Course Name - Operations and Revenue Analytics

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Week - 04

Lecture - 18

Welcome, friends. In the last few classes, we discussed the role of data analytics in various decisions related to inventory management. We discussed different cases where we saw how, in a variety of situations, we need to manage inventory. Most of the cases are related to uncertainty, and in uncertainty, there are different types of possibilities: whether you have a single opportunity for procurement, whether demand is lost in a cyclic system, or demand is backlogged. And we saw that if we can improve the quality of our data, if we can improve our forecast, we can reduce the values of sigmas. We will have better cycle service levels, and we will have better expected profit. So, as I said at the beginning of the course, the quality of data plays a very important role in all analytical-related decisions. If the quality of data is inferior, whatever type of algorithms you apply, the results will not be so impressive.

So, we need to focus a lot on improving the quality of data because the quality of data is going to decide whether you are going to get a good decision or not. Moving further in this particular session, we are going to discuss another very important aspect of inventory management. Now, all the inventory decisions we were taking in the previous few classes can be classified under independent inventory systems. You have a requirement of the item, and that requirement of the item is not dependent on any other item. But we know, in reality, there are a large number of examples where almost all products are dependent on the demand of some other product. And therefore, in our discussions of inventory management, you can say just 50 percent of inventories are decided on an independent basis.

But, in a variety of other cases, inventories are decided based on the requirement of some parent item. For that purpose, another very important decision-making area is material requirement planning. So, in this particular class and for the next two more classes, we will be talking about material requirement planning, which, practically, I personally feel is a more widely used area of inventory-related decisions than independent inventory management. Now, in this particular case, we are going to discuss what MRP is, its benefits, why we do MRP, how we create MRP, and then what the structure of an MRP system is. In this case, let us first understand that MRP is basically a computational technique that converts a particular master schedule for end products into a detailed plan for the raw materials and components used in the end products. You understand that every product requires so many components and sub-assemblies.

Take the example of a car. Now, in a car, you have around 10,000 plus different types of components and sub-assemblies. You have tires, you have gear assemblies. You have steering assemblies, then you have an engine, and in the engine, there are also many components and sub-assemblies. So, to make a car, you require all these components at the right time, and only then can you deliver a car. Consider a simple table, a simple wooden table. Now, in that simple wooden table, you also have four legs, a top, and maybe a drawer. So, you require four legs, a top, and a drawer; only then will you be able to make a table.

So, for this parent product, the table, you require many components, sub-assemblies, etc. So, planning for these components and sub-assemblies—ensuring they are available to me at the right time—that is our MRP. Now, when you are planning for all these components and assemblies, each item must be ordered and delivered to meet your master schedule for final products. I need a table; the table is my product. I need the table in the month of July.

Colleges are going to open in the month of July, and I need tables at that time. Now, to deliver the tables in July, maybe I need to have the legs in the month of June, and then there may be a lead time for making the legs. So, the order for that should come in the month of May. Only then will the legs be delivered in the month of June, and then these will be used in assembling them into a table, and that table will be delivered in the month of July. So, you see that to achieve this master schedule for the final product—that the table is required in the month of July—the component and sub-assembly work has started in the month of May itself.

So, this is the reason and purpose of MRP; otherwise, you may not be able to deliver. You can easily understand. There is always some kind of firefighting that happens, and that firefighting will ultimately lead to delays in the delivery of this table in the month of July. It will slip to the month of August. So, to minimize or avoid all such kinds of unnecessary delays and unnecessary holding of inventory components, if you do not know that you are going to deliver in the month of July and you have procured the legs in the month of April. Now, for three months—April, May, June—you are holding the inventory of legs, which is also adding to your inventory holding cost, taking up space, and there are possibilities that some of these legs may get, let us say, some wear and tear.

So, all these are the challenges if you do not follow a proper MRP system in your organization. So, MRP is, as I already said, independent and dependent demand. So, this is what we are discussing: MRP is part of independent demand, and all these items which are part of some final product have dependent demand. If you remember our supply chain discussions, this is the OEM—original equipment manufacturer—and these are component suppliers to the OEM, designated as T1, T2, T3, etc. Tier 1, tier 2, tier 3 suppliers, and this OEM is making the end product, while these are making components or sub-assemblies.

Now, these components and sub-assemblies need to be made as per the schedule provided by the OEM. And therefore, the role of the dependent demand system is very much for all the members who are part of this supply chain because they have to follow the given schedule. Only then will the OEM be able to deliver the products to the customer as per the delivery schedule. Then come the wholesaler, retailer, and others on the other side of the supply chain. So, this dependent demand is very useful for all the upstream members in your supply chain. Here, when you have the forecasting available for the end products of a particular organization, the raw materials and component parts used in the end product should not be forecasted. If you have an independent forecast for all these components, then MRP will not be possible.

