Material Requirements Planning (MRP): demand-driven material planning in manufacturing

Material Requirements Planning (MRP) is the demand-driven planning and provisioning of materials, components and pre-products based on bills of materials, stock levels and dates. The method translates primary demand from customer orders or sales planning into concrete purchase and production proposals. For technical buyers, MRP is the backbone of operational procurement and determines when, in what quantity and from which supplier each requirement arrives.

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Key facts at a glance

01 MRP derives secondary and tertiary requirements from primary demand via bill of materials explosion.

02 Key figures are gross and net requirements, stock coverage, lead time and lot size.

03 MRP logics typically work deterministically, i.e. with fixed planning parameters.

04 Data quality of bills of materials, stock levels and delivery lead times determines the reliability of the results.

05 In practice, MRP today almost always runs as part of an ERP system with planning lists and exception messages.

Definition: Material Requirements Planning (MRP)

Material Requirements Planning refers to the systematic method for determining the quantitative and temporal requirement for materials and components in production.

Primary demand, secondary demand and bill of materials explosion

The starting point is primary demand: firm customer orders, framework agreement call-off orders or sales planning for finished products. From the bill of materials explosion, the secondary requirement for

components, raw materials and semi-finished goods is derived. For example, a wheelset manufacturer requires defined quantities of hubs, discs and fasteners per unit; MRP multiplies these quantities by the planned production volume and distributes them across the requirement dates.

- Primary demand: customer orders, call-off orders, forecasts
- Secondary demand: derived component and material requirements
- Requirement consolidation into order quantities via lot-sizing procedures

Net requirements and stock reconciliation

From gross requirements, the system deducts available stock, open purchase orders and plant stock. The result is the net requirement, i.e. the quantity that actually needs to be procured or manufactured. Blocked stock for spare parts or customer-owned material is excluded in the process. The net requirement forms the basis for purchase order release and production orders; it makes visible which items still require procurement activity at all.

Methods and approach of material planning

MRP follows a multi-stage process that is largely executed automatically by the system. The buyer is involved at interfaces such as planning parameters, supplier releases and exception handling.

Setting planning parameters

Planning parameters are maintained for each material master: procurement type (in-house production or external procurement), replenishment lead time, safety stock, lot-sizing procedure and planning blocks. In practice, the replenishment lead time typically includes a buffer above the supplier's confirmed delivery lead time in order to absorb variation. Dynamic safety stock extends fixed safety stock with fluctuation-dependent components and is suitable for supplied parts with strong demand or supply variability.

- Lot-sizing procedures: exact, fixed lot size, period demand, weekly demand
- Safety stock: static or dynamic based on demand and supply fluctuation
- Planning blocks for samples, maintenance spares or legacy parts

MRP run, planning lists and exception messages

The MRP run – often nightly or several times a day – compares demand, stock and supply dates. Results end up in planning lists: purchase proposals, shortage lists and the date list showing upcoming requirement and coverage situations. Exception messages such as future date overruns or under-covered requirements must be assessed and resolved by the planner. A clearly defined escalation process specifies from which value, level of significance and remaining lead time buffer procurement rather than planning takes over – for example in the event of supplier failure risk on critical components.

Call-off orders and demand alignment with suppliers

For series and framework volumes, MRP converts the net requirement into call-off orders against existing framework agreements. These call-offs are structured by quantity and time bands – often separated into fixed, semi-fixed and free bands. Aligning demand changes with the supplier is part of planning discipline: short-term increases beyond agreed tolerances should only run through a governed process, not through individual phone calls resembling maverick buying.

Key KPIs and success measurement in MRP

The quality of material planning can be measured using a few clear KPIs. They combine inventory costs, delivery reliability and data quality.

Delivery performance and inventory efficiency

Key metrics are the fill rate, i.e. the proportion of items delivered on time and in full, as well as inventory cover and the stocktake result. In addition, on-time delivery of procured materials and the number of planned versus unplanned orders count.

- Fill rate: proportion of requirements delivered on time
- Inventory cover: average days of cover per commodity group
- Share of unplanned demand as an indicator of planning quality

Data and process quality as a success factor

Without reliable master data, MRP produces incorrect proposals. Key control figures are therefore the completeness of bills of materials, the currency of stock levels and the deviation between recorded and actual replenishment lead time. Low data quality typically manifests itself in frequent reorders, excess safety stock and part shortages despite high inventory values. Regular master data maintenance cycles and clear responsibilities in data management are a must, not an option.

Risks, typical sources of error and controls

MRP only works as well as its input data and the discipline in exception handling. The most common sources of error are well known and can be systematically limited.

Incorrect master data and system circumvention

Outdated bills of materials, unrealistic replenishment lead times or safety stocks maintained on gut feeling distort every MRP run. In practice, circumvention through maverick buying adds to the risk list: requesters order directly from suppliers outside the system, and stock and demand no longer reconcile. Release workflows in the requisition process, clear ordering policies and a consistent escalation process for deviations help counter this.

