



What is an MRP system?

E-Book by



Foreword

We have written this e-book for educational purposes. We wish to share our experiences and some of the best practices in manufacturing planning and management. This is not a consultation. As there are many ways to implement a methodical approach to manufacturing planning, the choice of solution, execution, and the result is the sole responsibility of the implementation project manager. Hopefully this material will be helpful for anyone who is undertaking, or looking to start, an MRP implementation.

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Part I

What is an MRP system?

MRP is a modern approach, a method, to a manufacturing company management, which allows to accurately and efficiently plan the company's resources in terms of materials, equipment, and workforce.

How does MRP work?

There are not plenty of materials available now, various parts will be available earliest in 2 weeks. And, looking at the schedules of required work stations, it comes out that it is not possible to start production earlier than in 2.5 weeks.

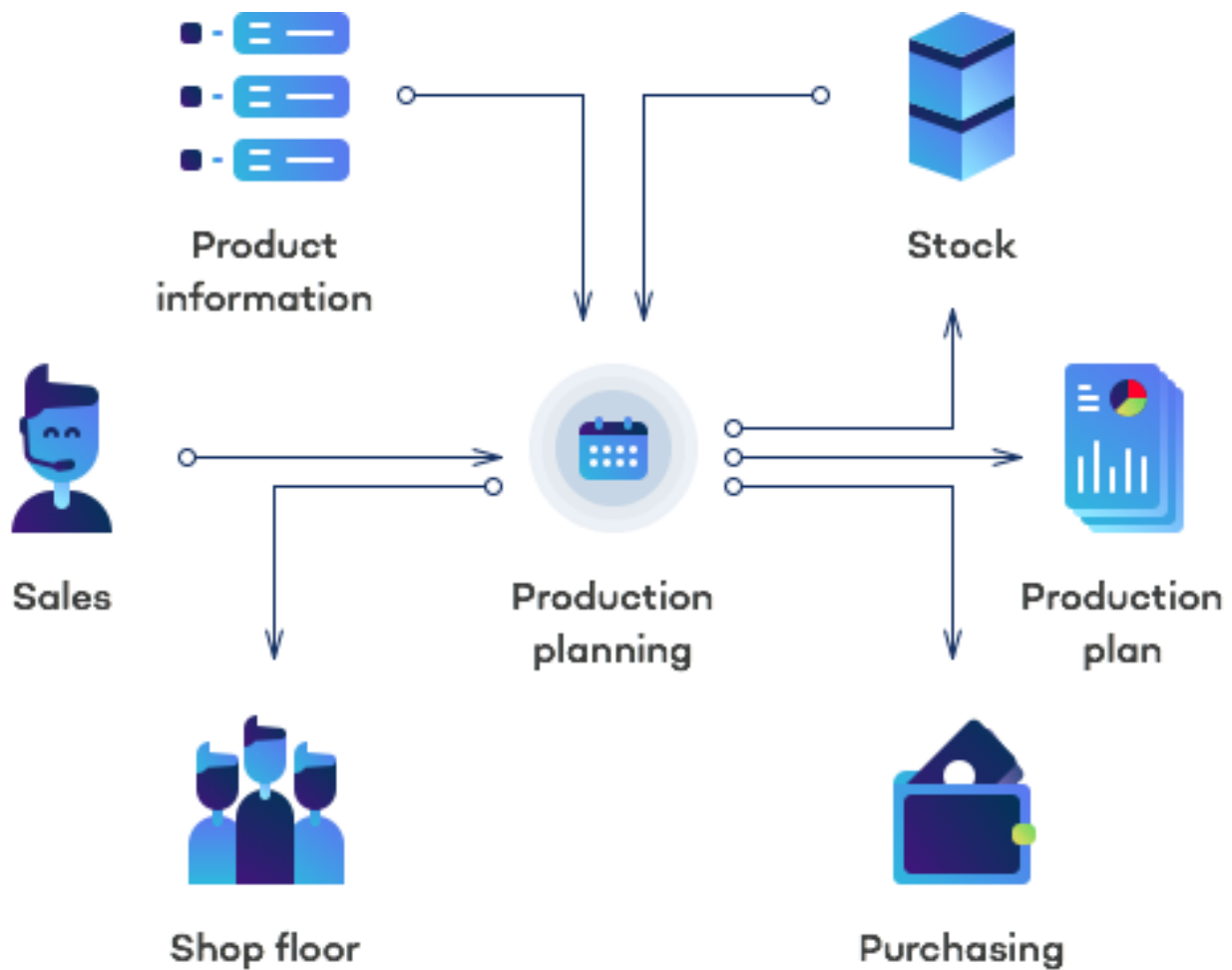
Hence, the production operations are scheduled to start in 2.5 weeks. Simple, but often not easy. To make it easy, that's why we've built MRPeasy!

