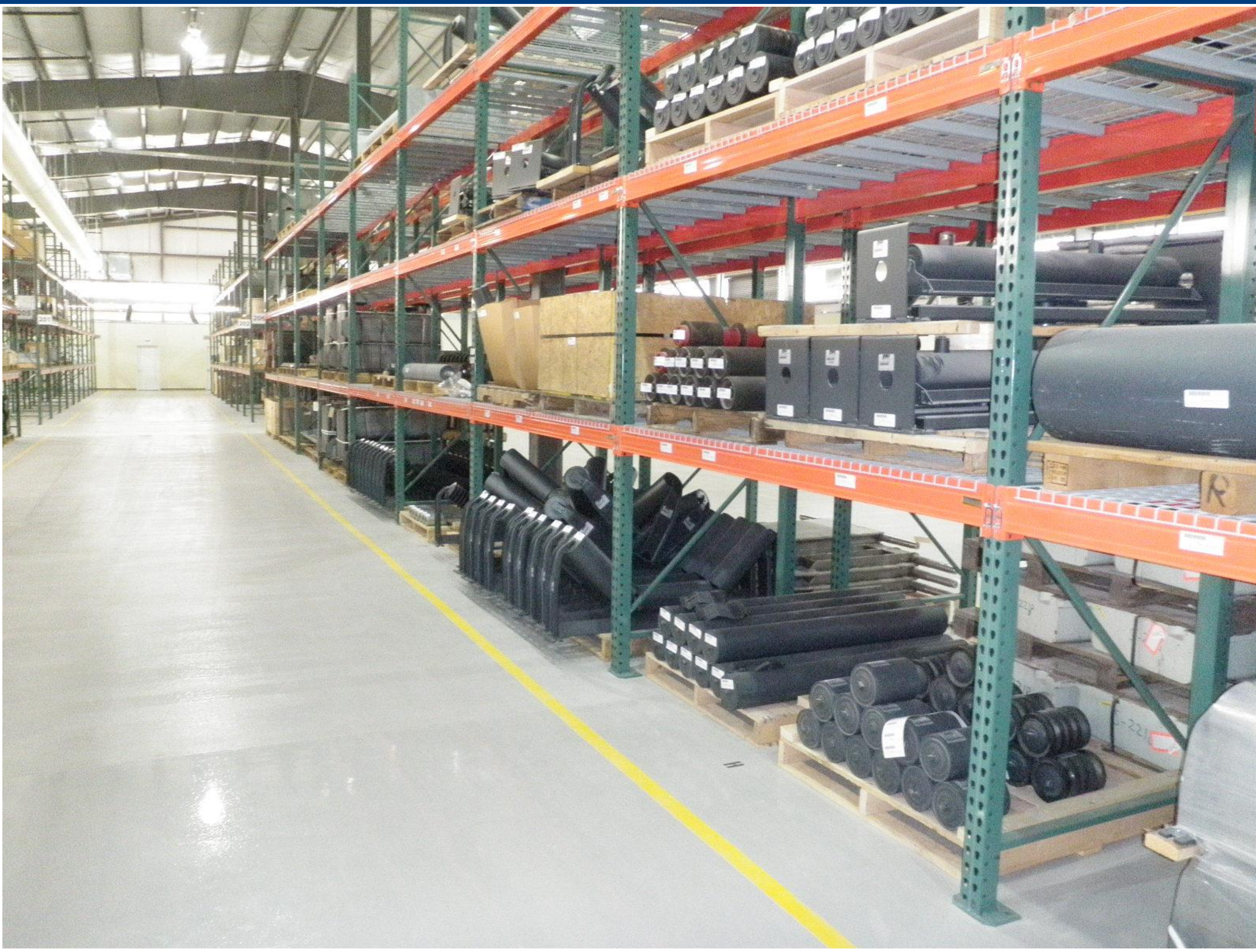
Materials Requirement Planning (MRP) Optimization

Business Process Recommendation

Holcim Group Support Ltd - Procurement



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Picture:

Front cover: Warehouse at Holcim (US) Inc. Ste. Genevieve plant

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Executive Summary

Holcim operating companies (OpCos) can optimize their inventory levels and increase their overall equipment efficiency (OEE) by choosing the right inventory stock strategies. Keeping large amounts of inventory at the plant may ensure availability of materials at all times, but it can also easily entail inefficient processes. Conversely, a low inventory volume may reduce carrying costs but can impair availability of required materials. This conflict of objectives is exacerbated by uncertainties in demand and related planning activities.

When properly set up, materials requirement planning (MRP) is a system that comprises all the activities necessary to provide an OpCo with the optimal required amounts and types of materials at the right time. The main objective is therefore to increase inventory service levels with optimum stock amounts.

The core goal of a materials requirement planning (MRP) system is to balance the following objectives:

- To optimize the inventory service level;
- To optimize the availability of materials;
- To minimize the warehouse stock levels (when excess is detected); and
- To optimize the logistics costs.

This business process recommendation (BPR) aims to support the achievement of these goals, describing the different components of the MRP system and providing recommendations on how to sustain an optimal MRP strategy.

As of January 2011, 19 Holcim OpCos have successfully completed the Net Working Capital development program through which the review and enhancement of the MRP system resulted in improved inventory management and materials availability and reduced inventory costs and potential risks.

