material requirement planning therefore, becomes a very good tool with the help of which we are able to decide. When we are going to place the order and how much quantity we are going to place the order, here let me give you one or two cautions also in this particular example, I have not assumed any in-hand inventory, I did not assume any in-

hand inventory and I assumed for the purpose of simplicity the lead time for all these items, sub assemblies as one period. But, in practicality the lead time for different components may be varied and there may be some available inventory with you, there may be some available inventory with you. So, you also need to see that how much inventory you have in hand and therefore, you should be ready to give order of only the balanced inventory.

Another important thing is that there may be some constraints from the supplier side as well. For example, if you see here in this diagram, there are many situations where we have placed orders for only 50 units. For S1, C1, and C3 as well, we have placed orders for only 50 units many times. It is quite possible that the supplier may say, 'Hey, I am not going to fulfill an order of just 50 units.' You may need to place an order of, let us say, a minimum of 100 units, and we have this situation where suppliers may prescribe a minimum order quantity.

So, MOQs are also an important factor in determining order quantities. I have not imposed any restrictions to explain the formation of MRP, but I am cautioning you that, in practice, those limitations will exist, and we must operate within that realistic environment with many constraints. We have come to the end of this video, and in our next class, we will discuss some important ways to place your orders. This means you cannot always place orders for the exact required quantity; there may be different restrictions. We will also discuss how many such restrictions exist and whether following them benefits us, using profit calculations. So, with this, we come to the end of this video.

Thank you very much.