Expert's Guide to Successful MRP Projects

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Executive Summary

For most manufacturers, the planning department performs business critical functions. It is responsible for balancing organizational supply with demand, and directing production, distribution, and purchasing activities accordingly. A planning department strives to balance oftentimes competing organizational forces, including customer service, inventory requirements, and operating efficiency.

To succeed in their tasks, planners and schedulers rely on materials resource planning (MRP) software to make recommendations and send signals. MRP software typically covers purchase planning, master production scheduling, capacity requirements planning, and distribution planning, among other things.

To make meaningful suggestions, MRP requires a steady diet of accurate, relevant, and timely data. If any of these data requirements are missing, MRP is likely to issue recommendations that are harmful – not helpful – to a company. And, the potential harm can be significant, including: bloated inventories, missed order promise dates, and production schedules that are unresponsive to actual demand priorities.

In this Expert's Guide to Successful MRP Projects, we break down two critical MRP project success factors:

1) Tips to select the right MRP software, and
2) Best-practices to extract meaningful value from MRP solutions

More specifically, this report covers the following:

- An Historical Definition of MRP
- MRP Today – Manufacturing Resource Planning (MRP II)
- A The Planning and Scheduling Department – A Control Tower Function
- A Prerequisite to MRP Success – Timely and Accurate Data
- Key Requirements when Evaluating MRP Functionality in a Selection Project
    - Order Quantity Parameters
    - Lead Time Parameters
    - Purchase and Production Order Dates
    - Production Routings
    - Production Bill-of-Materials

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Overview – Leveraging MRP to Balance Supply with Demand

Without question, the success of any manufacturing business depends on its ability to maintain an appropriate balance between supply and demand. And, manufacturers rely on their planning and scheduling departments to achieve this balance. Planners and schedulers, in turn, lean on MRP software systems to help them execute material requirements plans, master production schedules, and capacity requirements plans.

MRP software performs complex calculations to make suggestions that are intended to put the right people and product in the right places to satisfy demand requirements. However, MRP will be incapable of making meaningful suggestions if the underlying data is either not timely, not accurate, or not co

In this Expert's Guide to MRP, we break down best-practices that companies can leverage to achieve the following purposes:

- Selecting MRP solutions that fit their requirements
- Implement business processes to optimize the effectiveness of MRP solutions

In the sections that follow, we break down a brief history of MRP's evolution, followed by a discussion of the key requirements to successful MRP project execution. Specifically, this report covers the following:

- An Historical Definition of MRP
- MRP Today – Manufacturing Resource Planning (MRP II)
- A The Planning and Scheduling Department – A Control Tower Function
- A Prerequisite to MRP Success – Timely and Accurate Data
- Key Requirements when Evaluating MRP Functionality in a Selection Project
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Historical Definition of MRP

Historically, there was only one definition of MRP, and that was material requirements planning. Under this historical regime, manufacturers would leverage computer information systems to plan material movements through an organization's supply chain and production processes. These systems would generate requirements in a time-phased manner by "netting out gross requirements against on-hand and in-process inventory". MRP would also make recommendations relating to master production scheduling and capacity requirements planning.

APICS - the American Production and Inventory Control Society – defines material requirements planning as follows:

> A system built around material requirements planning that includes the additional planning processes of production planning (sales and operations planning), master production scheduling, and capacity requirements planning.

One of the critical success factors of material requirements planning was the development of a closed-loop system that fed execution-related data back into the planning process. This was a very important development because the real world seldom proceeded according to plan. For example, customers change orders, suppliers miss delivery windows, production workers get sick, and machines unexpectedly break down. To make plans meaningful, companies needed their systems to account for these types of changes. APICS describes the closed-loop planning system as follows:

> Once this planning phase is complete and the plans have been accepted as realistic and attainable, the execution processes come into play. These processes include the manufacturing control processes of input-output (capacity) measurement, detailed scheduling and dispatching, as well as anticipated delay reports from both the plant and suppliers, supplier scheduling, and so on. The term closed loop implies not only that each of these processes is included in the overall system, but also that feedback is provided by the execution processes so that the planning can be kept valid at all times.