Nowadays, the term MRP is mainly understood as **Manufacturing Resource Planning (aka MRP II)**, which allows for very accurate planning and management of resources.

Historically, when it came to be, MRP was coined Material Requirements Planning (aka MRP I). Due to computational limitations, it was a more simplistic method for finding what your future stock levels will look like, it gave you a basic schedule etc. It's worth to point out, that even though MRP as a methodology can be applied without a computer, it would be very laborious and unthinkable nowadays.

Today, **all different operational functions in the company interface the same software in real-time** – the salesperson, purchaser, stock

clerk, production planner, shop-floor worker, engineer... they all have a common platform where they conduct some of their work.



Knowing...

- the Bills of Materials (BOMs),
- the operational details for building items (Routings),
- the schedules of every work station,
- inventory availability,
- lead times and costs of materials (Purchase Terms),
- demand from sales,
- requested delivery dates (for backward planning),

... the MRP solution can instantly tell with a great accuracy:

- when each operation should start and when the production will finish;
- how much the product will cost;
- what materials need to be purchased.

What are the benefits of MRP?

As MRP utilizes a lot of information from different sides of the business and automates the scheduling, which is often unthinkable done manually, the direct results on a grassroots level are:

- Very fast planning.
- An accurate production schedule.
- A clear understanding of required materials.

In turn, coming from the previous, **any company which has properly implemented MRP will likely see:**

- better estimations of delivery dates,
- reduction in inventory levels,
- less or no stock-outs of raw materials,
- improved machine loading,
- greater productivity,
- less downtime,
- fewer missed customer orders.

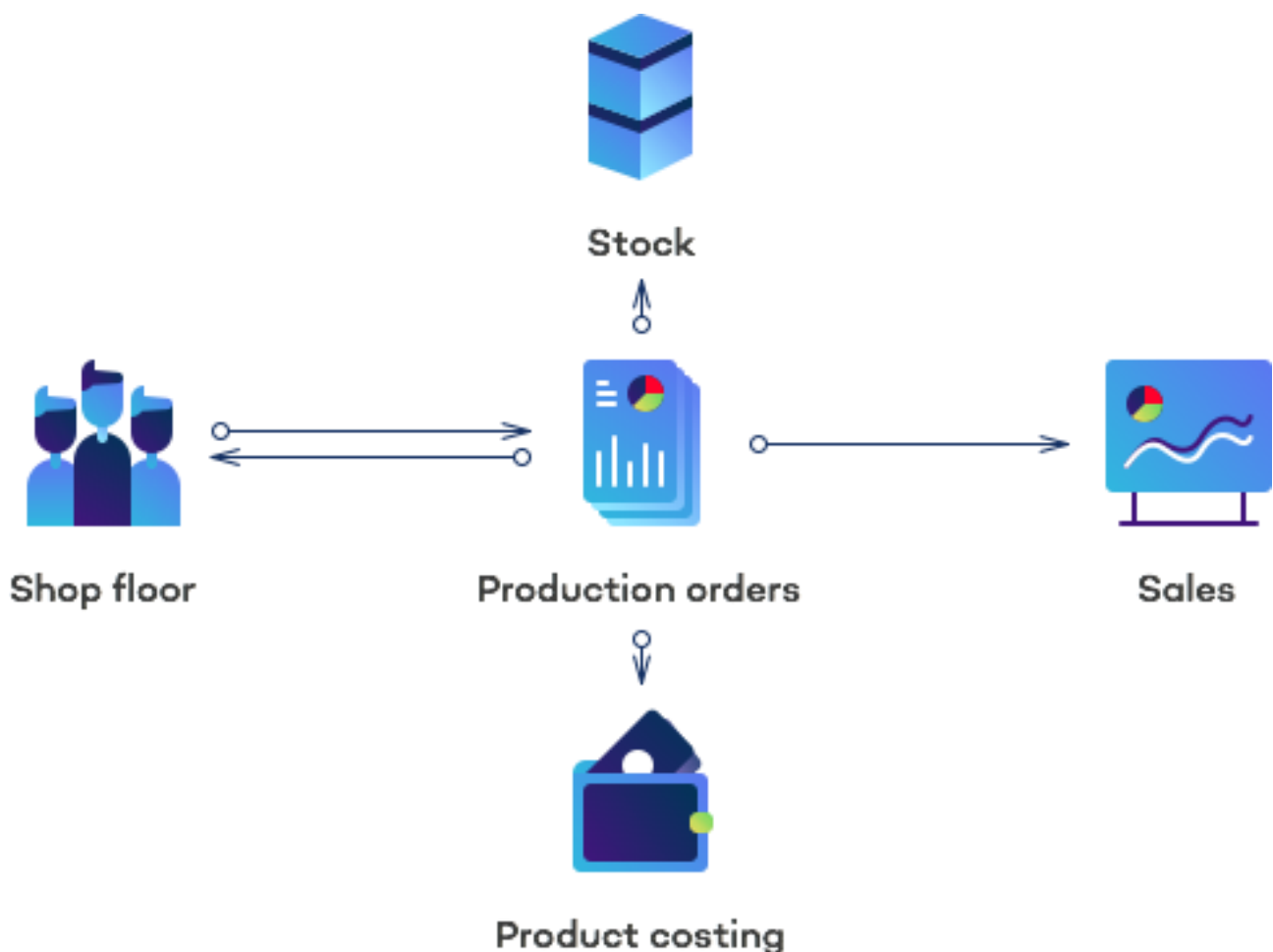
MRPeasy customers report a **14%** reduction in inventory levels on average.