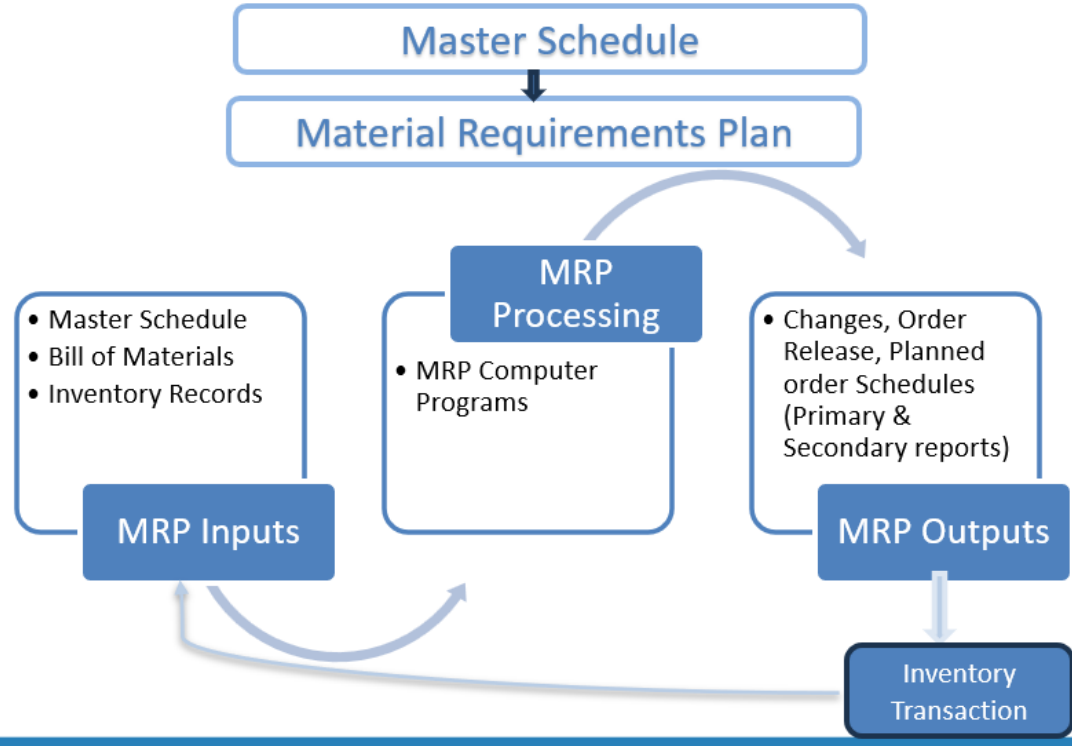
So, for MRP to execute, only the forecasting of end products is required, and the forecasting of all these dependent items, components, and subassemblies should not be there. Once the delivery schedule for the end products is established, the requirement for components or raw material can be directly calculated based on lead time. If you have these lead time calculations available for all of them, then you can directly calculate what the delivery schedule is, what the requirement is, and there is no need for separate calculation of any kind of inventory requirement for these components. And you can see in the form of this diagram how all these things are actually flowing. Let me give you the idea of inventory management, which we discussed in a large number of previous classes.

Does inventory management actually give us the concept of MRP? Material requirement planning, which is talking about components and sub-assemblies. Then people thought that there may be other kinds of resources also required for the manufacturing of these final products. Not only final products but also these components and sub-assemblies. And for that purpose, for example, time available on a machine, or for example, the amount of labor required. These are other resources which are required for making the product at the right time.

You are planning that, okay, I will do the manufacturing of the legs in the month of June. But in the month of June, machine space is not available. In the month of June, labor is not available. Then how will you make those products? So, therefore, for the success of MRP, more manufacturing resources are required.

So, people started talking about manufacturing resource planning. So, now MRP and this is also MRP. So, to distinguish between material requirement planning and manufacturing resource planning, MRP is designated as MRP 1, and manufacturing resource planning is designated as MRP 2. Now, MRP 1 and MRP 2—further, people said that for all these resources, you need enterprise-wide support. You also need finance; if capital is not available, working capital is not available, you cannot manufacture the products. So, slowly and steadily, the scope expanded to organization-wide resources, and then the term ERP—which I hope most of you are quite aware of—enterprise resource planning, came into existence.