Holcim OpCos should use this document to evaluate and assess their MRP system processes and inventory stock strategies in order to detect areas for improvement that will positively impact inventory management and service level.

As with any other BPR, we encourage your feedback so as to be able to continue improving this document.

Introduction

Overview

In 2010 the Holcim Group reported a total of USD 1.3 billion as inventory[1] in direct materials (raw materials and additives, fuels) and indirect materials (parts and supplies). Thus, efforts to optimize inventory levels will have considerable impact on the Net Working Capital performance of Holcim.

Some of the issues faced by OpCos related to inventories can be summarized as follows:

- High amounts of inventory value tied up in low-rotation materials;
- Obsolescence;
- Excess inventory;
- Low inventory and warehouse service level (e.g. low confidence in inventory quantities or quality for usage);
- Materials stored in warehouse under poor conditions; and
- Significant amount of emergency purchases.

With the aim of providing guidance to overcome these issues, this business process recommendation focuses on the following topics:

Chapter 1	MRP process and scope definition;
Chapter 2	The process for defining the Stock Strategy using a qualitative and quantitative methodology;
Chapter 3	Overview of the main MRP parameters;
Chapter 4	Program planning and order conversion stages; and
Chapter 5	Recommendations on how to detect areas for MRP system improvement through the monitoring and controlling of inventory levels.

Link to business process recommendations

This recommendation is one of a number of business process recommendations (BPRs) that have been established by Holcim Group Support (HGRS). This document complements the following BPRs:

- "Inventory Management BPR"
- "Unclassified Spend Analysis BPR"

OpCos can find these and other procurement-related BPRs on the Holcim Portal through the link "Business Process Recommendations"

This BPR also complements the Holcim Procurement Handbook (HPH) V.5.0, Chapter 4 and 5.2.

[1] Source: Holcim Ltd Annual Report 2010

Target audience

This recommendation applies to all personnel in the Holcim Group who may be involved in the material replenishment process and material master data management, such as:

- Material master data administrators;
- Procurement, inventory management and warehouse staff; and
- Production staff (e.g. planners) involved in planning.

Development and revision

This recommendation has been developed by HGRS Procurement with contributions from experts at OpCos and IT service centers.

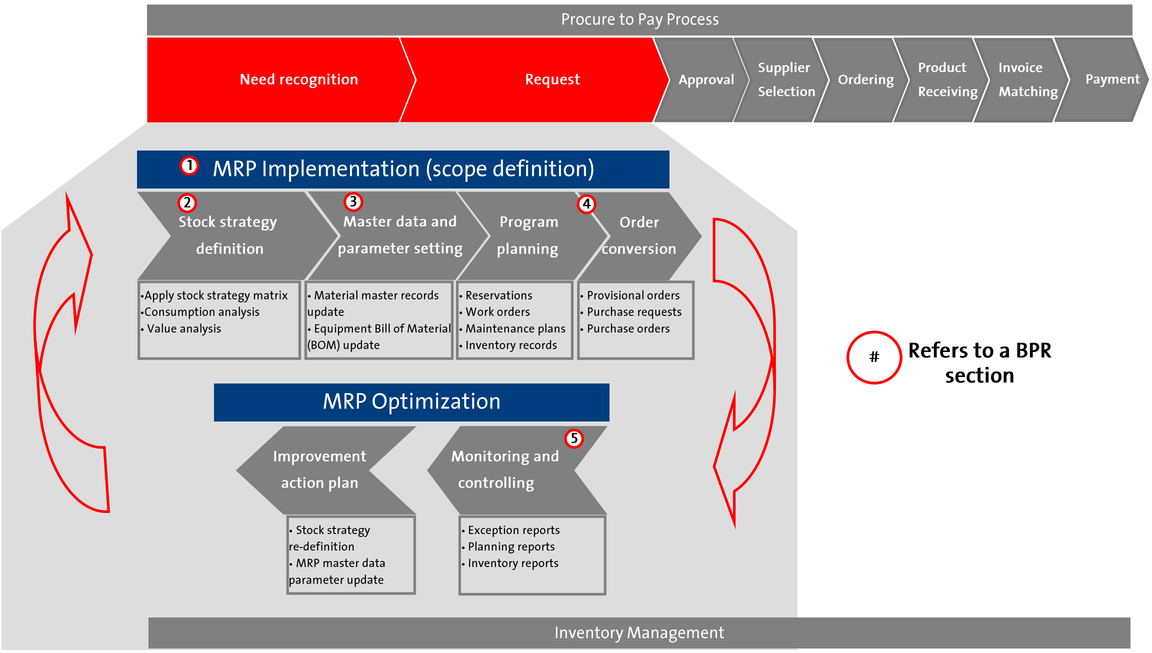
Change management

As with any other recommendation, this document will require updating over time. Suggestions for changes should be sent by e-mail to procurement@holcim.com.

1. Materials requirement planning (MRP) process

The MRP process has a direct impact on procurement activities (see figure below), as the execution of MRP triggers the purchasing process. The main MRP process steps are:

- MRP scoping and definition;
- Stock strategy definition;
- Material MRP master data and parameter setting;
- Program planning;
- Order conversion (MRP execution);
- Monitoring and controlling; and
- Improvement action plan.

