Industrial Engineering
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Module - 04
Lecture - 03
Materials Requirement Planning

A very warm welcome to all of you, today we are going to start our discussion on Materials Requirement Planning. In the previous 2 lectures, we have discussed various tools and techniques of inventory management; we have seen that in inventory, so many types of tools, such as A B C. A B C analysis we have seen, we have seen, what are the other specific tools, like economic order quantity model, production order quantity model.

And we have seen basics of materials requirement and we have seen that these tools can be used by any organization or an enterprise to increase their profitability. Today, we are going to discuss regarding the materials requirement planning, which is also and very important aspect and is being used by the modern say industry. Many companies are using the MRP software's for planning their materials requirement, as well as ordering as well as the inventory.

So, many functions are there for materials requirement planning software and it works on a certain set of input, there is input, which we provide to this, suppose till now, we know that MRP is a black box. To that black box, we are providing certain input and that input is converted by the logic, which has been in built in that black box into a certain desired output.

So, in today's lecture, we will see that, what is the input which has to be given to the MRP and what is the output, that we can think of getting from the MRP or what we are getting as compared to the software, that is there available in the market. So, if software is available on MRP, we need to understand that what is the input and what is the output.

And, brief understanding of how the software operates, so that we are going to discuss today, in this particular lecture. Initially, we will have an introduction or a basic definition of a MRP; then we will see, what are the various input parameters, then we

will see how the MRP works. And then we will see, what is the output that, we get out of materials requirement planning.

Basically, we have seen in inventory management that we have to take two or three very important decisions. What are those decisions, the decisions are, what do we need to procure, like what is the requirement, what is the item, what is the component, that we want to procure or that we want to purchase. Second thing is, when do we need to purchase, that we need to understand, that this material will be required by the end of December.

So, we have to take a decision depending upon the lead time, that at what particular moment of time, we should place an order, so the time component is also very, very important. First thing is to identify the component that we have to purchase; then we have to take a decision that when we have to purchase. And then, the last most important question is that, how much we have to purchase, which means that what quantity, we need to purchase.

So, three important questions are that, what we have to purchase, then when we have to purchase and how much we have to purchase. So, when we have answer to all this three questions, we will be able to save a lot of money, for our company, if we have a judicious decision, for all these elements of inventory management. So, MRP software helps us understand and helps us in a way, that we can generate a lot of profit, for our organization.

But, certainly there are certain drawbacks of the MRP software also or the materials requirement planning system also, so what are those drawbacks that also we will see. Advantage, already one of the most important advantages, it improves the profitability of the company, I have already told you, but there are certain disadvantages also related to this software.

What are the limitation areas, that also we are going to understand in today's lecture, so let us now start the discussion, I have given you a brief summary of what are we going to discuss in today's lecture. I will again like to summarize, what we cover in this lecture, so that you have a overall idea, that what is materials requirement planning. So, let us now start the discussion, first part is the introduction.

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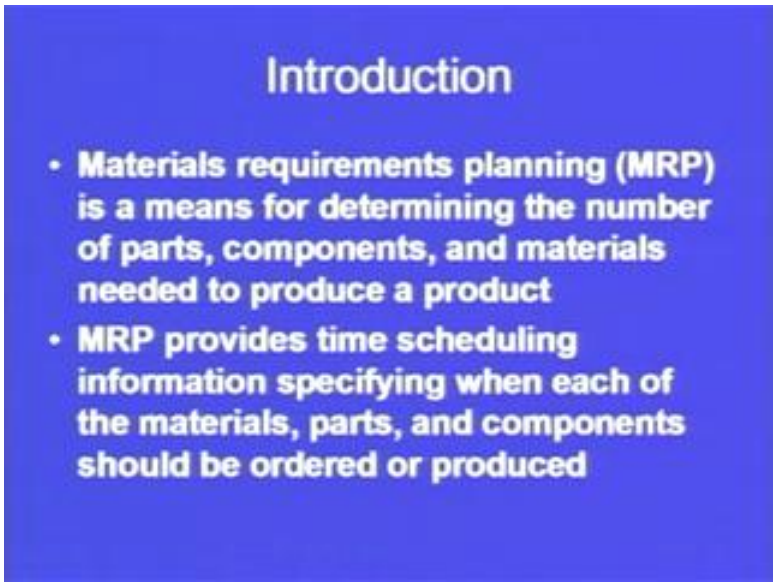

Materials requirement planning is a means for determining the number of parts, components and materials needed to produce a product. So, you can say, it is a mean by which we can identify that, if we know, let us take an example, because I feel with the help of examples. We are able to understand the problem in a much better way and in a much easier way.

Now, suppose we want to manufacture a car, we can understand that, when we have to manufacture a car, when we have to make a car. So, many different components may be 1000's of different components and subassemblies need to be assembled to make a complete car.

Now, let us understand that, we have a forecast, suppose a particular company has a forecast, that they would be able to sell, 1000 cars per month. Now, depending on 1000 number of cars, that will be used or that will be produced by that company. In that particular month, we need to understand, that how many different components, which will make up that car would be required.

So, MRP will help us to do to generate a demand, for all those components, which would be required to make one particular car. And now, if we have a certain demand of suppose 1000 cars we will be able to see that, what is the requirement of the number of components that will be used to manufacture 1000 cars. So, in a way this will be helping us to identify the requirement of those particular parts.

So, here in the very basic definition we can see, materials requirement planning is a means of determining the number of parts, so how determining it will help us to on the bases of certain logic. For example, for one particular automobile or one particular car, suppose we need four tyres. So, this is the logic, that for this particular product, the number of sub components required may be tyres is 4.

So, determining the number of parts components and materials needed to produce a product, for one product, it will generate the demand for different components. And then that can be multiplied to the number of products that are there for one particular season or one particular year or one particular week. So, on the basis of that, we will be able to very easily manage the material, within our organization.

So, MRP provides time scheduling information specifying, when each of the materials parts and components should be ordered or produced. So, it will even help us to schedule our procurement process, schedule our materials management process, that when an order should be placed, if we want a particular component or a part by such date. Suppose for procurement of a particular material 10 days are required.

So, it is required, suppose on 25 of December and 10 days is the procurement time or we can say the lead time, then we have to place a order, 15 days, 10 days in advance, that is by 15th of December. So, that by 15th, we place that order and by 25, we will able to receive the order, so what I mean to say is that in materials requirement planning. We are able to determine that, how many parts components would be required to make a final product.

And at what time, we should start the procurement process, so, that any time, when the need arises for a particular part or a material, we are ready with that particular material in our inventory. So, two things are there, first thing is that how many numbers are required, which you can see determining the number of parts, in the first part of your slide.

And the second, you can see, when it is required means MRP provides time scheduling information, specifying when each of the materials parts and components should be ordered or produce. Sometimes, we produce the items within our own organization; then we need to take a decision, that when the production for that particular part or component should start.

So, the two catch words in this slide is that determining the number of parts and when each of these parts should be ordered or produced. So, determining number that is one thing and second thing is the, what we have seen in the slide, that when it is required. So, two important things are there on the slide, which forms the basic backbone of materials requirement planning.