MRP Today – Manufacturing Resource Planning (MRP II)

The historical version of MRP - material requirements planning – gave companies an opportunity to rationalize operations by integrating processes relating to the planning and scheduling of materials, resources, production, and capacity.
In the mid-1980s, manufacturers realized that they could extend integration to other corners of

their businesses. Oliver Wight, author of Manufacturing Resource Planning: MRP II, explains the rationale of enterprise integration, as follows:

> Once the operating system in a manufacturing company could be made to work – and the closed loop MRP [materials requirements planning] system did work in a good many companies – ***making MRP a whole company system was the next logical step. MRP II is a system that includes manufacturing, finance, marketing, engineering, purchasing, distribution*** – and certainly changes a lot of things for data processing people. [Emphasis added]

Wight identifies three characteristics of MRP II, namely:

1. A system that fully integrates both financial and operational functions
2. An ability to perform "what if" scenario analysis to reflect policy decision alternatives
3. A company-wide system that includes all major functions

The integration of financial and operational capabilities proved to be a significant innovation. Historically, manufacturers would maintain an independent system(s) for budgeting, costing, and financial reporting. The lack of integration with operations oftentimes meant that financial reports and budgets failed to reflect the true state of the business. For example, reported inventory asset values would seldom reflect the true value of materials in transit, on shelves, and in process. By integrating financial and operations systems, businesses gained an ability to view a clearer picture of the financial impacts of their operations.

The third requirement – a fully integrated system - is what ultimately resulted in MRP II's evolution into what's known today as ERP, or enterprise resource planning.

For present purposes, the discussion of MRP will be constrained to software modules that perform purchase planning, master productions scheduling, capacity requirements planning, and distribution planning functions. Although these modules have costing and what-if scenario functionality, they are more in line with the historical definition of MRP, i.e. material requirements planning. For present purposes, references to MRP will relate to the historical materials requirements planning definition with costing and what-if scenario enhancements.

The Planning and Scheduling Department – A Control Tower Function

The function of an airport control tower is to effectively manage existing incoming and outgoing flights, and schedule future incoming and outgoing flights. Control tower managers have to adjust schedules based on delays, early arrivals, and applicable regulatory requirements. In other words, control towers are charged with the responsibility of ensuring efficient and safe flight-related airport operations.

A manufacturer's planning and scheduling department performs a similar function. As with a control tower, this department performs a logistics coordination function. The department is responsible for planning purchases, material movements, production capacity, production schedules, and logistics all in an effort to balance supply with demand.

A Prerequisite to MRP Success - Timely and Accurate Data

In essence, a planning department is tasked with ensuring that supply is well-timed with demand. To discharge its duty, a planning department relies on an MRP system to issue meaningful planning recommendations. And, for MRP outputs to be meaningful, a system must be fed data that is timely, accurate, and relevant.

If base data is inaccurate, a planning engine will issue recommendations that are not likely to reflect actual operational needs. The system needs to mirror business reality as closely as possible. Thus, MRP requires:

- Accurate data, including: item settings, bills of material, and routings;
- Correct inventory levels; and
- Timely registration of all inventory movements

In our experience, companies should aim for inventory accuracy rates of at least 95%, with rates of 90% hitting a range of acceptability. This accuracy rate means that system inventory records should reflect actual inventory with a discrepancy allowance of 5%, but no lower than 10%. If system inventory accuracy rates fall below 90%, a planning engine will issue suggestions that will be of limited use. For example, if a system contains an inventory record for an item that does not exist, MRP might issue a recommendation to pick a component that is no longer on the shelves. Any consequential delays could impact on-time delivery.

To ensure inventory accuracy, businesses should consider implementing any combination of physical and cycle counting programs.

Key Requirements When Evaluating MRP Functionality in a Selection Project

No two MRP systems are built alike. For this reason, businesses should only approach MRP solutions once they have defined their specific requirements, the ones that MRP should be capable of supporting. This best-practices guide breaks down some of critical factors to successfully selecting an MRP solution that's right for your business. It also highlights key best-practices that businesses can leverage to ensure that their MRP systems deliver the intended benefits.

