Chapter 11

Material Requirements Planning (MRP)

Materials Requirements Planning could be easily located under the planning section of this text, in the deliver section, or here in the sourcing section. It is related to inventory management and sourcing.

What is Material Requirements Planning? The APICS Dictionary app defines MRP as: "A set of techniques that uses bill of material data, inventory data, and the master production schedule to calculate requirements for materials. It makes recommendations to release replenishment orders for material. Further, because it is time phased, it makes recommendations to reschedule open orders when due dates and need dates are not in phase."[73]

Investopedia defines it as: "a computer-based inventory management system designed to improve productivity for businesses. Companies use material requirements-planning systems to estimate quantities of raw materials and schedule their deliveries." It further explains: "MRP is designed to answer three questions: *What* is needed? *How much* is needed? *When* is it needed?" MRP works backward from a production plan for finished goods, which is converted into a list

[73] APICS Dictionary app, "Material Requirements Planning," accessed 14 September 2020.

of requirements for the subassemblies, component parts, and raw materials that are needed to produce the final product within the established schedule."[74]

Ok, what does that really mean in plain language? MRP is a system that has been around since the early 1960s that assists planners to answer the manufacturing and inventory questions of what needs to be ordered, how much needs to be ordered and when to place the orders. MRP is closely related to the discussion of inventory management in chapter 16 and will be discussed in conjunction with the inventory management class.

Master Scheduling

The master scheduling process is a complicated process to balance capacity requirements with customer demand requirements with on hand or on order inventory requirements. The process starts with the Master Production Schedule. APICS defines the Master Production Schedule (MPS) as: "A line on the master schedule grid that reflects the anticipated build schedule for those items assigned to the master scheduler. The master scheduler maintains this schedule, and in turn, it becomes a set of planning numbers that drives material requirements panning. It represents what the company plans to produce, expressed in specific configurations, quantities, and dates."[75]

The master schedule takes into consideration the forecast, customer orders, capacity and material availability to help develop the Master Production Schedule. The process looks like Figure 11.1. It is imperative to success to ensure that the MPS is doable.

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[74] Investopedia.com, "Material Requirements Planning," accessed 14 September 2020.

[75] APICS Dictionary, "master production schedule," accessed 14 September 2020.

- Do we have the materials to make the products?
- Do we have the capacity to make the products?
- Can we make enough products to meet the demand of the customers and the marketing forecasts?

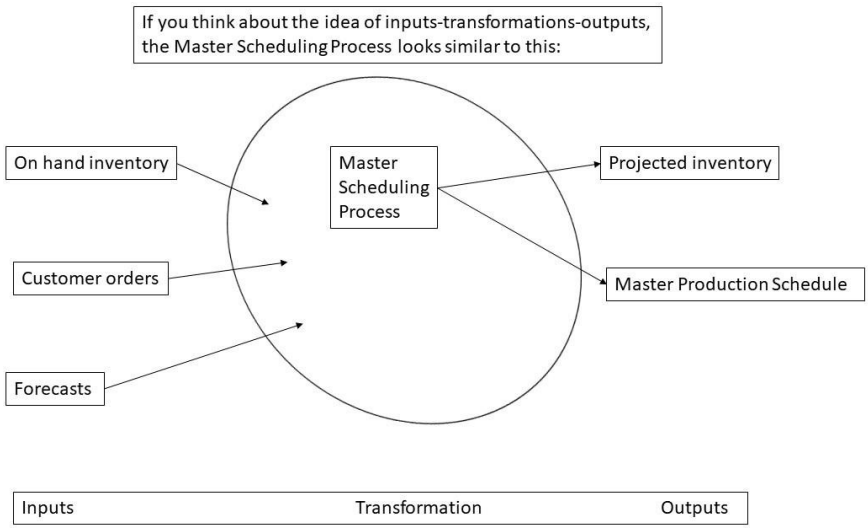

Figure 11.1: Master Scheduling Process

The MRP Process

The planning process for the MRP must exceed the longest lead time for components for the product being produced. The Bill of Materials is the component list or ingredient listing for a product. Every product has a Bill of Materials. Included in the file for the items on the Bill of Materials is the lead time (time from placing the order until the order is received) for each component of the product. The planning process must consider each item on the list and the lead times for each product.