So, from our standard management of inventory for independent demand, we needed to discuss dependent demands, and in that, more and more resource requirements were visualized, leading us from MRP 1 to MRP 2 to ERP. Now, in this particular class or even in this course, our focus is only on MRP. For MRP, you have a master schedule—that master schedule determines when to deliver which product, and this comes from your forecast requirements. Now, for MRP, the important inputs are the master schedule, the bill of materials—that is, for making one product, what type of components you require — I will be talking about that also—and then inventory records: how much of those components are already available in your warehouse or stores. So, these are the three important inputs for preparing your MRP, and from this, you will create MRP computer programs. These will give you the timing for releasing a new order, scheduling a new order—that is the important outcome: placing the order at the right time.

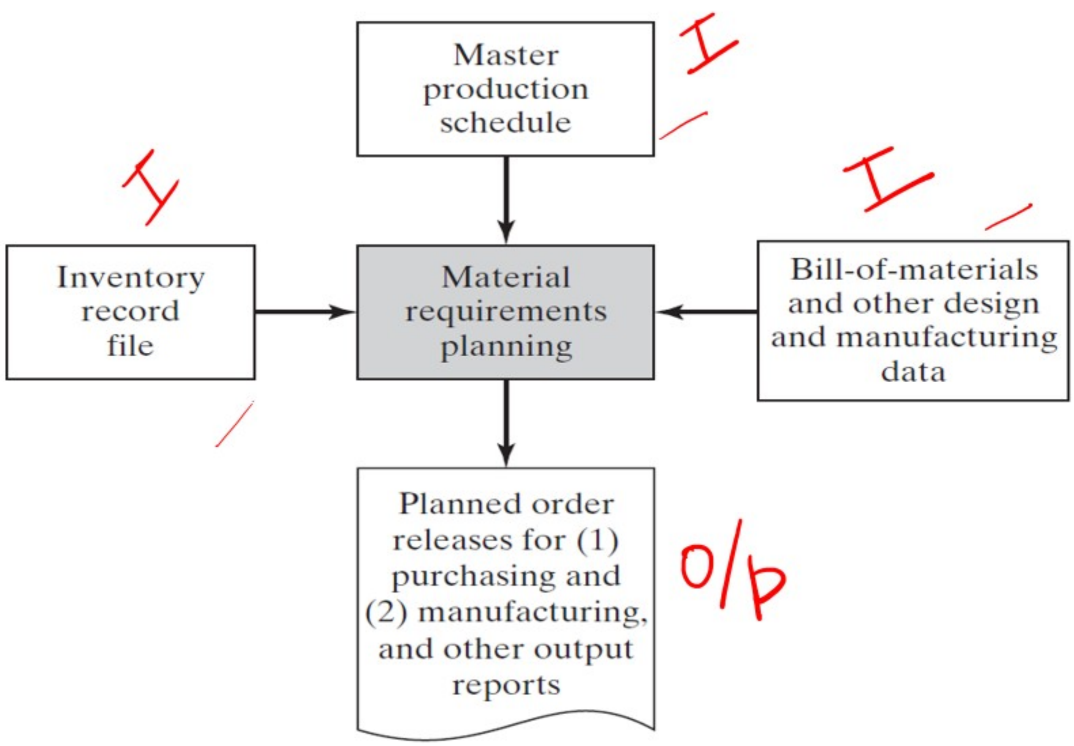


So, you can anticipate the delivery of that order when you require it in your final assembly. Based on the MRP output, you can increase or decrease your inventory levels. So, your inventory records are created because of the MRP output. You know how much inventory you have, how many orders you have released, and when these orders are expected. So, accordingly, you have a clear picture in front of you.

Many a time, when we talk in supply chain, I will like to tell you that we become myopic about inventories which are in pipeline, we only see that inventory which is physically available in our stores, but there may be some inventory which is in pipeline for which you have already released the orders, but somehow unfortunately we are not able to understand. Because of data, probably we should have a better understanding that how you are able to visualize the inventory which is in the pipeline also. So, with the help of MRP, you are able to reduce your unnecessary inventory. You see inventory in physical plus pipeline. All that inventory you are able to see and therefore, you give order with very careful with all your mathematical calculations.

You are able to response to changes in demand than is possible with a manual requirement planning system. Because, you know that you are able to see in a paper that which inventory is at which stage and accordingly it is easier to manage the changes than the manual systems. Reduced setup and product changeover cost, better machine utilization, the ability to easily determine inventory uses by black frushing and improved capacity to respond to changes in the master schedule. And it helps you in developing a more realistic master schedule for MRP as I said, there are three very important inputs one is the master schedule, second is bill of material and third is inventory required these are the three most important inputs And then with the help of these inputs we will prepare our MRP records.