The sections that follow break down MRP selection best-practices in the following areas:

- Defining order quantity and lead-time requirement
- Defining lead time parameters
- Defining purchase and production order date requirements
- Defining production routings
- Defining production bill-of-materials

Order Quantity Parameters

MRP generates supply recommendations (make, distribute, and/or buy) based on sales forecasts, new orders, and existing orders. To be meaningful, the recommendations require parameterization. For example, MRP needs to know whether orders should be grouped into batches of specific sizes or whether there are minimum order quantities that must be satisfied to trigger a replenishment requirement.

Order quantity modifiers allow companies to establish these types of replenishment parameters. They can be quantity and/or time based. Examples of quantity modifiers include requirements that items be replenished in multiples of 10, batches of six, or up to 100 at any given time. Examples of temporal parameters include limiting replenishment to monthly orders. When evaluating MRP solutions, businesses should assess the extent to which the systems support their order quantity parameter requirements.

The following table sets out common examples of order quantity modifiers:

Order Quantity Modifier	Description
Order quantity increment	Order quantity must be a multiple of this value
Minimum order quantity	Order quantity cannot be less than this value
Maximum order quantity	Order quantity cannot exceed this value
Fixed order quantity	Order quantity must equal this number
Economic order quantity	Order quantity must equal this number
Order interval	Time requirements during which orders are aggregated into a single order

Lead Time Parameters

Lead time modifiers establish the time constraints for getting items to their intended destination. If lead times aren't accurately defined, an MRP system will be incapable of making recommendation that satisfy order promise dates and/or stock requirements (for example).

It is important for businesses to define both internal and external lead times. Examples of internal lead times relate to procurement processing times, production times, unpacking times, and inspection times. External lead times include supplier processing and shipment times. For businesses that purchase common items from multiple sources, it will be important for a selected system to support an ability to define lead times at the supply source level. This will ensure that replenishment recommendations account for the specific lead times attributable to the selected supply source. It will also give the MRP solution an opportunity to make supply source recommendations based on time constraints. For example, if an order has a rushed promise date, MRP could recommend sourcing supply from the supplier with the shortest lead times.

When defining lead time requirements, businesses should consider those in the following categories:

Order Quantity Modifier	Order Quantity Modifier
Internal processing time	The time to obtain supply source quotes, approvals, and enter the purchase or work order
Supply time	The time the supply source spends to load the goods onto transport
Safety time	Vendor-dependent slack time
Transportation time in	The time it takes to receive the goods on the dock from the supply source
Build time (routings)	The time it takes to make the goods
Extra time	Vendor-independent slack time
Inbound time	The time it takes to receive, unpack, inspect and put the goods into inventory
Outbound time	The time it takes to pick, inspect, pack and load the goods onto transport
Transportation time out	The time it takes to deliver the goods from our dock to the customer

The Importance of Purchase and Production Order Dates

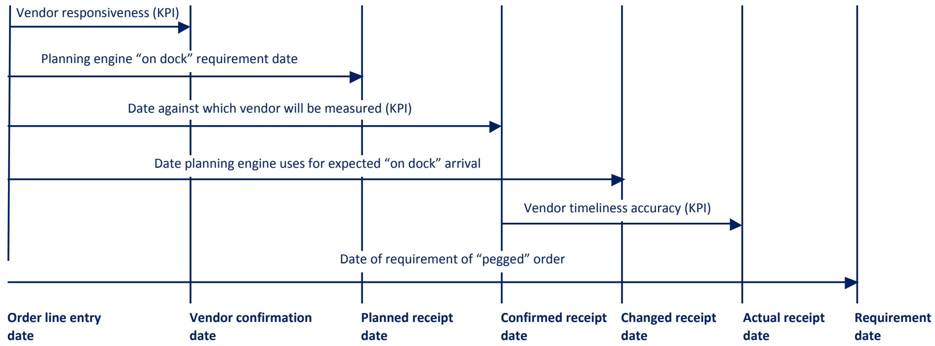
MRP is an effective solution to the extent that its outputs are derived from relevant and timely operations-related data. Purchase and production order dates are two key areas that can have significant impacts on MRP recommendations. These dates drive planning calculations, permit order status monitoring, and trigger vendor rating KPIs (key performance indicators).

Purchase Order Dates

The following list sets out some of the more common purchase order date requirements.