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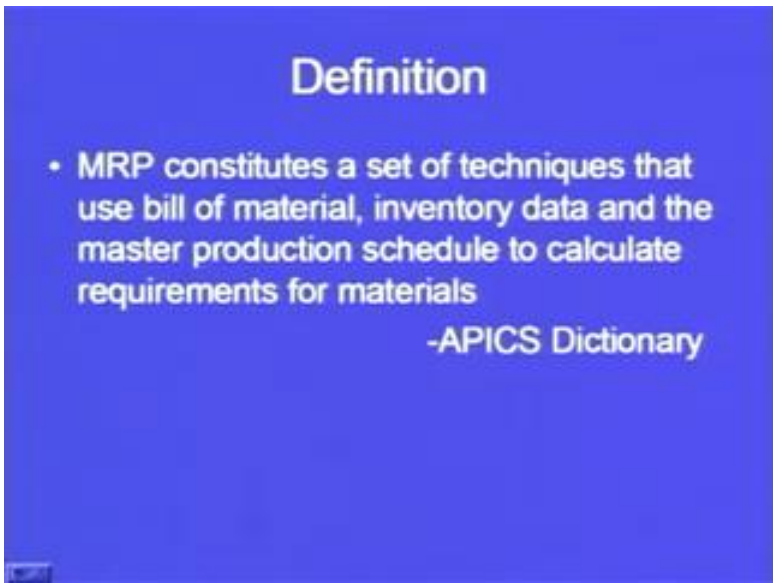

Now, let us see the definition, how do we define materials requirement planning, MRP constitutes a set of techniques, that use bill of material, inventory data and the master production schedule to calculate requirements for materials. So, this definition is giving us an idea, that what are the inputs and what is the specified output of a materials requirement planning system.

For your information, you can see on your slide or on your screen that MRP constitutes a set of techniques that uses. Now, uses means that these are the input parameters, now what are the input parameters, the bill of material, inventory data and the master production schedule.

So, if we have these three things available with us, then we can feel or we can be confident that the MRP will be able to generate the number of components required for a finally, making the product. And when the procurement should be done or when the production should be started. So, in this slide we are seeing that, what is the input and how it will be used to generate the output.

So, by now we have understood that how materials requirement planning works, what are the input parameters and then subsequently. We will see that, what are these three things with the help of certain examples or with the help of certain diagrams, we will be trying to understand that, what is basically a bill of materials, what is basically a master production schedule, what is the inventory data that is required. That, we will understand in today's lecture.

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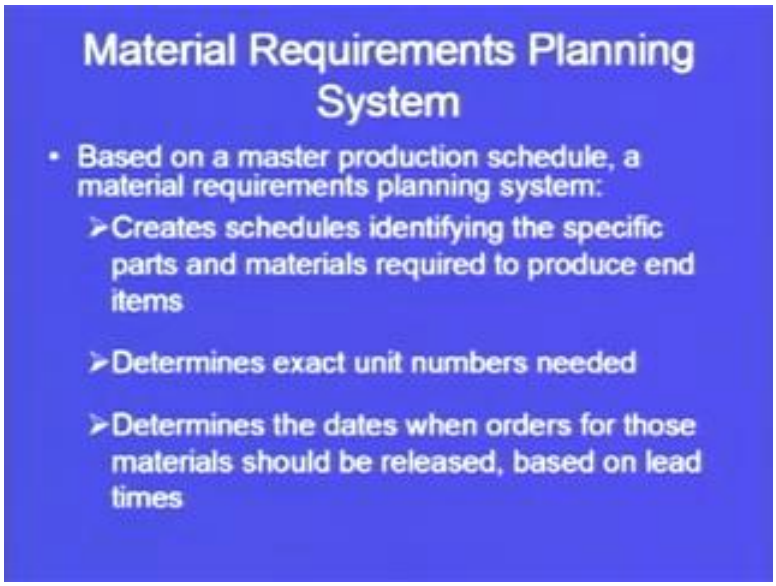

Now, materials requirement planning system, based on the master production schedule, a materials requirement planning system, now what it is going to do or if we have this master production schedule available with us. It creates schedules, identifying the specific parts and materials required to produce and items. Now, we can see this already I have told you, but again depend discussing regarding the system based on the master production schedule.

If we have the master production schedule available with us, on the basis of that schedule, a materials requirement planning system, a MRP system. This will create schedules, identifying the specific parts and materials required to produce the item. So, we will be able to identify the specific parts and materials, which are required to produce that item, I have already given an example of a car.

So, if the final product is a car, it will be able to generate that, what are the various components that are required to finally, manufacture the product. It determines the exact

until numbers needed, now it will also be able to tell us that, what is the requirement, what is the amount, what is the number of components or part required. Then, it will determine the dates, when the orders for those materials, should be released, based on the lead time.

Already, I have explained these thing that if suppose we require a particular component on a certain date and we know the lead time for that particular component, we should be able to place an order by such and such date, depending upon the lead time. So, basically master production schedule is an input parameter and if we have this input, on the basis of this input, we will able to generate these three important information's.

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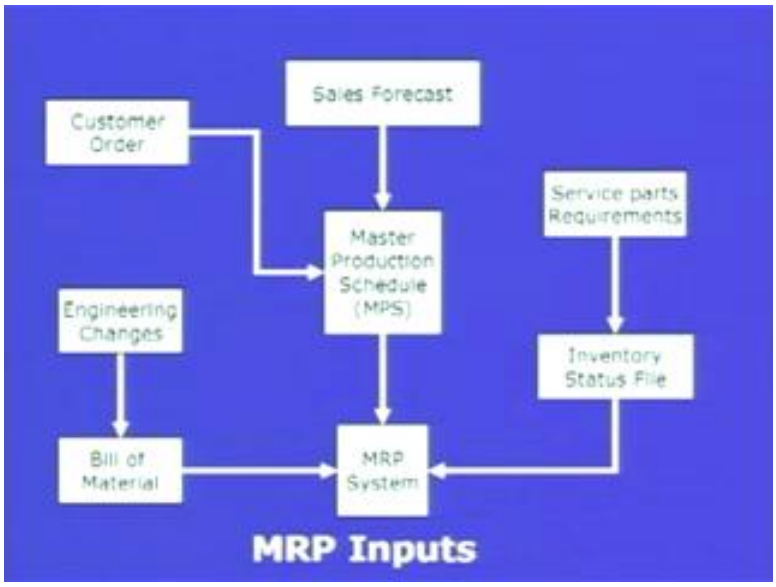

These are the all individual components that will be used by the MRP system, so you can see we need to have sales forecast, we will have some lectures on sales forecast also in this series of lectures on industrial engineering. So, what is the sales forecast, why do we need to do sales forecast; what are the most important techniques of generating a sales forecast that we will be able to understand with the help of a large number of examples.

So, and we will see, what are the different types or different classifications of forecasting technique. So, all that we will cover, but here in a MRP system, we need to have we need to generate a sales forecast. Why it is required, because you see we need to understand that of for a particular month or for a particular year or for certain specified amount of time, we should know how many final products we require.

Because on the basis of that number, only MRP system will work to generate, that what are the requirements of the parts components or certain subassemblies, which are going to make up the final product. This, I will explain with the help of a particular diagram, but sales forecast is very, very important in case of MRP, system in order to identify the demand of the final product.

Similarly, the customer order, because the customer order is always fixed, this is something that we are definitely going to make. Forecast, basically is our guess work on the basis of certain statistical techniques or certain mathematical models, we will be generating. We may be able to send; we may be able to sell, this much number of components, that is our forecast that is our guess work.

And customer order is certain thing that is very, very specific, for example a particular company only manufacturers the things, which has been ordered by the customer. Then, their forecast is very, very accurate, because they are working on a particular customer order. But, if there is no customer order we are manufacturing the things on our own and then selling it into the market, then we have to do certain forecasting, that how many components, we would be able to sell in the market.

So, two types of demands are adding up here, that we need to understand, one is a very, very sure demand, order placed by the customer. Second is a little bit probabilistic type of demand, where we are using our intuition, we are using certain tools established in the text books to generate the demands. So, two types of demands are coming in picture, one by the sales forecast and another by the customer order.