Supply-side risks and forward positioning

MRP plans deterministically; unforeseen failures are only captured after the event. Critical pre-products with a narrow supplier portfolio therefore carry an elevated supplier failure risk. Countermeasures include dual sourcing for A-parts, contractual notification obligations in the event of force majeure, early supplier discussions when bottlenecks become apparent and a defined supplier escalation with tiered response levels. A contingency/scenario window in MRP – for example simulations with increased safety stocks for critical items – complements operational planning.

Planning cycles and handover points

Overly slow MRP runs, delayed demand notifications from sales and unclear handover points between sales, production and procurement create response disadvantages. Defined interface rules – such as cut-off deadlines for demand changes and defined responsibilities in the requisition catalogue – give all parties planning certainty.

Current developments: forecasting, data landscapes and integration

Classic MRP is increasingly being supplemented by predictive and data-driven elements. The core remains, but becomes better informed and faster.

Demand sensing and predictive planning

Demand sensing refines classic demand planning using short-term signals from orders, Kanban stock levels, throughput and consumption data. Instead of weekly and monthly forecasts, planning then relies on near-daily demand pictures. In practice, this typically shortens the lead time gap between sales planning and the procurement decision – for example for long-lead imported components with several months of replenishment lead time.

Data infrastructure and decision support

A data lake or comparable data landscape consolidates stock levels, movement data, supplier KPIs and market prices across system boundaries. From this, variability parameters for safety stocks, critical items and supplier selection models can be derived. Reliable data quality remains a prerequisite; without uniform material masters across sites and systems, any analytics remain superficial.

Integration into lean procurement and digital procurement

MRP as the planning core fits well with lean principles in procurement: clear net requirements, standardised call-off orders, digital transfers to suppliers and a minimum of duplicate data entry. Lean procurement here does not mean driving down inventory at all costs, but friction-free processes with defined goals: fewer follow-up queries, less manual maintenance, less firefighting in day-to-day planning.

Typical metrics

Metric	Typical value
Fill rate	> 95 % *Typical benchmark for requirements delivered on time; often set higher for A-parts.*
Inventory cover	30–60 days *Usual practical range for production materials, depending on procurement lead time and criticality.*
Master data quality	> 98 % *Proportion of complete and plausible material masters as a prerequisite for reliable MRP runs.*
Share of unplanned demand	< 10 % *Indicator of planning quality; high values point to sales or engineering interface problems.*

Practical example

A medium-sized mechanical engineering company with around 6,000 actively procured part numbers suffered from recurring part shortages and high safety stocks. The cause was less the MRP logic than the data foundation: outdated replenishment lead times, incomplete bill of materials changes and a lack of call-off discipline towards framework suppliers.

- Replenishment lead times calibrated on a sample basis against actual order history
- Dynamic safety stock introduced for the roughly 15 % of items with the strongest demand fluctuation
- Exception messages from the planning list converted into a tiered escalation process with clear responsibilities
- Call-off orders switched to fixed, semi-fixed and free time bands and aligned with suppliers

Conclusion

MRP is not a self-running solution but a process tool that only works with clean master data, disciplined planning parameters and clear exception paths. For buyers, it provides the quantity- and date-specific foundation of every procurement decision – from series call-off placement through to individual purchase orders. Combining it with demand sensing, robust supplier structures and a reliable data landscape elevates MRP from mere inventory calculation to active steering of material supply. Those who consistently measure the KPIs around fill rate, inventory cover and data quality identify weak points early and can take targeted corrective action. Combined with lean principles in procurement, MRP thus becomes the most effective lever for supply security at manageable inventory costs.

Frequently asked questions

? What does MRP mean in material planning?

MRP stands for Material Requirements Planning and refers to demand-driven determination of material quantities and dates. Net requirements are derived from primary demand, such as customer orders or call-off orders, via bill of materials explosion. These in turn generate purchase and production proposals with planned dates.

? What is the difference between MRP and ERP?

ERP is the overarching system landscape covering all corporate functions from finance and HR through to production. MRP is the planning logic within this system that plans material requirements and generates proposals. An ERP system can run several MRP logics simultaneously for different material classes and plants.

? How high should safety stock be in MRP?

Safety stock covers demand and delivery fluctuations within the replenishment lead time and is typically derived from statistical measures such as standard deviation and the desired service level. In practice, safety stocks often amount to one to several weeks of cover, depending on criticality and procurement stability. A blanket value is not meaningful; what matters is item-specific calculation with regular review.

? Which data is particularly important for MRP?

Reliable bills of materials, current stock levels including blocked and quality stock statuses, realistic replenishment lead times and correct lot-sizing procedures are central. In addition, call-off data from framework agreements and demand changes from sales and production play a role. Weaknesses in data quality directly lead to incorrect proposals and part shortages, even when the logic works correctly.

? How does MRP react to delivery delays?

MRP flags overdue orders in exception messages and pushes dependent requirement dates further back. The actual solution lies outside the logic: escalation with the supplier, use of alternative sources or short-term demand prioritisation. MRP therefore necessarily requires a defined escalation process and active supplier management.

? What is an MRP run and how often should it take place?

The MRP run is the systematic recalculation of requirements, stock levels and coverage situations for all or selected materials. Common practice intervals range from nightly to weekly, and for critical materials also several times a day. An overly infrequent run delays the response to changes; an overly frequent run increases system load and creates unrest in day-to-day planning work.

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