Certified in Planning and Inventory Management

MRP Road Map and Design

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MRP Road Map and Design

1. Purpose and Objectives of MRP

Material Requirements Planning (MRP) is a systematic approach to ensuring materials and components are available for production when needed. Its objectives include minimizing inventory, improving service levels, and synchronizing material flow with demand. Understanding MRP's role in converting the Master Production Schedule (MPS) into time-phased material plans is essential. MRP ensures organizations can meet demand efficiently, reduce stockouts, and avoid excess inventory. Mastering the purpose enables planners to align operational decisions with strategic goals and ensure that downstream processes receive accurate, timely signals.

2. MRP Inputs: MPS, BOM, and Inventory Records

The accuracy of MRP is heavily dependent on the quality of its three major inputs: the MPS, Bill of Materials (BOM), and inventory records. The MPS must be feasible and stable; BOMs must be complete and accurate (including levels and component relationships); and inventory records must reflect true on-hand, on-order, and allocated quantities. Understanding how these three inputs interact is essential for preventing shortages, unnecessary orders, and system nervousness. Reliable inputs ensure that MRP plans are trustworthy and executable.

3. MRP Logic and Explosion Process

MRP explosion expands the MPS into component requirements through the BOM structure. It determines how much of each lower-level component is required to

support planned production. Planners must understand offsetting logic, which adjusts requirement timing based on cumulative lead times. They must also grasp how gross-to-net calculations determine order quantities. Understanding this logic ensures planners can validate MRP outputs, troubleshoot errors, and maintain realistic supply plans.

4. Gross Requirements vs. Net Requirements

Gross requirements represent total demand for a component, while net requirements reflect actual replenishment needs after considering on-hand inventory, scheduled receipts, and safety stock. Planners must understand how MRP netting calculations derive the true replenishment need. This knowledge helps prevent over-ordering, stockouts, and inaccurate planning. Understanding netting also supports decisions on lot sizing, order release timing, and inventory policies.

5. Lead Time Offsetting and Scheduling

Lead time offsetting adjusts component requirements to appropriate time periods based on manufacturing, purchasing, or cumulative lead times. Planners must understand lead-time types—processing, waiting, queue, and transit—and how inaccurate lead times distort the MRP plan. Lead-time maintenance is critical for feasible schedules and timely component availability. Mastery ensures MRP produces realistic planned order release dates aligned with actual production flow.

6. Lot-Sizing Rules in MRP

MRP supports various lot-sizing methods such as Lot-for-Lot (L4L), Economic Order Quantity (EOQ), Period Order

Quantity (POQ), and minimum/maximum quantities. Choosing the correct method impacts inventory levels, capacity requirements, cost structures, and schedule stability. Planners must understand trade-offs between responsiveness, setup costs, and carrying costs. Proper lot-sizing design ensures optimal balance between inventory efficiency and production flexibility.

7. Time-Phased Planning and Bucketing

MRP uses time-phased buckets (daily, weekly, or monthly) to align material requirements with demand timing. Understanding bucket size, bucket change logic, and how scheduling within buckets works is essential for interpreting MRP output. Proper time-phasing supports capacity planning, vendor communication, and on-time material availability. Incorrect bucket definitions can distort material flow and lead to shortages or excess.

8. Low-Level Coding

Low-level coding assigns components to the lowest level at which they appear in any BOM structure. It ensures that MRP explosions occur in the correct sequence and prevents misaligned demand calculations. Understanding low-level codes is essential when restructuring BOMs, introducing new products, or modifying assembly processes. Without proper low-level coding, MRP calculations become inaccurate and unreliable.

9. Planned Orders and Order Release Logic

Planned orders are MRP's recommended replenishment signals, specifying order quantity and timing. Planners must understand the role of firm vs. unfirm planned orders, when

to convert them to purchase or work orders, and how to align releases with capacity constraints. Understanding this logic ensures procurement and production teams receive accurate instructions without unnecessary last-minute changes.

10. Scheduled Receipts and Open Orders
Scheduled receipts represent orders that have been placed but not yet received. Understanding how MRP incorporates these into netting ensures planners avoid duplication or shortages. Open orders must be managed, updated, and rescheduled based on system recommendations. Effective management reduces expediting costs, improves supplier performance, and maintains data integrity.

11. Safety Stock and Safety Time
Safety stock protects against variability in demand or supply, while safety time provides buffer in lead-time scheduling. MRP must balance these buffers with the need to minimize inventory. Excessive buffering distorts MRP signals, while insufficient buffering leads to shortages. Planners must understand when to apply safety stock, safety time, or both—and maintain appropriate parameter settings.

12. Handling Engineering Changes (ECNs) in MRP Design
Engineering changes affect BOMs, materials, routings, and components. MRP design must accommodate effective dates, phase-in and phase-out logic, and inventory depletion strategies. Poor ECN control causes mismatches between material requirements and production needs. Understanding ECNs ensures smooth transitions, reduces obsolescence, and prevents production errors.

13. MRP Exception Messages and Planner Action

MRP generates exception messages such as expedite, delay, cancel, increase, or decrease order quantities. Understanding how to interpret and prioritize these messages is crucial for maintaining an accurate and stable plan. Not all messages require action; planners must evaluate root causes before making changes. Effective exception handling enhances responsiveness and reduces system nervousness.

14. Pegging and Traceability

Pegging provides visibility into which orders or forecasts generated specific material requirements. It helps identify the origin of supply issues, prioritize responses, and support decision-making. Understanding pegging ensures planners can trace the impact of changes, manage customer expectations, and prevent unnecessary system reactions. Pegging is essential for troubleshooting and strategic planning.

15. MRP Data Integrity and Governance

MRP accuracy depends heavily on data integrity—accurate BOMs, inventory balances, lead times, scrap factors, and lot sizes. Maintaining clean data through governance processes ensures reliable planning outputs. Inaccurate data leads to stockouts, excess inventory, and production disruptions. Mastery of data governance ensures robust, predictable MRP performance.

16. MRP II Integration and System Architecture

MRP II extends MRP to include capacity planning, financial planning, simulation, and shop-floor control. Understanding

how MRP integrates with other modules—such as purchasing, inventory, and scheduling—enables planners to design cohesive, cross-functional planning systems. MRP II provides the foundation for modern ERP planning architectures. Mastery ensures better coordination across business functions.

17. Demand Types and MRP Behavior
MRP handles multiple demand categories: independent demand (MPS-driven), dependent demand (BOM-driven), safety stock replenishment, and forecast consumption. Understanding how each type behaves in MRP ensures correct planning logic and prevents misallocation of supply. Proper demand classification stabilizes the system and supports accurate replenishment.

18. Planned Lead Time Compression and What-If Analysis
MRP allows simulation of changes in demand, lead times, or capacity. What-if analysis helps planners evaluate alternate scenarios such as supplier delays or demand surges. Understanding how to adjust parameters and interpret results strengthens proactive decision-making and resilience. Scenario modeling enhances strategic readiness and supports S&OP alignment.

19. MRP Outputs and Reporting
Typical outputs include planned orders, exception messages, pegging reports, inventory projections, and time-phased requirements. Understanding how to read, analyze, and act upon these outputs is crucial for daily planning. Effective use of MRP reports enables planners to make

informed decisions, manage risk, and maintain supply continuity.

20. Continuous Improvement in MRP Design

MRP design is not static; it requires regular refinement based on performance metrics, data quality reviews, process audits, and operational feedback. Continuous improvement involves updating planning parameters, improving BOM accuracy, refining lead times, and enhancing scheduling rules. Mastery ensures the system evolves with business needs and delivers maximum value.

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