When should a company use MRP? It is a great tool when:

- There is dependent demand for discrete components

- Complex assembly/manufacturing jobs
- Assemble to order operations

MRP consists of the following sub-processes:

- Exploding the Bill of Materials. This sounds dangerous but really is nothing more than taking the Bill of Materials to the lowest level possible. For example, if we are assembling a piece of equipment for the gym, the explosion of the Bill of Materials would include taking the components all the way the down to the bolts, nuts, screws and washers for the assembly and accounting for the number of each required for the assembly. We are simply answering the question, what do we need and how many of each do we need?
- Netting out inventory. In plain language, this is determining from the MPS and the exploding of the Bill of Materials, determining the delta between what we have and what we need to produce the numbers in the MPS.
- Lot sizing. This may or may not be an issue. Some suppliers package their products in preconfigured quantities. For example, screws may come in a lot size of 100 in a package and the supplier does not sell anything less than 100 and only in quantities that are multiples of 100. So, if you need 125, you must buy two lots of 100. In some cases, the lot size is based on the quantity that can be safely packaged in a container.
- Time-phasing requirements. This is simply backing off the required number of days, weeks, or months specified in the Bill of Materials under the lead time. MRP works on a just in time logic. If the lead time is 12

weeks, then the item needs to be ordered 12 weeks before it is needed, and the system assumes it will show up just in time for use.

Applying the MRP Logic to the MPS

Figures 11.2 through 11.5 show the calculation for the MRP requirements. Step one is to determine what is needed to make the quantity shown in the MPS line on the grid. There will be one MRP grid for every component or ingredient on the Bill of Materials. The next step is to determine if there is a short fall of inventory on hand. Then if there is a short fall, back off the number of periods shown in the lead time and place an order for that quantity if there is no lot size (Figures 11.2 and 11.3). If there is a lot size, then the order quantity must be the lot size or multiples of the lot size (Figures 11.4 and 11.5).

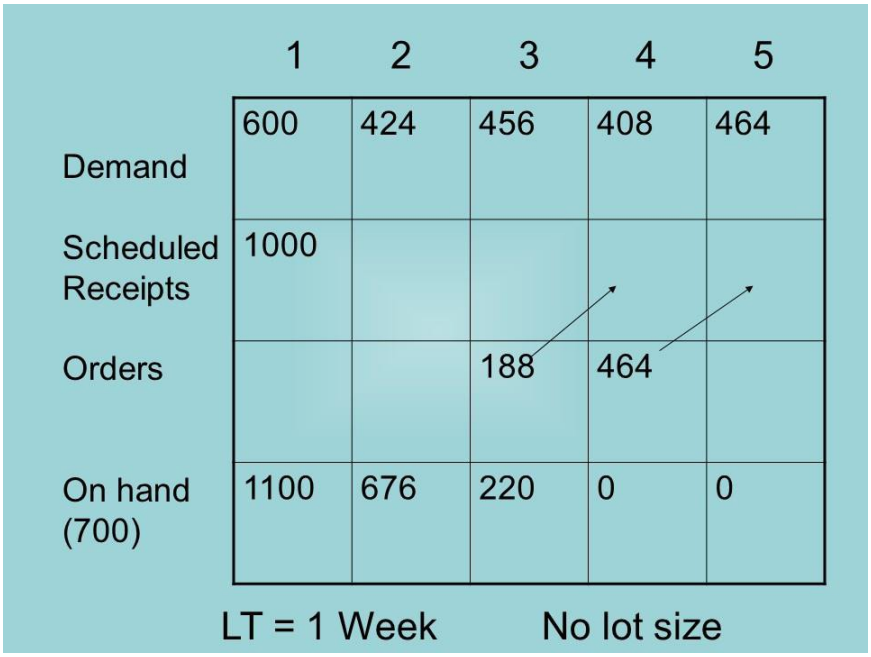

Figure 11.2: MRP Grid Example

In Figure 11.2, we have 700 on hand today of this component. In week 1 we are planning on making 600 of the end-item that this component is a part of. In step one the requirement does not exceed what is on hand, so, simply subtract what we need from what we have on hand plus