And then, this two will be used in the master production schedule; then there is a service parts requirement. There are certain engineering changes in the product, now we need to understand, that a particular product we are manufacturing. It is being made of certain number of parts, certain number of materials; certain number of subassemblies. Now, that particular product, if the engineering design changes for that product, instead of using four nuts and bolts, now we are using two nuts and bolts only.

Then, we the total system will have to adapt to that kind of an engineering change, because initially, when we know this is the final product, the output will be generated or within the system. A need will arise, that four nuts and four components will be required, in order to process this final product. But, when the engineering design changes, we

know that, we need only two nuts and two bolts; then the system has to be adoptable to that kind of a scenario, so engineering changes is also an input to the MRP system.

Similarly, bill of materials will be changed on the basis of the engineering changes, so how these different items are clubbed together in a MRP system that you can see for yourself now. Sale forecast and customer order, already I have told you these will be used in the master production schedule. Engineering changes will alter the bill of materials, similarly the service parts requirements, that will alter the inventory status file and these three will then finally, add up to the MRP system.

So, we can see that from all the areas the input is coming and then this is being used in the MRP system. From where the input is coming, sales forecast, customer order, similarly if there are certain changes, I have explained this with the help of a diagram, with the help of an example of nuts and bolts. So, engineering changes, customer order, sales forecast. Similarly, service parts requirement, they will update the inventory status file and these three will be used in the MRP system as the MRP inputs. On the basis of these three inputs, the system will itself generate a certain output.

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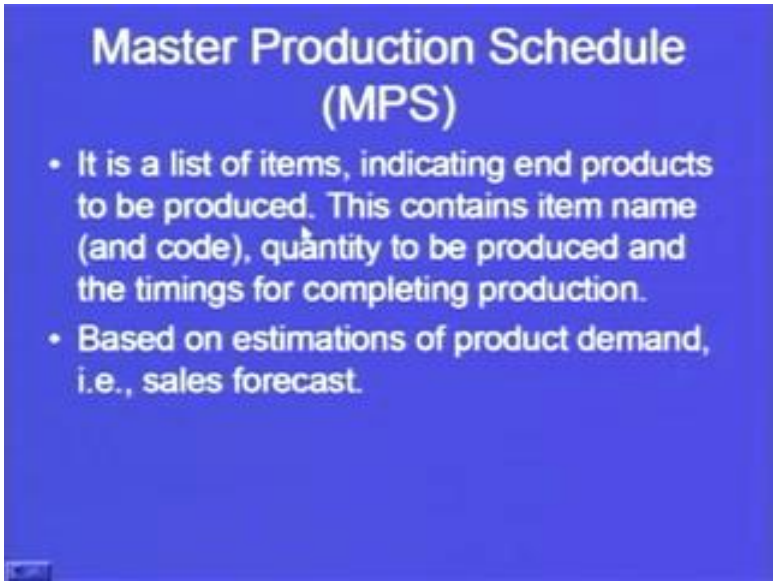

So, master production schedule, now we try to understand that, what basically master production schedule is? Although, till now we have understood that, this is one of the primary inputs to the MRP system, but what basically master production schedule is, it is

a list of items, indicating end products to be produced. So, it will tell us, that what is the number of and products that we need to produce.

In our example, I have already told 1000 number of cars per month or 1000 number of cars per year or we can say 50 cars per week. So, that basically is a list of items indicating end products to be produced, so that is basically the end product. And that, how that end product can be made, that end product, basically is assembled from a number of small, small, small, small different parts materials or sub assemblies.

So, this will help us to identify what is the final product that is required, so it is a list of items, indicating end products to be produced, this contains item name and code may be certain times, we have to enter the code. Quantity to be produced, it will tell us the number, that has to be produced; already I have given you an example, 500 or 1000.

And the timings for completing the productions, so by week by week, this will be able to tell us that after the end of suppose six week, this much number of product should be produced. After the end of twelve weeks, this much production should be done or this much number of products should be ready. Based on estimates of product demand, that is sales forecast.

Already, I have told that sales forecast, we have discussed in other lectures on sales forecasting, but on the basis of sales forecast master production schedule will be able to identify, what is going to be the product demand. So, also it can be on the basis of customer requirement, if customer requirement is there, then we have a sure, short MPS system working that, this much number of components are required by such and such date. Otherwise, if you do not have a sure short demand that has been placed by the customer, we will used sales forecasting tool to generate the demand.

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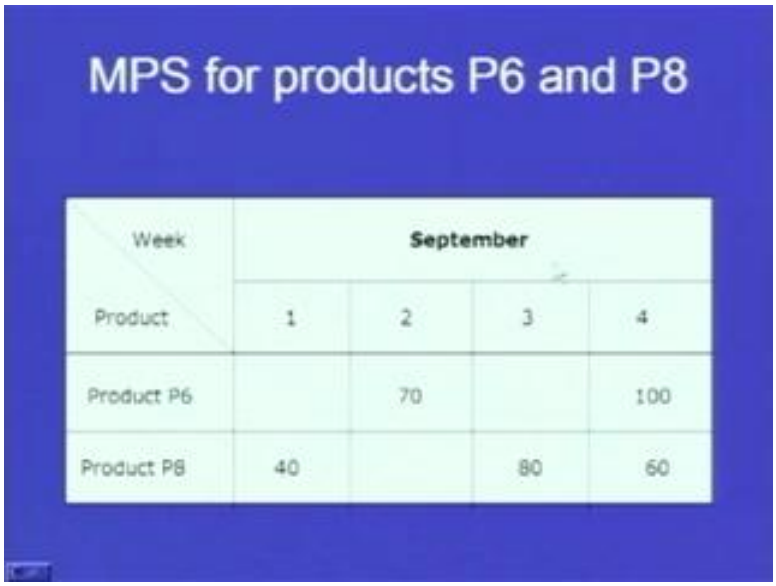

Now, on your screen you can see MPS for products P 6 and P 8, suppose P 6 and P 8 are the codes, this is the weeks, suppose these are the month running is September, so first week, second week, third week and 4th week. This is the product this is product P 6 and product P 8, now you can see that by second week product six requirement is 70. In first week, the product 8 requirement is 40, similarly by 4th week; the product 6 requirement is 100 and by 4th week product 8 requirement is 60 and third week 80.

So, week wise we know that, how many components have to be made for P 6 and similarly for P 8. Now, this is the master production schedule with respect to time, we know the quantity that has to be produced. Now, for this quantity, suppose product 6 require certain number of materials, certain number of subassemblies, which will be finally, assembled together to make product P 6, so that will be generated by the MRP system.

We know in our MPS are this is the requirement, than the MRP system will work on the basis of this MPS input and it will generate the independent or this is the independent demand, then it will generate the dependent demand. So, we will see with the help of an example that what is independent and what is dependent demand, but I think by this diagram it is very, very clear that, what is a master production schedule.

For a particular month, four weeks, every week, we know how much is the quantity, that has to be produced for the final product, this is for the final product P 6 and product P 8.

Now, now we come on to another input parameter, now we have understood, what is master production schedule, so basically there are three input parameters, the second input parameter is the bill of materials file.

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So, first point is it provides the list of materials and their quantities required to produce the end item. So, in order to understand it, we can take an example of a particular dish that we are going to prepare. So, bill of materials basically provides us the recipe for that particular dish, we know that we are going to produce a particular dish. For example, we say we want to produce a samosa or we want to make a samosa.

For making a samosa, we need to understand, what will be the input parameters or what will be the ingredients or what will be the recipe of making a samosa. So, this bill of materials is going to help us that if the final product is known and the quantity is known, how it is going to be made. And what will be the materials, what will be the components, what will be the particular subassemblies, that will join together to make the final product.