Purchase Order Date Line	Description
Order line (entry) date	The date the order is taken (entered into the system)
Vendor confirmation date	The date the vendor confirms receiving the PO
Planned receipt date	The date the product must arrive "on your dock"
Confirmed receipt date	The original date the vendor confirms he can get the product "on your dock"
Changed receipt date	The revised date the vendor reports the product will arrive "on your dock"
Actual receipt date	The date the product actually arrives "on your dock"
Requirement date	The date the product is needed for its "pegged" requirement

The following graphic illustrates the inter-relationship of purchase order line dates:



In general, an MRP system will calculate an additional purchase order-related date: the "current planned" receipt date. It does so by referencing the following entries:

- Changed receipt date, if not blank
- Confirmed receipt date, if not blank
- Planned receipt date (cannot be blank)

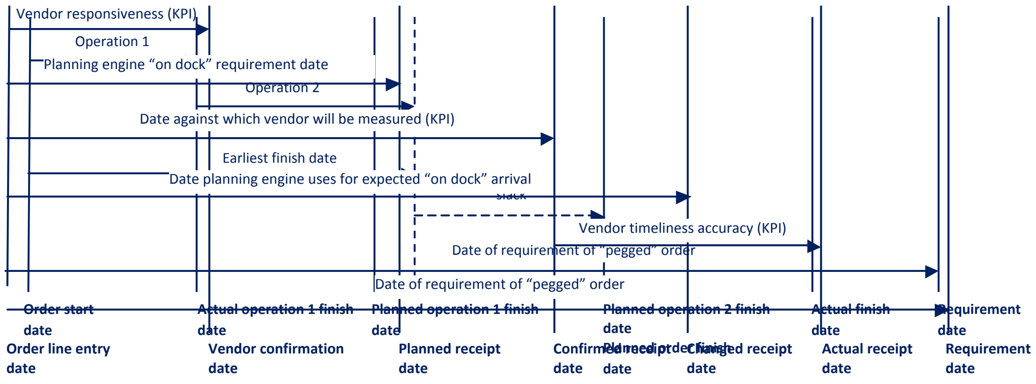
MRP relies on the current planned receipt date to generate reschedule-in (i.e. expedite) or reschedule-out (i.e. delay) recommendations. So, if the planning engine determines that a current planned receipt date is later than the requirement date, a signal to re-schedule the order line "in" is generated. And, conversely, a line that is scheduled to arrive too early is signaled with a re-schedule-out (i.e. delay) message.

Production Order Dates

Similar principles apply to production orders. A production order has its own series of dates, including the following:

- Order start date
- Planned finish date
- Earliest finish dateLatest finish date
- Actual finish date
- Requirement date

The following graphic illustrates the relationship of some production order dates:



From a business process perspective, it is critical that key data be inputted in a timely manner – as a product moves through production. The planning engine needs this data to calculate the earliest finish date and time (and related slack) for each operation in particular and for the entire work order in the aggregate. The engine also relates this information to the "pegged" requirement date of the work order for the purpose of generating signals to highlight early and late delivery of manufactured product.

Examples of key production data that require timely recording include the following:

- Shop labor: The actual labor cost accrued at a work order operation
- Operation quantity completed: The quantity of semi-finished product completed at the operation (and moving to the next operation)
- Operation completion status: The status of the operation (still active, completed, etc.)

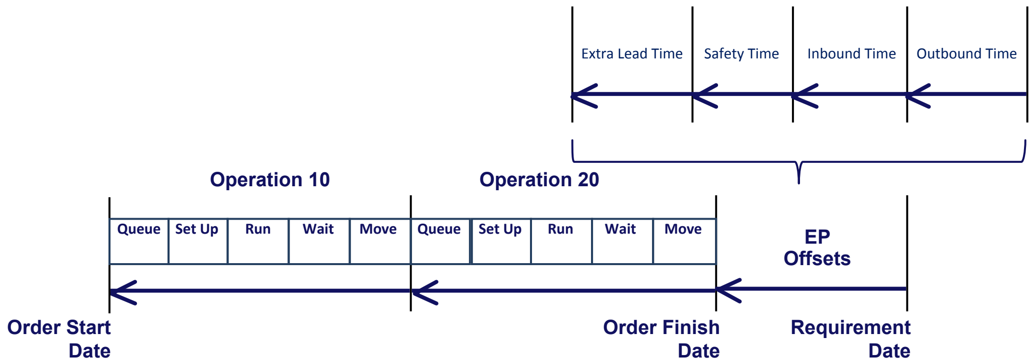
Increasingly, companies are investing in mobile technologies to facilitate real-time shop-floor and warehouse data collection. Mobile technologies such as barcode and RFID scanning give businesses opportunities to ensure that MRP has access to accurate, up-to-date data.