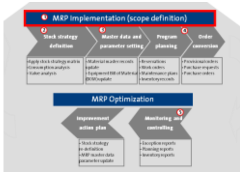


MRP processes involve the review and analysis of system-generated proposals for the replenishment of inventoried materials and the initiation of the subsequent procurement process. This includes the maintenance of material master data parameters that control replenishment determination.

It should be considered that MRP works best when:

- Documents related to materials (e.g. work orders, purchase requisitions, purchase orders) are processed in a timely manner and **duly closed.**
- Material records use a standard master data structure (e.g. naming convention);
- A proper bill of materials (BOM) is in place for equipment;
- There is a relatively good certainty of the production/maintenance planning horizon;
- Maintenance planning is accurate;
- Material descriptions are compiled properly and are complete; and
- Lead times for materials are accurately calculated and have low variance.

[2] Details described in the Holcim Procurement Handbook (link)



1.1. <u>MRP and inventory management optimization</u>

The core goal of a materials requirement planning (MRP) system is to balance the following objectives:

- To optimize the inventory service level;
- To optimize the availability of materials;
- To minimize the warehouse stock levels (when excess is detected); and
- To optimize the logistics costs (reduce replenishment times).

In order to facilitate the achievement of these objectives, it is essential that materials requirement planning is done in cross-functional collaboration (e.g. Procurement, Warehouse, Operations), as all these roles provide relevant information for proper setup of the system.

1.2. <u>MRP scoping and definition</u>

MRP is a system that comprises all the activities necessary to provide the optimal required amounts and types of materials at the right time.

An analytical process is needed during implementation of the MRP system because there may be lack of historical data, insufficient knowledge or, simply, limited resources and time. Also, often a systematic decision-making process (like the one described in Chapter 2), supports the implementation of MRP.

The nature of the demand (independent or dependent) plays an important role in determining the requirement for materials; hence materials planning must be flexible so that it can be adjusted to meet the needs of different materials with different types of demand.

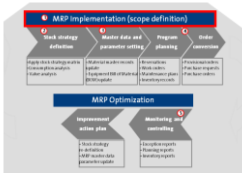
The first step of any MRP implementation or optimization process it is to identify the type of demand for each material or group of materials. For this purpose, the various types of demand are defined as follows:

1.2.1. **Independent demand:** Independent demand is demand that is not linked to or caused by the demand for another material. This demand normally is erratic and follows consumption patterns that are not predictable or that are difficult to predict.

At Holcim, materials such as personnel protective equipment (PPE) are materials with independent demand.

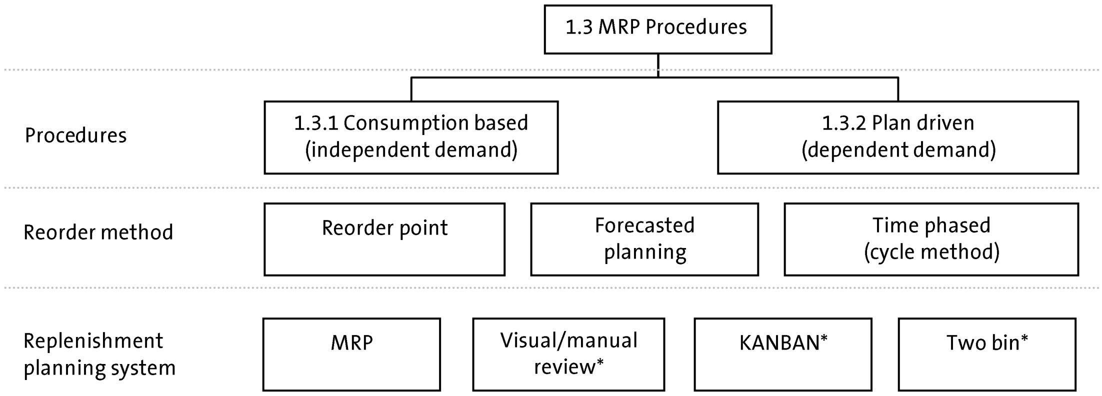
1.2.2. **Dependent demand:** Dependent demand is linked to or caused by the demand for another material. Materials with dependent demand are required as dictated by other materials planning activities, such as those of maintenance or production.

At Holcim, limestone, fly ash, and some solid fuels such as coal and petcoke are examples of materials with dependent demand. Certain spare parts that are part of an equipment bill of material (BOM) can also be considered materials with dependent demand since they depend on planned maintenance activities.



1.3. MRP procedures

MRP procedures depend on the nature of the demand, which will affect the reorder method to be used by MRP. The chart below summarizes these procedures and the different reorder methods that can be used.



* Definitions can be found in the Inventory Management BPR

1.3.1. **Consumption based:** The MRP procedure for independent-demand materials is based on material consumption patterns. For consumption-based materials it is necessary to regulate both when the material requirement is to be channeled through a purchase order (PO) (order date) and the quantity of material to be ordered (PO quantity or lot size). The combination of a fixed or variable PO quantity and fixed or variable PO period determines the right requirement. This concept is generally known as the “reorder policy.” Definitions and examples of the reorder policy can be found in Annex 3.