So, first on your screen, you can see it provides a list of materials and their quantities required to produce the end item, it contains the list of finished products material needed for each finished product in unit is. So, number is very, very important, there it will tell that this much number of units is, for this particular component is required to manufacture the final product.

Assembly structure, sub assemblies parts and material, this already I have explained with the help of an example, if final product is known, then bill of materials will generate, the number of subparts, parts and assemblies required to make the final product. Similarly, bill of materials file is revised, every time there is a change in product design or specification, if you remember in the diagram, very first diagram in which the MRP inputs were shown, there every engineering change was going to the bill of materials file.

So, whenever the engineering design changes, the bill of materials file is updated, so bill of materials is revised, every time there is a change in product design or specification, any engineering change will lead to the updation of the bill of materials file. Already, I have explained with the help of an example, where initial design was using four nuts and four bolts, new design is using two nuts and two bolts. So, that information has to be updated in the bill of materials file.

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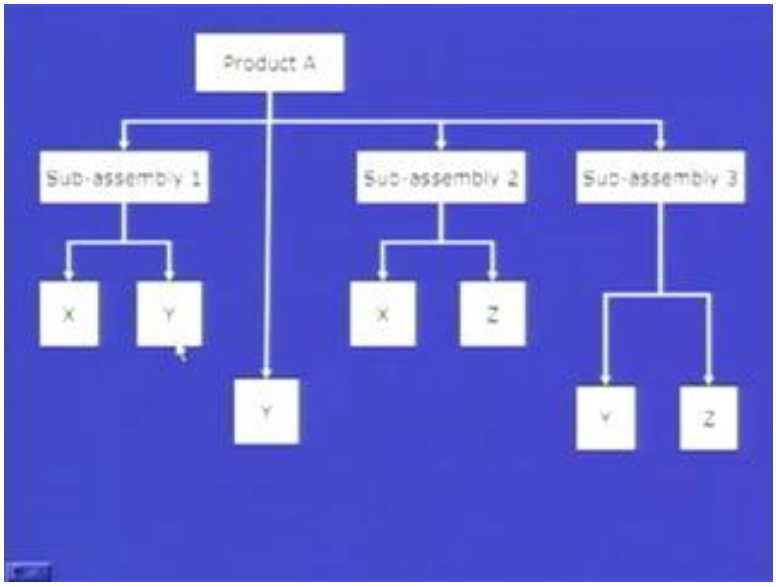

Now, here suppose with the help of an example, we can see on your screen, you can see that the product A has to be manufactured. Now, there are three subassemblies, which will be finally, assembled to produce product A, so this is basically the requirement for finally, producing the product A. Now, product A require subassembly 1, subassembly 2 and subassembly 3.

Now, further subassembly 1, will be made up by joining two parts together, that is X and Y, now X and Y will be assembled together to form subassembly 1 and similarly

subassembly 2, would be requiring X and Z and subassembly 3, will be requiring Y and Z. So, we should know that, how many X Y and Z are required in order to finally, produce product A and similarly one part Y will directly go into the product A.

So, product A requires four important ingredients to be finally, manufactured of what are those four important ingredients, that you can see on your screen. And we need to understand, how many product A will be made, that we will know from the master production schedule. That by such and such week we require this quantity of product A or this much quantity of product A.

And when, that is known on the basis of that, we will be able to generate, how many subassembly, one will be required, how many subassembly, two will be required, how many subassembly, three will be required. On the basis of subassemblies, we will be able to identify, how much quantity of X, how much quantity of Y and how much quantity of Z will be required.

So, this is basically the importance of materials requirement planning, that this is this will be able to identify the quantity, what is required to finally, make the product A. Now, third important part is the inventory status file, now three important ingredients or three important inputs are there to the MRP system. Two already, we have understood, what are those two, the master production schedule and the bill of materials. Now the third part is the inventory status file.

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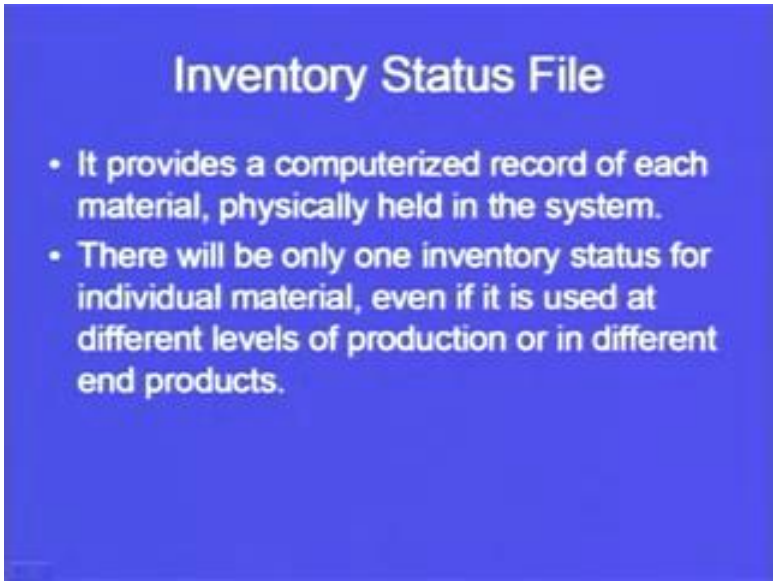

It provides a computerized record of each material, physically held in the system, now all these materials if we go to the previous slide, you can see that product A required subassembly 1, 2, 3. Now, subassembly 1, 2, 3 requires components X Y and Z, so how many components X are present, how many Y and how many Z are present in the inventory. That will be stored in a computerized manner, so in the particular machine or in a particular computer.

And that will be storing all the information, how much quantity is there, how many has been ordered, how much has been sent to the shop floor for the assembly, all that record would be maintain in a computer. There will only be one inventory status for individual material, even if it is used at different levels of production or in different end products, so there would be one inventory status that is very, very clear.

Once again, I will go through this point there will only be one inventory status for individual material, now suppose individual material is X, so there will be one inventory status for that. Even, if it is used at different levels of production or in different end products. Now, in the previous slide, we have seen product A only, suppose the company is manufacturing different products like, product B, product C, product D.

Now, for different products same material can be used, but the inventory status will be singular only or same only or individual material will have only one inventory status that is clearly mentioned in the second point on your screen. Now, what does the inventory status file indicates.

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Now, inventory status file will indicate the material code, there can be certain coding mechanism or certain coding schemes used for the material. So, it will indicate the material code, it will indicate the material name, inventory on hand it means how many numbers are physically available in the inventory. So, inventory on hand, will also be indicated in the inventory status file; then inventory on order, ordered, but yet to arrive.

So, we have already seen in our previous lectures on inventory management, that there is a lead time between placing an order and receiving an order, so during that period, it will indicate what is inventory on order. Means that order has already been placed, but we have not yet received the lot of inventory or we have not yet received the quantity that we have already ordered.

So, in a particular system, if we take an example in particular software the number or this much quantity can be shown by a different color. Suppose, we are showing that on hand inventory or physically available inventory by a blue color that this is already available with us, we can use yellow color to show that inventory on order. So, that we can very easily be able to distinguish that, this is what we are going to receive after so many number of days.

So, the will also be a data that will be available in the inventory status file, similarly customer order for item, that will also be available in the inventory status file.