What is MES?

A Manufacturing Execution System (MES) is a central unified way for shop floor to stay in touch and communicate with the rest of the company, and vice versa.

MES allows to convey instructions to workers in real-time, and get real-time feedback for a clear overview of what is happening in the company. No need for paper print-outs, or walking the floor just to understand where things are, or manually processing finished orders at the end of the day.

This is an integral part of an effective and modern MRP system.



How does MES work?

When the production planner enters a job, the responsible worker will see it in their schedule via the shop-floor kiosk, which could be a desktop computer, laptop, tablet, or even a smartphone.

The worker will see the order of operations, when and where these must be conducted, as well as work instructions, drawings, etc. With just a click of a button, everyone will know that the important order just went into production, or finished.

What are the benefits of MES?

On one end, it is **great for saving the time** of the production managers, who can easily issue orders and monitor progress in real-time. On the other hand, the reporting is **great for getting valuable feedback** – if your estimated timing for operations is on par, what are the actual costs of production, how various workers perform, if there are issues, etc.

Also, MES records the track record of every product, which is especially important in highly regulated industries.

The other benefits include:

- Transparency of shop-floor.
- Faster and better feedback.
- Traceability of production.
- Better labour utilization.
- Reduction in paperwork.
- Reduction in lead times.

MRPeasy customers report
a **17%** increase in on-time
delivery on average

Part II

How does planning work in MRP systems?

There are two sorts of planning, that good MRP systems conduct at the same time: **material planning** and **operations planning**.

If properly implemented, the two sides of the planning make up an all-around **finite resource planning** system, which is a crucial foundation for the success of a serious manufacturing business.

(If you get stuck in terminology, see the Glossary of important terms on page 14!)

How does material planning function?

There are four main inputs to material planning:

- Firstly, **an article** is defined for each material, which all have individual **purchase terms** – which importantly contain the lead time and cost information.
- Secondly, each product, represented by an article, has a **bill of materials** (BOM), which states the parts are needed and the quantities.
- Thirdly, inventory information: current and future stock levels (based on planned **purchase orders**, and **stock lot** tracking).
- Lastly, current production schedule, including the existing demand for materials, since some materials are already reserved.

The material planning logic works like this:

1. The BOM is multiplied by the number of products in the order.
2. The number of available materials in stock is compared to the required amount.
3. If some materials are not in stock, the lead time is looked up from the purchase terms.
4. Today's date + lead time = the earliest time it is possible to start production.

If you save the order to the production calendar, then

- Available materials are reserved for this production order from specific stock lots. That means that these materials are booked, and cannot be used anywhere else.
- Demand for purchasing is raised, or purchase orders are automatically created.
- Based on the purchase report ("Critical on-hand" report in MRPeasy) it is possible to raise POs for needed amounts of materials if POs were not raised automatically.

Of course, the earliest time materials can be available does not necessarily mean that production can start. The work stations might not be vacant, to consider this information, operations planning must also take place.

How does operation planning function?

There are three main inputs to operation planning:

- The routing of the product, which describes which operations and in which sequence, and on which work station types, need to be processed.
- The individual calendar of each work station.
- Material availability information from material planning

The operation planning logic works like this:

5. Using the routing of the product, the length of each operation is determined based on setup and cycle times, and the quantity to be produced.
6. For the first operation, all calendars in the required work station type are pulled up.
7. (On a routing level, the operation is assigned to a work station type, which governs a set of work stations, which all can complete the task.)
8. The earliest time is found at which the operation can start based on three premises: (1) there's a long enough vacancy in the calendar of the work station (or work stations, if parallelization is used); (2) considering all work stations of that type, the start time is the most suitable; (3) all materials are available at that time.
9. The operation is assigned to a specific work station's calendar for that time slot.
10. Steps 6-9 are repeated for all the next operations in a manner that satisfies the required sequence of the operations. For example, the next operation could start when the previous operation is fully finished, partially finished, or it can start immediately and in parallel, depending on the required scenario.