1.3.2. **Plan driven:** The MRP procedure for dependent-demand materials is based on planning activities based on the bill of materials (BOM) explosion for production materials or for maintenance activities that generate planning-related interdependencies (e.g. work orders, material reservations, purchasing orders).

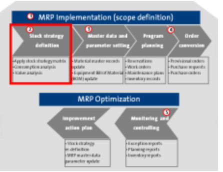
There are three different reorder methods that can be used with any of the two MRP procedures described above:

Reorder point (ROP): the system verifies whether the stock available is below the ROP determined for the material. If the stock falls below the established ROP, a replenishment process is triggered.

Forecast planning: a forecast based on historic consumption values is used to estimate future requirements and trigger a replenishment process according to the forecast.

Time-phased planning: this system is used for materials with defined demand periods within a certain time horizon. This method is also called “cycle method.” The replenishment process is triggered in synchronization with defined periods.

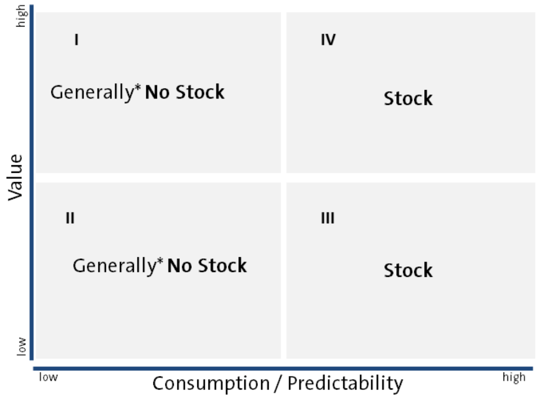
The outcome of this first step is the understanding of different demand types, enabling the establishment of the proper MRP process and reorder methods. This will facilitates the selection of the optimum MRP parameters in later stages.



2. Stock strategy definition

It is essential that the correct MRP parameters are set for each material in order to obtain optimum results from the implementation and execution of MRP.

As defined in the Holcim Procurement Handbook, the Stock Strategy Matrix (SSM) can be used to select the proper stock strategy for each material or group of materials.



* Exceptions may be found e.g. critical spare parts from FMEA or Risk analysis

According to the definition of the SSM, once materials are mapped into the matrix, the quadrants help to determine whether a material should be kept in stock.

The Pareto principle combined with ABC and XYZ analyses is highly recommended in order to properly apply the Stock Strategy Matrix. Both analyses, ABC and XYZ, are defined and explained in the Inventory Management BPR.

2.1. Applying the Stock Strategy Matrix

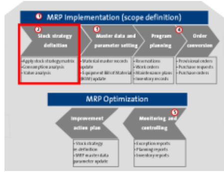
This section describes the key process steps to be followed in order to establish a proper MRP system based on the SSM.

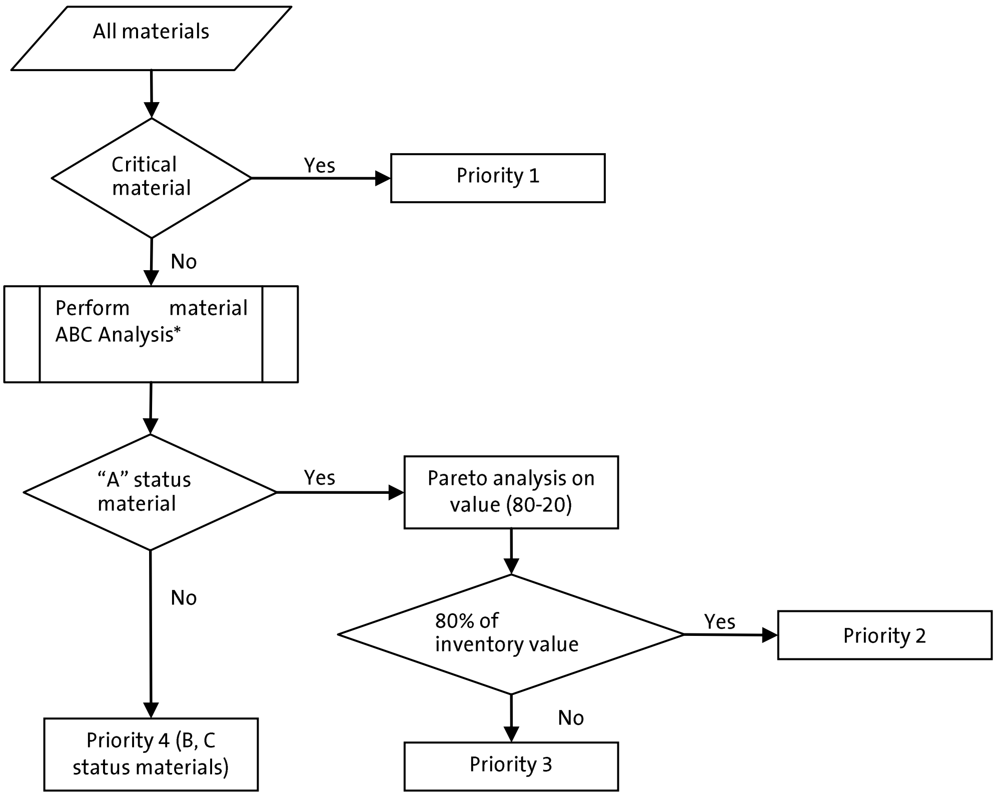
It is recommended that the application of the Stock Strategy Matrix be prepared by a cross-functional task force comprising Operations, Warehouse and Procurement staff, as all of these functions provide relevant decision-making information.