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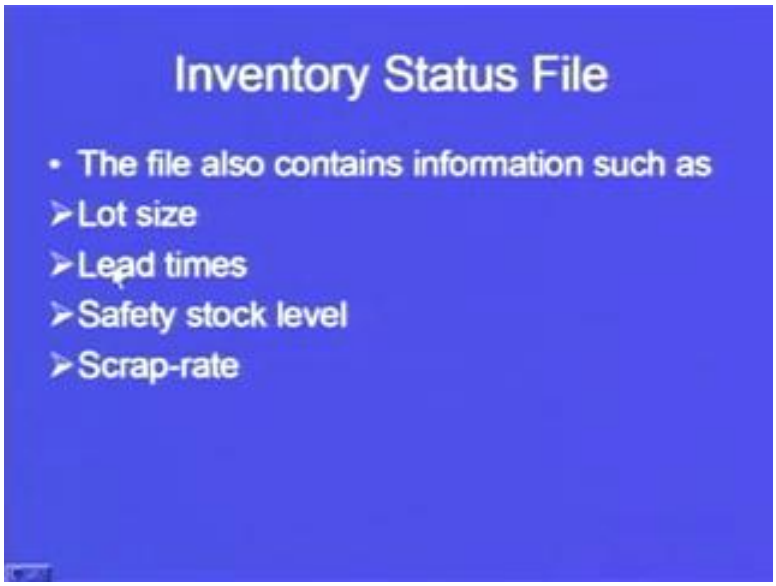

The inventory status file also contains the following information; it contains information, such as the lot size, the lead times, the safety stock level, as well as the scrap rate. Now, safety stock level and scrap rate are two new terms that are coming in our discussion. Now, safety stock level basically is a stock or a buffer; that we are maintaining, if we have an independent demand.

So, if the demand is changing or irregular demand is there, sometimes we do not know that how much number of parts or components would be required. In that particular scenario, that particular case, we need to keep certain things in stock or certain things as a buffer stock. Although, we have a certain amount of inventory, we know that for one particular week, suppose 1000 components would be required.

But, sometimes the requirements, because of the change in the demand, there may be requirement of 1200 components, so 1000 we have already kept, but there is a requirement of 1200. So, 200 extra we need, so that basically, we are maintaining as a safety stock. So, that will not be used in normal course of time, but it may be required, if the need arises.

So, that basically is the safety stock level and similarly the scrap rate, sometime within the inventory, when we manage so many different things, there is damage to one or the other components stored in the inventory. So, that becomes therefore, the scrap and the scrap rate is also stored in the inventory status file. Lead time and lot size, already we

have discussed, but I feel that a little discussion on the lead time will help us to understand the manufacturing or the normal lead time.

And the manufacturing lead time in a better manner and in a more concise manner and how lead time is used by the companies, that we will be able to understand, so let us now have a very brief introduction to the lead time. It is the time needed for completing the job, from the initial stage to the final stage.

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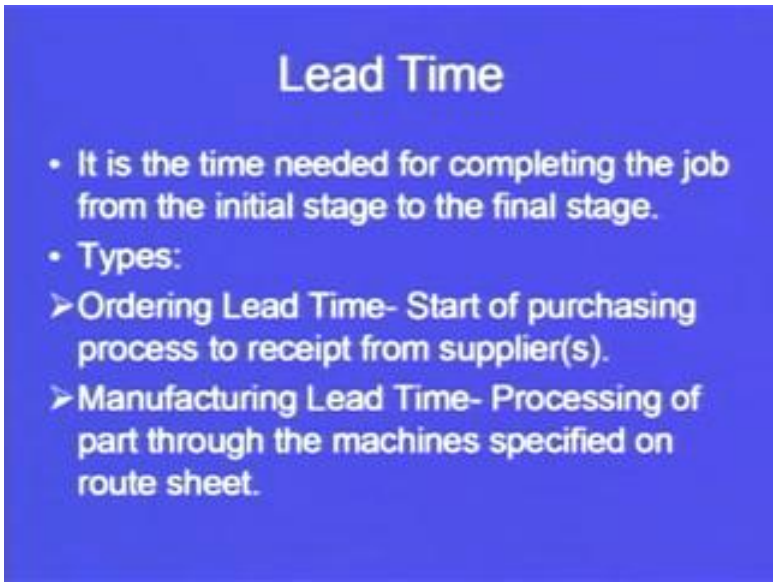

Now, suppose we are ordering, today we are receiving after 10 day, so the lead time becomes 10, so it is basically of two types, first is the ordering lead time, start of purchasing process to the receipt from the supplier. So, today we start the process, suppose after 10 days we receive the order, we will say that the lead time is 10 days. Similarly, there is a manufacturing lead time also, that is the processing of part, through the machines specified on the root sheet.

So, processing of part through the machines specified on the root sheet for a particular root sheet, we know that this much time would be required to finally, process this material, so that basically is called the manufacturing lead time. So, we have a ordering lead time, we have a manufacturing lead time, so how lead time is used, that you can see on your screen.

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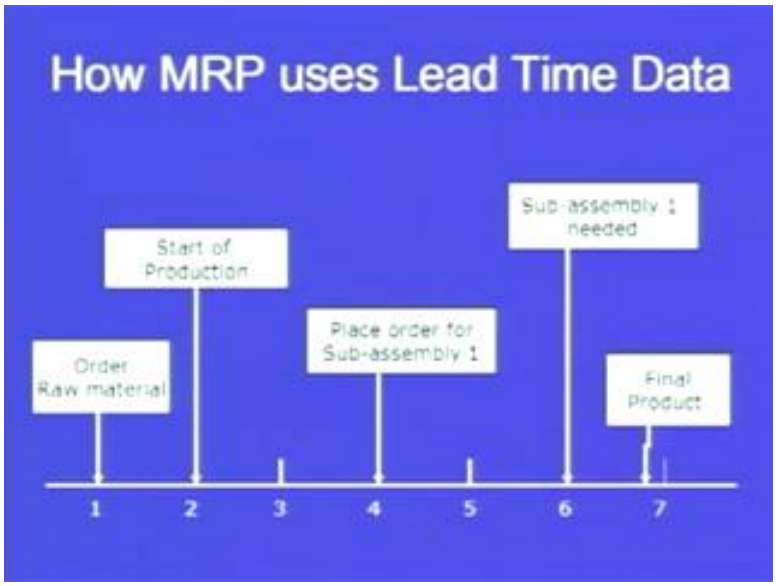

How, MRP uses lead time data, now lead time we know that, if today we order, we will receive it after 7 days, so that is used by the MRP system. Now, on your screen, there is a very simple diagram, suppose this is the number of days, we want a final product by this day may be by the end of 7th day. Last subassembly 1 will be needed on 6th day, place order for subassembly 1, because the lead time may be 2 days, 2 days would be required for order subassembly one to be procure.

Start of production is 2 days, if we know that subassembly 1 would require 2 days to process; then we can say at start subassembly 1, should the production of start subassembly 1 should start at this second day. And suppose, one day is required for the raw material, then the order the raw material here, so we have offset. We know that the final product is required after 7 days, how should we plan, so that we are able to produce that final product.

So, we need subassembly 1, for subassembly 1, we need some raw material, so this will the lead time will be used in this way for a particular company. Now, this is the offset in this direction, so we know that 7th day, this is required; how should we plan in advance, so that by the end of 7 day, we are able to produce the final product.

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Now, how why this lead time is important, because the characteristics of demand always changes, now there is the dependent demand and there is a lumpy demand. Now, dependent demand, basically if we know that this much number of components have to be produced. Suppose, 500 now these 500 components require, suppose any part A which is required in four numbers.

Now, we know 500 final products have to produced, each product will require four components A and then 500 multiplied by 4 will give us the dependent demand. So, I have given you an example, now let us see how we can define the dependent demand, product demand related to other items as item is component of other product. So, final product we know and this item is a component of that particular product.