any scheduled receipts to get the projected on hand balance at the end of week 1 ((700 on hand + 1000 due in) – 600 needed) = 1100 projected on hand at the end of week 1. Continue this process across the grid. For week 2 we are projecting a demand for 424 – the calculation for this week is 1100 on hand – 424 projected to make; this leaves a projected 676 on hand at the end of week 2. The same procedure is followed for week 3. In week 4 there is a shortfall of 188 when comparing the on hand inventory to the anticipated build schedule. Since the lead time is 1 week, we need to back off 1 week and order the needed quantity to arrive in week 4 as shown in Figure 11.3. We follow the same logic for week 5 by placing an order 464 in week 4 to arrive in week 5.

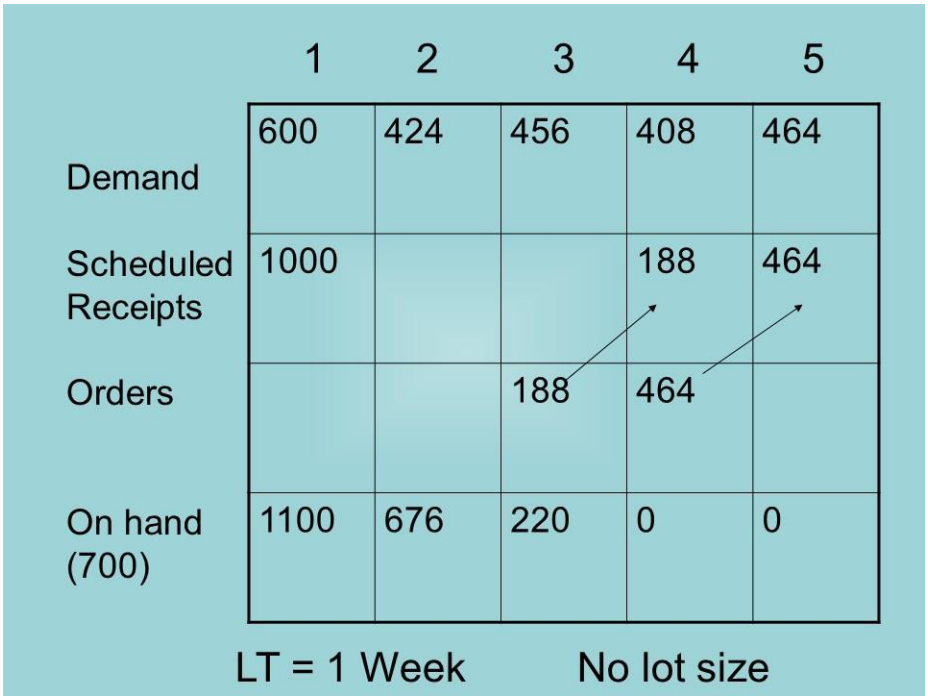

Figure 11.3: Completed MRP Grid Example

If there is a lot size as shown is Figures 11.4 and 11.5 the calculations look a little different and the use of lot sizes may impact inventory carrying costs and inventory storage area requirements. The calculations for the first three weeks in this example do not change since there is sufficient quantity on hand to meet the anticipated build schedule. The calculations change in

weeks 4 and 5. Now we must order a lot size or multiples of the lot size. In week 4 we are still short 188 but the lot size is 400, so we have to order 400 in week 3 to be available in week 4. This changes the projected on hand quantity at the end of week 4 to 212. This means we will have a projected shortfall of 252 for week 5. However, because of the lot sizing we will have to order 400 again in week 4 to arrive and be available in week 5. Figure 11.5 shows the completed MRP grid.