2.1.1. Defining priorities

In order to assess and optimize MRP parameters, materials should be grouped (listed) for prioritization and further analysis.

The following decision tree is recommended for defining the priority and sequence of materials or groups of materials to be analyzed and for setting their MRP parameters.





*ABC analysis definitions and implementation process can be found in the Inventory Management BPR

2.1.1.1. Recommended actions by priority

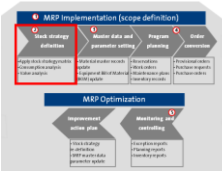
Priority 1

1. Select those materials already identified as critical materials;
2. Include them in Quadrant I of the SSM (or in Quadrant IV if high consumption is detected), regardless of the limits defined;
3. It is recommended that the stock strategy for these materials be defined by a risk analysis assessment and/or the failure mode effect analysis (FMEA)[3]; and
4. Define and select MRP parameter combinations as required. Chapter 3 includes a description of the main MRP parameters to be considered and defined by the cross-functional team.

Priority 2

1. For non-critical materials, perform an ABC analysis[4] and select those materials defined as type A;
2. It is recommended that type "A" materials be split into a second group based on the Pareto principle, whereby further analysis is focused on the materials that represent 80% of the total inventory value under analysis.
3. In coordination with Operations and Procurement staff, plot each material in the SSM (see Section 2.2.2 for details on how to define the boundaries); and

[3] Information on FMEA can be found on the Holcim Portal (link)
[4] ABC analysis definitions and implementation process can be found in the Inventory Management BPR



4. Define and select the MRP parameters in cross-functional collaboration. Chapter 3 includes a description of the main MRP parameters to be considered.

Priority 3

1. Once Priority 2 materials have been mapped and the parameters selected, proceed with the materials defined as Priority 3 (the remaining 20%) by following Steps 3 and 4 as described under Priority 2.

Priority 4

1. Once the parameters and settings for the materials allocated to the previous priorities have been discussed and established, the actions and steps defined for Priorities 2 and 3 should be applied to Priority 4 materials (B & C materials).

2.1.2. Defining boundaries

The next step is to map each material or group of materials correctly onto the SSM. For this task a material list, ordered by priority, needs to be prepared and the boundaries (limits) established for each quadrant of the SSM. Following are recommendations for defining the boundaries:

2.1.2.1. Download material lists

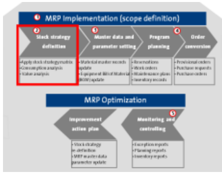
For each of the defined priorities, a list of materials must be downloaded from the ERP system (e.g. SAP) and organized in a file containing the following information for each material.

a. Material ID code;
b. Material description;
c. Material group (PCS) description;
d. Total stock amount;
e. Unit of measure;
f. Unit value;
g. Total inventory value;
h. Criticality of material; and
i. ABC analysis status.

Here is a sample list extracted in the proposed manner:

Material ID code	Material Description	Material Group (PCS) description	Stock Amount	Unit of measure	Unit Value	Total Inventory Value	ABC Status	Critical
408000003123	REF;BRICK;ANKRAL Z1;VDZ;B322	040106 Magnesia Bricks	12,640.00	EA	669.05	8,456,845.50	A	
408000003124	REF;BRICK;ANKRAL Z1;VDZ;B622	040106 Magnesia Bricks	6,300.00	EA	615.22	3,875,855.20	B	
408000000517	REF;BRICK;MAGNESIA MA-SPINAL;VDZ;B318	040106 Magnesia Bricks	4,354.00	EA	571.75	2,489,416.08	C	
408000004205	REF;BRICK;MGOS;VDZ;B-618 ANKRAL-R1	040106 Magnesia Bricks	5,832.00	EA	348.19	2,030,672.33	A	X
408000000116	REF;BRICK;ANKRLZ1;425;250X198X103/91.50M	040106 Magnesia Bricks	2,000.00	EA	996.20	1,992,397.99	A	
308000091440	BALL;DW:LP/CO-M/2005/03	040404 Wear part for Mill	10.00	EA	184576.55	1,845,765.45	A	
408000003571	GRINDING MEDIA;90MM; HI CROME;SPHERICAL	040203 Grind Ball Stel Cast	222.00	QNT	8209.33	1,822,471.26	A	X
408000007751	IMP;REF;ANKRAL ZC-CB B322;MAKE:RHI	040106 Magnesia Bricks	4,480.00	EA	387.65	1,736,690.88	B	
408000002917	REF;BRICK;ALMAG 85;B-322	040106 Magnesia Bricks	2,350.00	EA	715.68	1,681,840.00	B	
408000004206	REF;BRICK;MGOH;VDZ;B-322I ANKRAL-ZE	040106 Magnesia Bricks	2,600.00	EA	615.56	1,600,457.36	B	X
408000000065	REF;LCC;HYDR;ACCMON-CAR	040109 Castables	30,000.00	KG	41.93	1,258,007.68	C	
458000016305	BAG;D/C;150X4267MM;CO POLYMER ACRYLIC	040701 Filter Bags	1,000.00	EA	1154.96	1,154,962.38	C	
408000004095	GRINDING MEDIA;25;HI CR;SPHERICAL	040203 Grind Ball Stel Cast	160.00	QNT	7157.88	1,145,260.14		
408000002916	REF;BRICK;ALMAG 85;B-622	040106 Magnesia Bricks	1,600.00	EA	702.96	1,124,735.54		
408000000115	REF;ANKRLZ1;825;250X198X103/91.50MM	040106 Magnesia Bricks	1,100.00	EA	996.20	1,095,824.43		
408000007752	IMP;REF;ANKRAL ZC-CB B622;MAKE:RHI	040106 Magnesia Bricks	2,720.00	EA	387.33	1,053,527.85		
458000014115	TYRE;OFF ROAD;29.5IN.WIDTH;25IN RIM DIA	041101 Tire-Off-RoadMo.Eqpt	3.00	EA	335245.67	1,005,737.01		
308000182698	GRATE PLATE;DW:LP/GC/2005/29;IS:4522 GR9	030526 Plates	180.00	EA	5508.00	991,440.00		
408000003283	REF;BRICK;MGOH;VDZ;B-622I ANKRAL-ZE	040106 Magnesia Bricks	1,460.00	EA	615.79	899,049.01		
408000000356	REF;BRICK;ANKRLZE;425;250X198X103/91.5	040106 Magnesia Bricks	1,200.00	EA	721.00	865,197.75		