Now, lumpy demand basically is demand is sudden or is a large quantity increment, so as to take a batch or a final product. Sometime, the lumpy demand is there, may be sudden change in the demand, so dependent demand may be very, very stable, lumpy will be very, very exaggerated or may be very high or very low at times. Now, let us see, what is a independent and a dependent demand.

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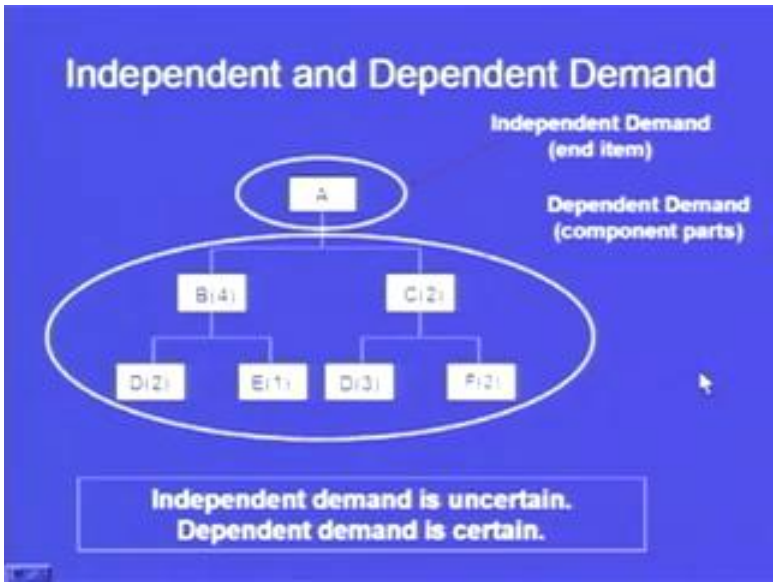

On your screen, you can say just to recall, now we want to manufacture product A, now A requires part B and part C final product is A, part B and C will be joined together to make A and how we will be able to make B, B will require D and E. So, D and E will be assembled to make B and then B and C will be assembled to finally, make A. In bracket is the requirement shown for part B, so four parts B will be joined with two parts of C to make A.

Similarly, how B will be made two parts of D and one part of E would be joined together to make B. Similarly, three parts of D and two parts of F will be joined together to make C and finally, B and C will be joined together to make A. Now, this is the independent demand, I have already told the final product is the independent demand and that is basically the end item on your screen.

And this is the dependent demand that is the component parts, now component parts will addition up to make the end item or the final product, so this is the dependent demand. Once, we know what is going to be A the number of A, number of A, I mean to say that, whether we are requiring 500 product A or 1000 quantity or 5000 quantity of products the A.

On the basis of the independent demand, we will be very easily able to understand, how many components B would be required, how many components C would be required. And once, we know how many components B are required, we would be very easily able

to understand, how many D and E components would be required. So, on the basis of the independent demand, we would be very easily able to generate a dependent demand, which is done by the MRP system.

The independent demand is uncertain, always we know that, why sales forecasting is done, so that to come close to that particular demand, that is independent. We do not know; how many components would be sold in the market or how many products would be sold in the market. So, in order to come close to that, we use certain sales forecasting tools to generate that independent demand or the quantity; that would be sold in the market.

Dependent demand therefore becomes certain, once we know that, this is the independent demand may be 100; then we can very easily understand, that what is going to be the dependent demand. For the components, that are going to add up to make the end item or the final product, look this is continuous verses lumpy demand.

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Now, this is the stable demand more or less it is constant, but lumpy demand, you can see, sometimes we have very large, this is on x axis, this is time at one particular movement of time. The demand is high, then there is no demand, after sometime again certain demand is there, then there is no demand, then there is a certain demand. So, we can see, basically if we have a stable demand, the system would be able to adapt very quickly.

But, if the lumpy demand is there, then it is very difficult for the system to become stable and here is the problem, where the system or this MRP is going to help us.

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Now, how MRP works, so very quickly we will try to understand certain terms, which are related to the processing of the MRP, so basically three important stages are there in any MRP system, input stage, processing stage and finally, the output stage. So, till now we have been discussing the input stage, only in which we have seen what MPS is, what is bill of materials, what is inventory status file and now we will just quickly go through the MRP working, how it works.

Now, first term to understand is bucketing, at what time and in what quantity our product is needed, MRP starts with consolidating period requirements for different end products, these time periods are called buckets. It adds services or spare parts, which are not included in MPS. Now, MPS tells us that this much number of product has be produced by such and such week, if you remember in the same lecture.

Today's lecture, we have seen one diagram in which we have seen, that in this week; this is the requirement, which was a MPS schedule or master production schedule slide. Here, we see that, if certain spare parts are not shown in the MPS that will be added here, part explosion, each item exploded divided into constituent materials. Now, from MPS we know 100 have to be produced, now this 100 will be exploded into it is subcomponents.

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Offsetting, displacing requirements by a period equal to the lead time of the product, now we know, what is a lead time, now the requirement will be seen and understood that when a particular order should be placed. So, whenever the requirement for that particular component is there to be assembled in the final product, we should be ready with that particular material. So, that basically is offsetting, if you remember the diagram there on x axis, we have shown what is the offset.

Then, the aggregation finding gross requirements for each component or raw material, now we will add up the requirements for each material or we will see the final product, what is going to be the aggregate requirements of the subcomponents. Then, netting involves modification of aggregate or gross requirements, so what will be the net requirement, it would be the gross requirement minus the inventory on hand minus safety stock minus inventory allocated to other users.

So, basically we will be able to judge, what is the net requirement, that will be from gross requirement, whatever we are having that will be subtracted, what is the safety stock, because we do not want to use the safety stock. That is only for certain exigencies or because of certain lumpy demand, if requirement arises, then only we are going to use the safety stock and similarly inventory allocated to other users.

Now, we see that, so many different products are manufactured, so for any other product, if we have already allocated certain inventory items with that will be subtracted in order

to get the net requirement. So, gross requirement minus these three components, this will involve the netting.

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Procurement schedule, the requirement is now advanced by a lead time for final assembly, pertains to the production process lead time. So, the requirement is now advanced by a lead time, lead time here pertains to the production process lead time. Now, we know that this much will would be required, we have identified this much would be required. Now, the lead time will be used for the procurement for of that particular item.

Now, lot sizing, this is used to consolidate the requirements in pre specified lot sizes, so that economic order quantity may be ordered. If you remember the lectures on inventory management, we have very clearly understood, what is economic order quantity, now economic order quantity, basically minimizes the total cost. So, we always want to order the economic order quantity, so that order always you want to place in order to minimize the total cost, so the lot sizing will also be done here.

So, this is used to consolidate the requirements in pre specified lot sizing, now we have already found out that is pre specified lot size that is we have already identified, what is the economic order size. So, that order size will be used here in order to minimize the total cost.