The previous logic exemplifies how **forward planning** works. It is also possible to utilize **backward planning** for just-in-time manufacturing. With backward planning, the logic works exactly the other way: from a due date moving back in time, the latest time slot for the last operation is found; then the previous operation is scheduled backwards, then the one before that, until all operations are planned and a start time is found.

MRPeasy customers report
a **14%** increase in
equipment loading

Glossary of important terms

Article, aka a **stock keeping unit (SKU)** – every item, which is unique, is represented by a separate article.

Raw goods, ingredients, materials, parts, half-products, sub-assemblies, assemblies, finished goods of every type and colour... every single item which is different from something else is represented by a unique article. This is how the software can distinguish and keep track of intrinsically different things.

An article is mainly defined by a unique code, description, a product group, and a Unit of Measurement.

Unit of Measurement – this is the unit in which it is useful to count and utilize the article.

For example, most common units are metric or imperial units like 'lbs', 'gal', 'ft', 'kg', 'l', 'm', or for parts and components - 'pcs'.

A smart UoM choice example, if an item is purchased from a vendor in 'pallets' (which is the vendor's UoM), which contains a number of packages, and in essence it's a liquid, which in the end, for production, is going to be measured in gallons – then the UoM should be 'gal'.

Purchase terms – the options for purchasing a specific item: vendors, prices, price breaks, lead times, etc.

This connected and pre-defined information not only simplifies purchasing but also greatly aids planning of production.

Bill of Materials (BOM) – the list and quantities of articles which make up the product.

This is the recipe. There is a distinction between an engineering BOM and a manufacturing BOM. There is a small but significant difference: the former contains strictly what makes up the product, the latter lists every single material which goes into production, including scrap and wastage, to produce the product. It is recommended to use the so-called manufacturing BOM since then the MRP system can effectively plan for scrap and wastage.

Routing – the list and details of operations required to make the product. Sometimes also known as the Bill of Works.

Operation – a production step for building the product. An operation is done in a specific work station, it has a specific length, assigned worker(s), plus optional setup times, and associated fees.

Importantly, on a Routing level, the operation is assigned to a work station type, and only during planning a specific work station is reserved.

Work station type – a group for one kind of work stations. For example, 5 CNC machines which all perform same operations form a group. Another good example is that 5 assembly tables form a common group.

Work station – an individual work station representing a machine or a location where operations will be conducted. A work station is always a part of a work station type.

Manufacturing Order (MO) – the order for production. This specifies what is to be manufactured, when, where, how, by whom, and which materials will be used.

A MO is the direct output of production planning. It is scheduled to the production calendar to a specific time, it lists all resources reserved for this production, all required operations and assigned workers.

The products from the MO can be produced to stock, to another MO as parts, or to one or many customers.

Customer Order (CO) - the order which you have received from a customer.

This gathers all details on what is being ordered from you, who ordered, due date, quantities, prices, and other details. Plus, importantly, this is where the project, which needs to be fulfilled, is managed – from reserving the goods and planning production to shipping and invoicing.

Purchase Order (PO) – the order you send to your parts and materials vendors, or subcontractors.

This gathers all details on what is being ordered, from whom, when it's due to arrive, the costs, order confirmations, shipment dates, receipt date, and more.

Stock lot - one batch of some article.

Each time a material is purchased, or products built, a new batch of those items is received or created. Therefore, a unique stock lot number (aka “a batch number”) is assigned to identify and

accompany these items in your company. In one batch, there can be many of the same item.

You may have many stock lots of the same material – purchased at different times, with different costs, possibly from different vendors, with different expiry dates, stored in different locations/shelves, some of which have certificates, files or notes attached, etc. This is the foundation of material traceability.

Finite resource planning – planning which considers and plans according to the premise that all resources are limited, i.e. materials, work stations, throughput, working hours, etc.

Illustratively, this means that if there is a bucket, and it is filled with water, it is not possible to ‘overflow’ it. The water needs to be put into the next bucket, or this bucket needs to be emptied beforehand.

Effectively, this means that each operation has a certain length, and on the other end, each work station has a limited number of hours every day. When the calendar for this station is planned, operations are loaded into the calendar from morning until evening, until it’s full, and then planning continues to the next work day.

This is the core of a great MRP solution.

Thank you for reading!
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