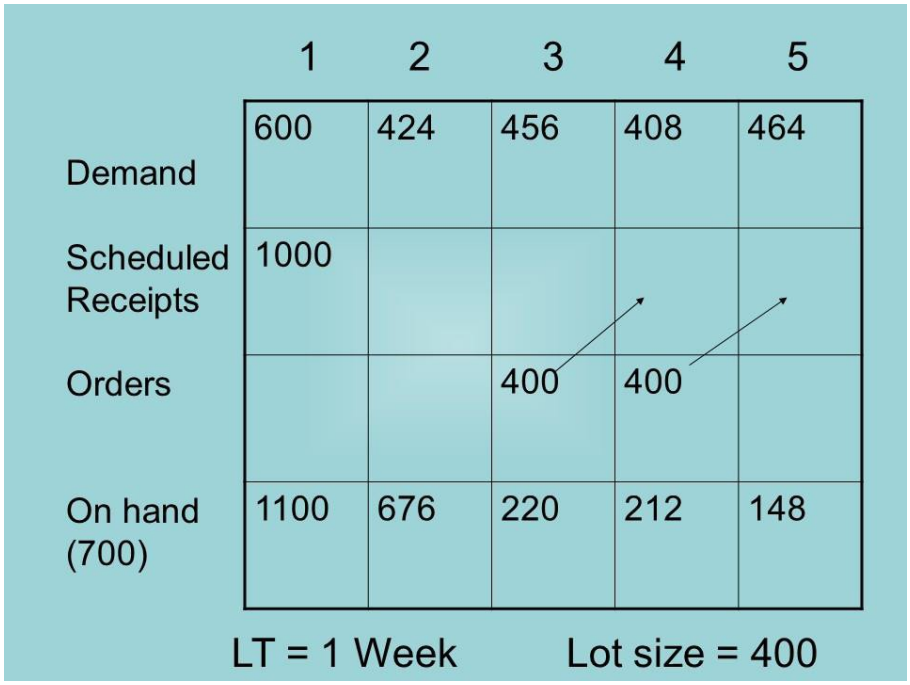

Figure 11.4: MPR with a Lot Size Requirement Example

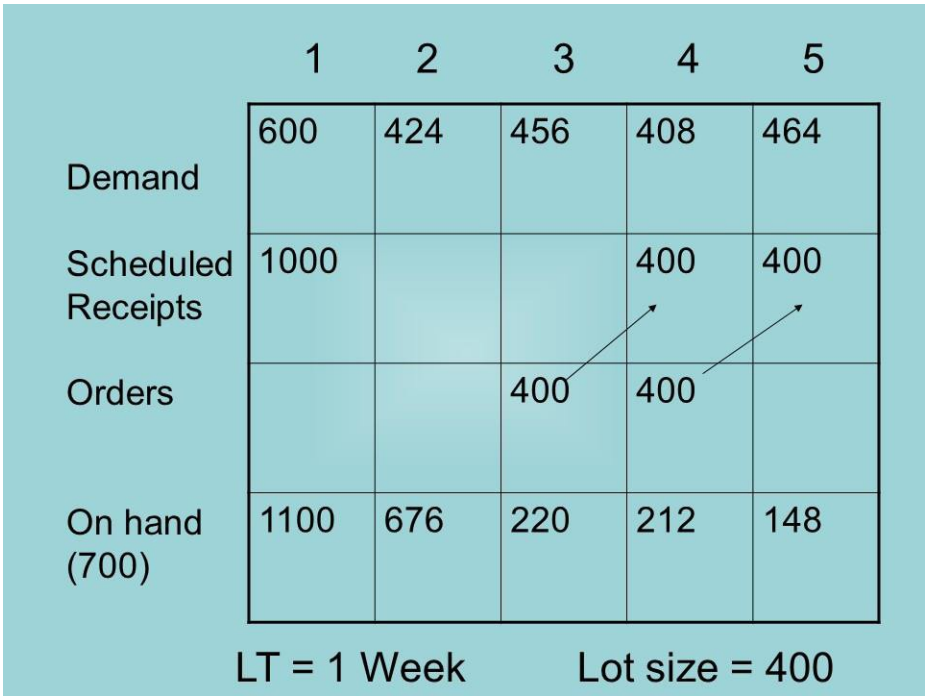

Figure 11.5: Completed MPR grid with Lot Size Example

Summary

Material Requirements Planning is a great tool to use in complex assembly operations or for dependent demand calculations using the Bill of Material as the foundation for how many of an item are needed for each end-time and the lead time for ordering and receiving the components.

If a lot size is mandated by the supplier, then the ordered quantity has to be the lot size or multiples of the lot size.