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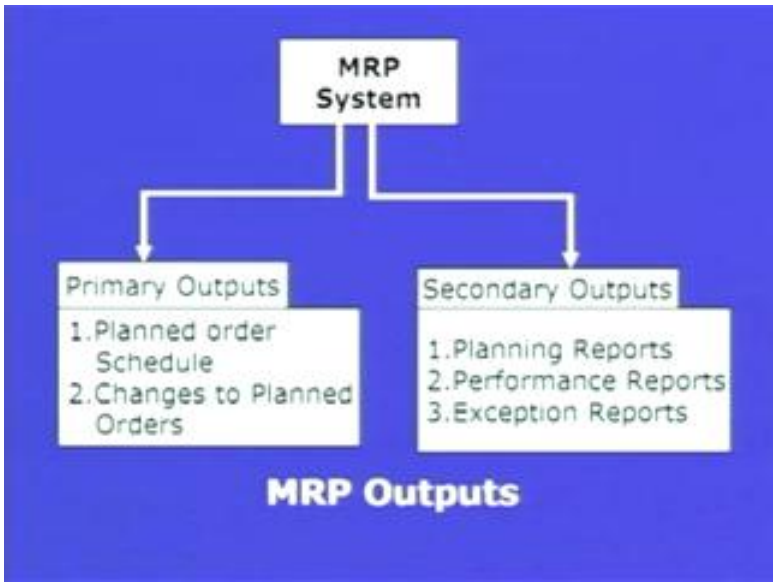

Now, MRP system will generate the output, till now we have seen, what is the input, three different inputs, how this input is influenced by other factors, that also we have seen. We have seen how MRP works, basically it is able to generate that when the order has to be placed in how much quantity, it has to be placed. And it is a self adjusting type of a system, now what type of outputs it will generate that we need to understand.

Now, primary outputs in this case will be planned order schedule that we have already seen, when we have understood, that how it works, changes to planned orders, certain times, there are so many changes that keep on happening in the enterprise. So, changes to planned order will also be a primary output of materials requirement planning system. There will be certain secondary outputs and now in order to understand this MRP output.

These can be generated after 1 week or 15 days depending upon, how the requirement of the information is desired by the company. Secondary outputs planning reports, performance reports, exception reports, so we will just have a brief introduction to all these outputs.

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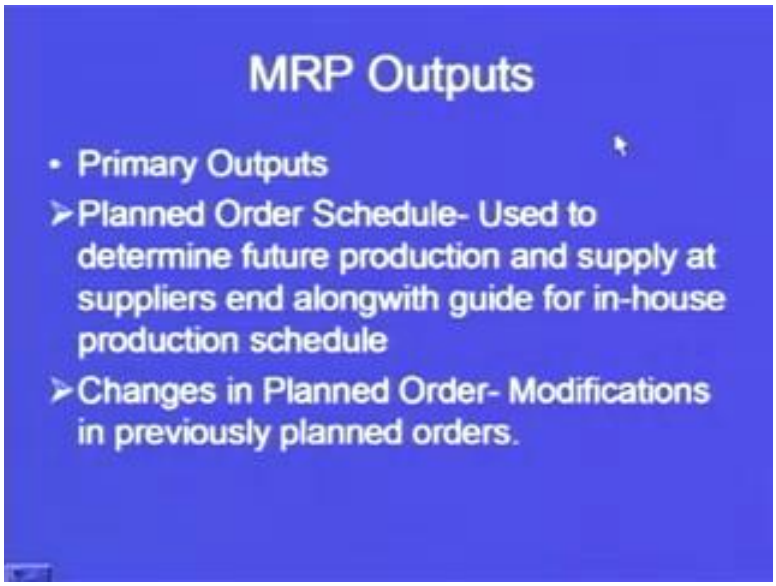

Now, MRP outputs, primary outputs we have seen two types of outputs, primary outputs and secondary outputs. So, the primary outputs are planned order schedule, this is used to determine future production and supply at suppliers and along with guide for in house production schedule. Now, we will get a complete planned order, scheduled at the supplier and as well as at our production schedule, also at our in house production schedule.

So, this is used time determine future production and supply at suppliers and along with guide for in house production schedule, changes in planned order, this is also primary output, modifications in previously planned order. So, if there are certain changes in the planned order that we have already planned, so those changes will also be shown as an output by the MRP system.

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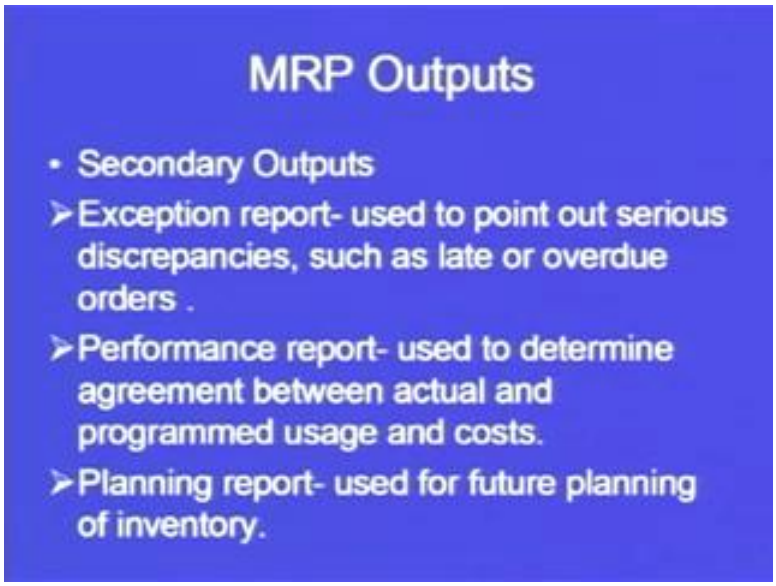

What are secondary outputs; first is the exception report, used to point out serious discrepancies, such as late or over overdue orders. Now, sometimes we are not manufacturing or we are not producing according to the desired plans, so whenever there is certain discrepancy that will be given as an exception report. Sometimes, we are late, sometimes overdue items are there; still pending orders are there, those will be given in the exception report.

Similarly, the performance report matching the planned order as well as per actual performance, used to determine the agreement between the actual and the programmed usage and cause. So, here if they certain discrepancy is there, that will also be given as an output. Similarly, planning report used for a future planning of inventory, now this time we have used certain components, suppose we want to plan for the complete new year, that kind of in output is also given by the MRP system.

So, basically this outputs will be used by the organization, in order to plan their materials in such a way, so that they derive certain benefit is of installing the MRP software. Now, coming onto the benefit is of MRP, what are the benefit is of MRP, we have seen that, there are three stages, first is the input stage, second is the processing stage and third is the output stage.

So, many types of outputs, we can derive from very simple materials requirement software. So, if we have a MRP software, we can get certain outputs and how these

outputs are to the benefit of the organization, that we are going to see in the subsequent slides.

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Understanding the effect of changes in the future period, so that is very obvious, I have already told the future planning can be done with the help of MRP software. So, what are the changes that are going to happen that we will very easily be able to adapt in the MRP system, so adaptability increases. Triggers are processed to improve bill of materials to guarantee reliable inventory records and better management.

Now, if suppose, there is a change in the design of the particular product, suppose product A changes, so the design when changes, it will trigger a process because the bill of materials file will be leaded to be updated. So, the triggering process will be done and very immediately we will be able to adjust to the new engineering design change or whatever change has taken place, new engineering design has been incorporated.

We would be very easily able to adjust to that type of a design and it will result in better management, improved customer service, so we can very easily satisfy the customer with the quality as well as with the time, which is very, very important in today's scenario. Then, reduction in lead time, we have seen two types of lead times are there, first lead time is the ordering lead time and second one is the manufacturing lead time.

So, it will result in reduction in the lead time, because whenever the requirement for a particular material is there. Already, we know with by the output of the MRP system that material or the subcomponent or the subassembly would be ready to be assemble, there will be no delay, because of the lack of availability of the material. So, when the lack of availability is not there, the material is very easily available, readily available.

According to the planned schedule, then there will be no hiccups, there will be no delays and there will be the smooth manufacturing process and the manufacturing lead time will reduce. It will further lead to the increase in the productivity, so when there is no delays, no breakdowns, no shut ups, then the productivity is bound to increase.

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Then the purchasing cost will also be reduced, when you have a better materials management package available with you, the purchasing cost will be reduced. Improve production and supply schedules, then that that is, but natural that production would be improve schedule. It will be working or it will be manufacturing at a particular schedule and there will be no breakdown.