Since boundaries may vary for each material or group of materials, it is recommended to segment (split) the priority lists for each material group (PCS) and define the different boundaries for each material group.



2.1.2.2. <u>Value threshold</u>

The vertical axis of the SSM is the material unit “$ value” that indicates the level above or below which a material should be considered “low value” or "high value". This value can be defined as the simple average of the unit values under consideration, selecting this value as the limit.

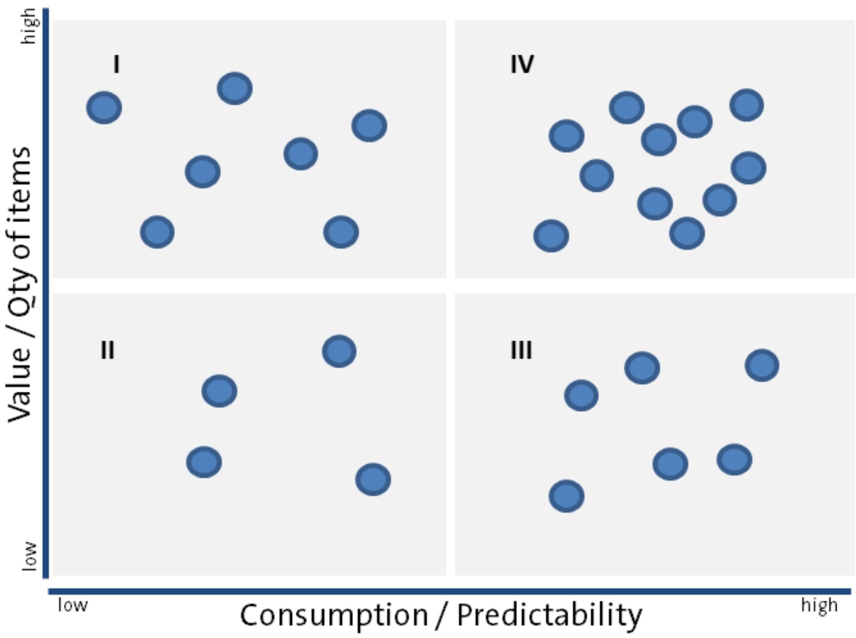
2.1.2.3. <u>Consumption thresholds</u>

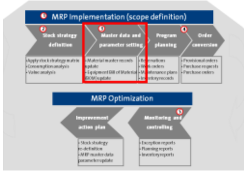
The horizontal axis of the SSM is the consumption rate for each material, calculated for a fixed period of time (e.g. yearly). High or low consumption limits are to be defined using the material master historical consumption rates within the same time frame. The threshold setting can be made using either of the following options:

- The cross-functional team selects a representative value for **all the materials or groups of materials** as the threshold between high and low consumption; or

- The cross-functional team assesses **each material** and establishes the consumption rate as either “high" or "low” based on historical data.

Once the limits have been selected, each material or group of materials will need to be assessed and mapped onto the SSM according to the scope and limits defined. The map for each group assessed will appear as follows:





3. MRP parameter setting

Once the materials have been plotted on the SSM, the selection and setting of MRP parameters should be completed and added to the material master record.

Data integrity (completeness of data) is required for the MRP system to yield good results. Any inaccuracy in the inventory master data or bill of materials (BOM) data will most likely result in incorrect output data.

Parameters that need to be maintained or updated during an MRP optimization process are described below.

It is recommended that all parameters be kept as material-specific as possible. This can be achieved once the materials have been mapped onto the SSM following the steps given in the previous section.