Production Routings

Routings represent the steps and associated times that are required to make an item. MRP relies on routings for several purposes, including the following:

- To calculate lead-times for replenishment planning purposes
- To create master production schedules
- To create capacity requirement plans
- To calculate the cost of an item, including production costs, set-up costs, and labor cost, among others

A typical routing is represented by a series of operational steps, each of which contains a task, associated lead times, and the next operational task in the production process. MRP relies on a standard routing to calculate an item's production time and cost. The following diagram depicts sample routing time components that are used to calculate lead times and costs:



The following table sets out certain common costing and lead-time requirements.

Sample Costing-Related Requirements	Sample Lead Time Requirements
Labor rate	Queue time
Machine rate	Set-up time
Overhead rate	Run time
Product standard batch size or economic order quantity (EOQ)	Wait time
Operation set-up time	Move time
Operation run time	Extra lead time
Man occupation	Safety time
	Inbound time
	Outbound time

Production Bills-of-Materials

The order modifier, routings, and order date requirements discussed above address the "when", "how", and "how much" questions of planning. The bill-of-materials (BOM) requirement answers the "what" questions of planning.

A BOM defines the structure of components that collectively make up a final product, assembly, or subassembly. A BOM can be either single-level or multi-level. A single-level BOM shows only those components that are directly required to make an item or assembly. A multi-level BOM - or indented BOM - shows multiple levels of breakdown. In this latter case, an item or assembly would be broken down into components, some of which may be sub-assemblies that are themselves broken down into components.

For present purposes, all BOM references relate to production BOMs, or PBOMs. PBOMs contain all components required to make an item, and are what MRP relies upon for planning and scheduling purposes. In contrast, an engineering BOM, or EBOM, is what engineers develop when they design a product and explode it into its components. Generally, EBOMs do not include certain items used in the manufacturing process, such as screws, nuts, and paint.

BOM accuracy is absolutely and uncompromisingly critical for MRP success. It bridges an organization's demand with supply. BOMs take actual demand requirements (e.g. finished goods) and explode them into supply requirements (e.g. components and materials). If BOMs are inaccurate, MRP will generate recommendations for the wrong supply, which can cause unnecessary inventory investments, production scheduling issues, or missed promise dates.

From the business process perspective, businesses should ensure that their BOMs are accurate. From a systems perspective, they should consider which of the following BOM requirements might be relevant when evaluating software alternatives.

Item	Description
Quantity Per (incl. units of measure conversion)	The quantity of the component required to build the parent item, and the ability to support the required units-of-measure conversions
Scrap Factor	The amount of the component item lost during the manufacturing process
By-Product and/or Co-Product	The ability to accommodate numerous outputs from a process independent of the number of inputs (more applicable to process manufacturers)
Routing Operation	The step in the manufacturing process (routing) where this component is required
Phantom Flag	For manufactured sub-assemblies, it determines whether the sub-assembly is built independently from or together with the parent assembly

Conclusion

To achieve MRP success, manufacturers should focus on two critical and related success factors: selecting the right MRP system and maintaining accurate data. In both cases, businesses need to have a clear understanding of their data requirements. On the one hand, these data requirements will put businesses in a position to assess the extent to which an MRP system will be capable of meeting requirements. On the other hand, they will give businesses an opportunity to define which data should be captured.

In the Expert's Guide to Successful MRP Projects, we defined key data and process requirements, including:

- Order quantity modifiers
- Lead time modifiers
- Purchase order dates
- Production order dates
- Routings
- Bill-of-materials

Although necessary, defining data requirements is not sufficient to drive MRP success. Other critical success factors include business processes that support timely data capture and achieving inventory accuracy rates of 95%.

Good luck on your MRP projects!

About the Author

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