Similarly, the supply schedule to the vendors or to the people, who are buying our product, would be very, very certain. Manufacturing cost will be reduced less scrap and rework, so these two points are interrelated only. When, there will be less scrap and rework, manufacturing cost will automatically come down. Higher production quality, so it will also indirectly result in a higher production quality.

So, the quality will be more time required will be less wastage will be less, so we can see there are so many direct and indirect benefits is of using a MRP system. Similarly, capacity constraints better understood, so we will try time take a lecture on capacity planning or capacity management also in order to understand, what is capacity management or planning.

So, here the capacity constraints would be better understood, we would be able to understand, what the capacity constraints is and on though the basis of that constraints only the MRP system will work and will generate the type of output, which is required. Now, there would be certain drawbacks of MRP as well, we have seen that what are the advantages, all those advantages we have been able to very easily outline in the previous slides. So, if there are certain advantages, there are bound to be certain drawbacks of the MRP system, what are those drawbacks.

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Now, first is the incorrectness in the suppliers lead time, MRP depends heavily on the correctness of lead time data, now this basically is a package or this basically is a system. We have used logic, we have used a input, that if we order for a particular component A, we will be able to get that component after 10 days. But, if there is incorrectness in this data, we are not able to receive that component A by the end of 10 days.

Suppose, it takes 12 days, then the whole system may crush, because the system is working on this information that the lead time is known with certainty and it is 10 days.

Suppose, it exceeds then the system will not be able to adapt to that kind of a change very quickly, so incorrectness in the suppliers lead time data may result in the failure of the system.

Similarly, incorrectness in the inventory data that is miscounting, unaccounted scrap, items lost in transit, so basically the incorrectness in the inventory data will also lead to the system failure. That is, if we are not having the right account or right numbers of the inventory available with us, then it may result in the failure. Last is the inaccuracy in the manufacturing lead time that is the change in the customer's demand, change in the workload of the factory.

So, if the manufacturing lead time is also changing, again we will not be able to adjust very quickly, for example I say that the we have an order of one particular product, which the customers have placed an order. The system has generated, what will be the requirement of the subcomponents that will be used to finally, produce this product. In the meanwhile, the demand of the customer changes, his specifies that, he wants certain modifications in this product.

And according to those modifications, the design of the product changes, now once the design of the product changes, if we are not able to incorporate those engineering design changes in the final product. Then the information is distorted for the MRP system to operate and if those things are incorporated correctly, then we know that, this is the final design for which our MRP system is working.

And if that information is not incorporated properly in the system or the input is incorrect, then the system will not be able to adapt and will give some faulty results. So, basically if we have incorrectness in the suppliers lead time data or there is an inventory data is not proper or the manufacturing lead time is not proper. Certain changes in the demand of the customer, which are not incorporated into the input of the system, then there, are going to be certain failures of the MRP system. So, it depends on the information and the information should be very, very correct, any level we are putting the information, which is not correct is going to result in the failure of the system.

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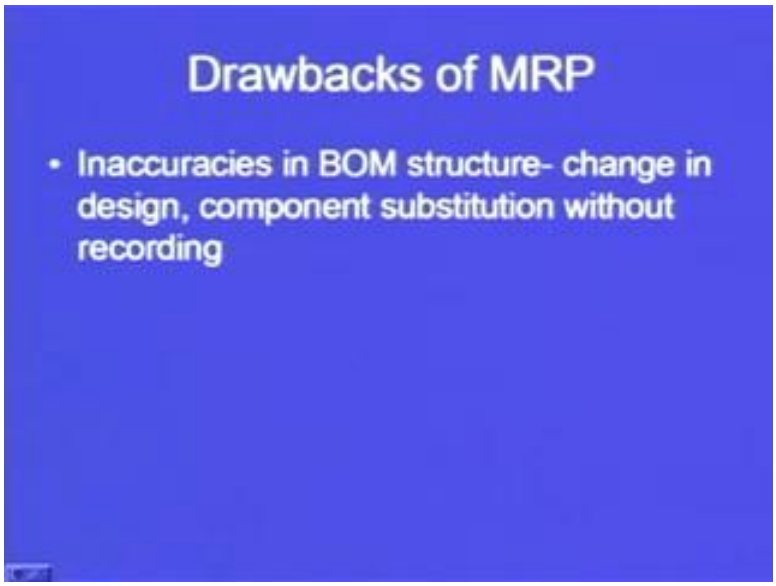

Then, there are another inaccuracies, what are those inaccuracies, those inaccuracies can be in bill of materials structure, change in the design. Already, I have told this thing, if the there is change in the design, then that has to be put as a input to the BOM file. If the bill of materials file is not updated according to the engineering design changes, then this is not going to be useful for the company.

So, inaccuracy in any type of input that we are supplying to the system is going to result into the failure of the MRP system. So, till now, we have tried to understand that, how the MRP system is important, for the well being of the company. So, we have seen that how the MRP system works, it works on the basis of certain inputs; the inputs basically are the master production schedule.

The bill of materials file, the inventory data or the inventory status file, then the MRP works we have seen so many basic concepts of MRP processing, that is bucketing of setting, netting, so many things we have covered. And then by finally, we have seen that, if we are using this type of system, what are the advantages; that we can derive out of using a MRP system.

And finally, we have seen that this type of system is based on the information that we provide to the system. If the information is not correct, it can be the lead time incorrectness, it can be the manufacturing lead time incorrectness, it can be the incorrectness, because of the certain engineering design changes. It can be the

incorrectness, because of the change in the customer demand that is going to result in the failure of the system.

Now, finally, we would like to come to conclusion, what basically MRP is, MRP is a computerized inventory controlled system. So, I have been using the term, package or system again and again. So, basically it is a computerized materials management or inventory control system.

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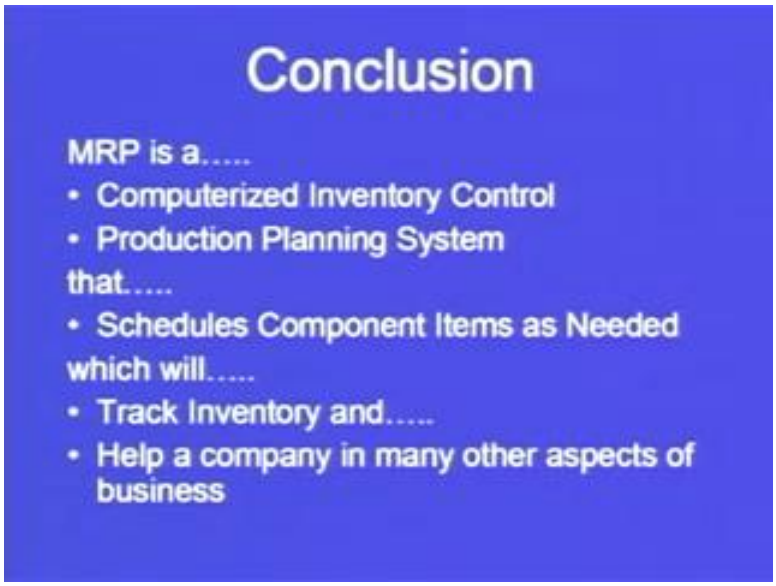

Now, this can also be used as a production planning system, that schedules the component items as needed, this we have already covered in this lecture, which will track inventory and help a company in many other aspects of business. So, finally, we can say that MRP is useful to the companies. Similarly, advancements like MRP 2 and ERP have been able to link manufacturing with other areas of business such as finance and marketing. So, we have seen that there are so many other packages available which we will discuss, if possible in next lectures.

Thank you.