3.1. Specific MRP parameters

These are the main parameters that impact the results of the MRP execution. The values and settings for each parameter should follow the definitions and general rules given in Annex 1. The main parameters to be considered are:

MRP type: This parameter determines whether and how the material is planned. See Annex 1 for the definitions of each of the different types of MRP available. Additionally, a reference table is given in Annex 2 to evaluate different combinations of this parameter with others, such as with lot size.

This parameter must be maintained for all materials that have been selected for planning with MRP.

Reorder point (ROP): This parameter determines the point (stock level) below which replenishment should take place. See Annex 1 for a definition and ROP calculation.

MRP controller: This parameter specifies the code assigned to the MRP controller responsible for materials planning.

Lot size: This parameter determines the quantity of materials to be ordered by purchasing event. See Annex 1 for a definition and different lot size options. Annex 2 also includes a reference table for evaluating the various combinations of this parameter with others.

In order to optimize overall costs[5], two aspects should be considered. The first is to combine several requirements in one lot that covers several periods of consumption in order to reduce ordering costs (purchase order and logistic costs). The second aspect to consider is that higher storage costs may be incurred if lots are combined into one lot size, since quantities procured earlier than actually required have to be stored.

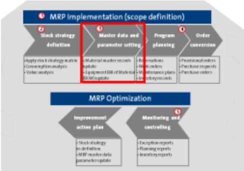
When selecting the minimum or maximum lot size, it is recommended that the lot size be calculated using the Economic Order Quantity (EOQ[6]) model.

Lead time: The total replenishment lead time is measured from the time the requirement is triggered to the time the material is received and ready for use. See Annex 1 for the definition of lead time and the different components.

Safety stock: Specifies the quantity required to accommodate demand variability in the period. See Annex 1 for a definition of safety stock and details of how to calculate it.

It is recommended that safety stock be calculated and set according to the service level defined for the material. The risk of shortfalls is reduced by having safety stock.

[5] E.g. purchasing costs, warehousing costs
[6] See EOQ definition on page 26.

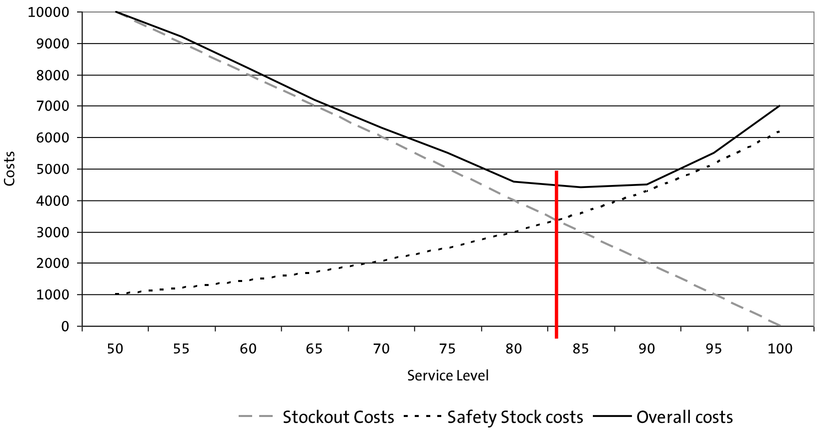


Service level: Service level is an expression of the ability of a process to deliver satisfactory results, expressed as a percentage value.

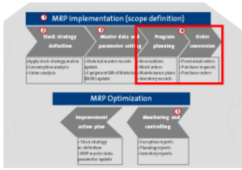
For inventory management, in the case of unexpected demand-related variation, this parameter specifies the desired probability that a chosen level of safety stock will prevent a stock outage.

This parameter criterion provides important information for setting the safety stock parameter (see safety stock calculation formula in Annex 1). For example, when reliable suppliers are available for a specific material, safety stocks can be kept low. When selecting the service level it is important to be aware that the higher the service level selected, the higher the cost of safety stocks.

Ultimately, the goal is to ensure that the service level is set at the point where the safety stock costs (carrying costs) equal the stock-out costs, so that the overall cost is minimized. See figure below:



A 100% service level cannot be achieved; furthermore, setting this as a target may lead to disproportionately high stocks, hence high carrying costs. Therefore, it is recommended not to set the service level at 100%, as this may oppose an optimization opportunity.



4. MRP planning and order conversion

This section introduces the main tasks of the MRP controller/planner and provides some recommendations on how to set up the MRP planning and order conversion processes.

4.1. MRP controller

In order to coordinate and monitor the materials flow more effectively, it is recommended that an MRP controller be established. An existing function in the organization could be nominated as MRP controller. This role is responsible for executing the MRP, responding to requirements by building up stocks of materials or directly initiating their procurement. This position is responsible for ensuring a high level of availability with a low level of tied-up capital (inventory).