So, you can see that for a MRP the structure is like we have master production schedule, inventory record and bill of material and the output is these three are in, in, in. This is output where you are planning the release of orders, when you are going to purchase or when you start manufacturing of some of these components.



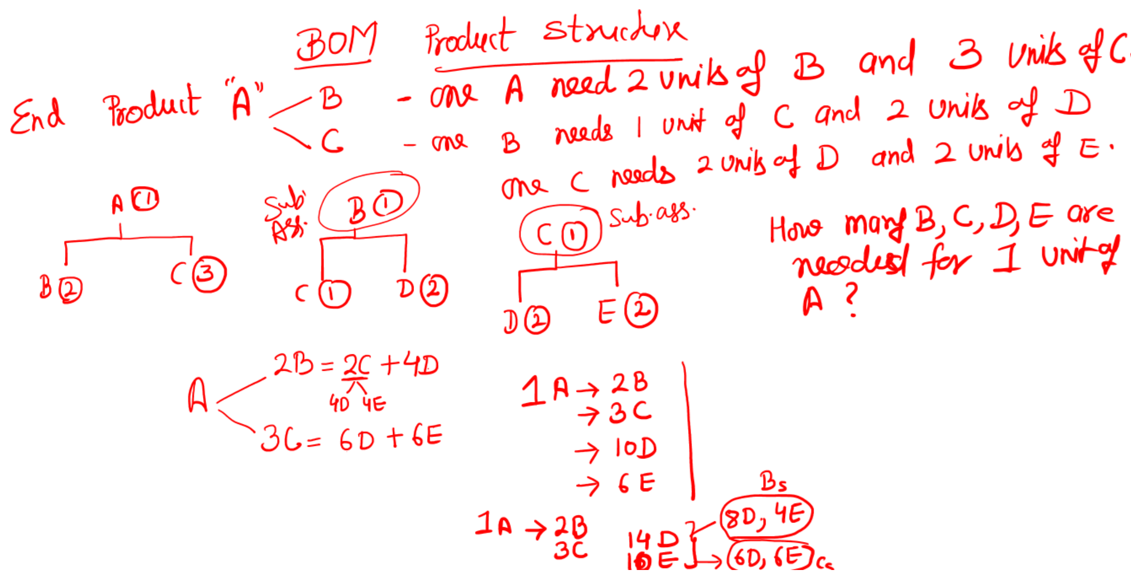
Just to give you the idea of one or two important things which are going to be there in making the MRP bill of material. Bill of material starts with our product structure. Let me give you a very small case where I want to make a product A. You can say it is end product.

Now, for making product A, I require two items B and C. One A needs two units of B and 3 units of C, 1A requires. So, you can write in such manner that 1 unit of A requires 2 units of B and 3 units of C. Now, for making 1B for making 1B. You need 1 unit of C and 2 units of D. So, you can say that B has 1 unit and this requires C -1 and D -2. For making 1 unit of B you require 1C and 2D and 1C needs 2 units of D and 2 units of E. So, 1C needs 2 units of D and two units of E.

So, now the simple question is how many B, C, D, E are needed for one unit of A. So, this is first required the understanding of product structure that we know that for these are sub-assemblies. B becomes one sub-assembly and C becomes another sub-assembly. So, you can very easily calculate that 1A requires 2B and 1A requires 3C. Now, 1B requires 1C and 2D.

So, 1B 2B equals to 2C plus 4D. 3Cs will require 6Ds plus 6Es. So, the answer becomes for 1A you need 2B, 3C. And then you see that 4D and 6D, total 10Ds are needed and 6Es. But, now you see this is not complete.

You require Cs, here also 2Cs. So, 2C means how many Ds? It means 4D and 4E also. So, basically you require 1A needs 2B and 3C's, while you require 4 plus 4, 8 plus 6, 14D and 6E. So, you actually require 14D and 6E Out of 14D some D's will go for making B and some D's will go for making C's and some E's will also go for making some B's and some you will take out of 14, 8D's and 4E this is sorry this is 10E for making the required number of B's. And 10E will be used remaining that means 6Ds and 6Es will go for remaining number of Cs.



So, this is the first important requirement for our material requirement planning that we should be clearly able to spell out that how many components we need. So, we need in this case 14D and 10Es so that we can make 1A. For making 1A you require these many D's and E's and then these D's E's will make another sub-assembly that is B and C and those sub-assemblies will finally be assembled for making our A. So, this entire process is the input for my material requirement planning because at some time I will get D and E. Those Ds and Es will help me in making intermediate assembly that is B and C and those intermediate assemblies will be used in making A and that entire backward calculation, we will see in our upcoming classes that how are we going to do these calculations in a very systematic. So, with this we come to end of this video.

Thank you very much.