The main tasks to be performed by the MRP controller are as follows:

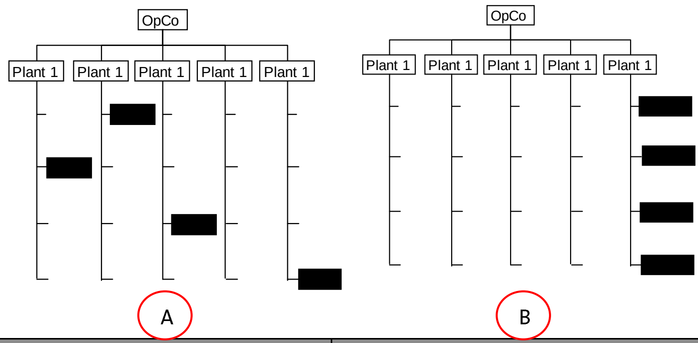
- Serving as a link between functions (e.g. Purchasing, Operations);
- Maintaining MRP material master data;
- Monitoring materials planning;
- Executing materials planning;
- Analyzing materials planning on a qualitative and quantitative basis; and
- Ensuring the closing of outstanding open objects (e.g. purchase orders, reservations, and work orders).

It is recommended that MRP controllers be responsible and accountable for the planning of a limited amount of materials. Responsibilities can be divided up either by priority or by material group. For instance, the warehouse or inventory manager could be assigned an MRP controller code, and all common, high-rotation, low-value materials could be set with this code. These materials would then be planned centrally for the whole plant. Specific and equipment-related materials (e.g. high value, low or high consumption) would be assigned to another MRP controller.

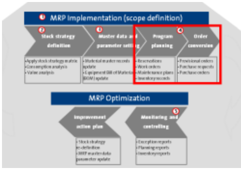
4.2. MRP execution formats

MRP can be executed in either a centralized or a decentralized form. The following chart summarizes and compares the advantages and disadvantages of the two different scenarios.

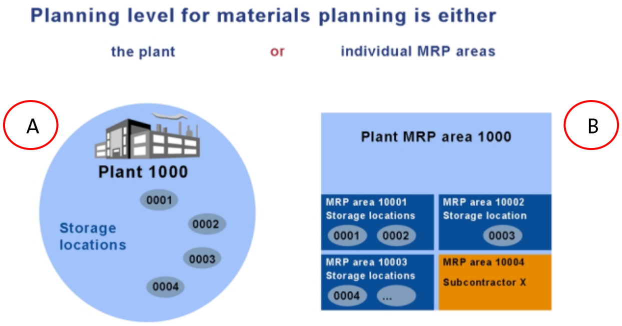
The recommended scenario will depend on the evaluation of the specific local situation and the availability of resources at OpCo level.



Criteria	MRP planning fully centralized, Plant level	MRP planning decentralized, Department level
Flexibility	Low	High
Speed of changes	Low	High
Coordination efforts	High	Low



Materials' planning is generally carried out at plant level, taking all available stock in the plant into account during planning. However, stocks from individual storage locations can be excluded from requirements planning or they can be planned independently.



Source: SAP R/3 MRP manual

In addition to these execution formats, is recommended to consider the concept of the **virtual warehouse**, which is an inventory management concept that can be used when demand and inventories from two or more sites can be consolidated. Geographical conditions and common systems (e.g. common SAP) allow such consolidation.

In this case, the MRP parameters for materials shared or consolidated by several plants should be predetermined jointly by all targeted OpCos/plants that will be supplied by the virtual warehouse.

The predetermined parameters are then set in the system but only for the OpCo/plant that will stock those shared/consolidated materials.

Based on identified good practices, the main steps of the process for managing MRP in a virtual warehouse are the following:

1. Define materials (item by item) to be virtually consolidated.

2. Define a geographical place/site (OpCo/plant) where each selected material will be stored.

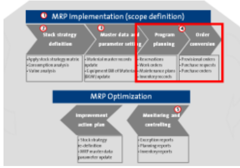
3. Set the MRP parameter only in the system of the selected OpCo/plant where the materials will be stored (see Step 2). The selection of the MRP parameters for the material to be set in the system has to take into consideration the demand patterns of all participating OpCos/plants.

4. The system must enable the requirement planning and stock selection (e.g. place reservations) at all the geographical places/sites (OpCos /plants). This can be done by providing access to and visibility of the shared and common stocks of the selected materials at each location.

5. Execute MRP only at the OpCo/plant where the materials are kept in stock and the MRP setting has been defined. The system will consider all the planned reservations by all other plants and the replenishment will be triggered according to all these requirements.

Additional definitions of this concept can be found in the Inventory Management BPR.

As a reference, Holcim has established the Holcim Spare Parts On-line search engine (link) to easily locate specific critical parts being used or stored throughout the Holcim Group, in order to identify opportunities for inventory sharing.



4.3. MRP execution frequency

MRP can be executed at a frequency that fits the planning needs and depends mainly on variables such as:

- Resources available; and
- Amount of materials to be planned.

The main frequencies available to be considered are
- Daily (d);
- Weekly (w);
- Monthly (m); or
- Flexible periods (f)

In order to establish the best MRP execution strategy, it is recommended to perform an analysis combining the execution format/frequency and the reorder policy summary table described in Chapter 1.

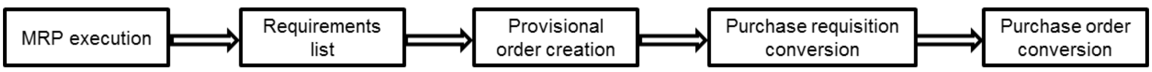
The **weekly** format is highly recommended; experience shows that it provides a manageable time frame for analysis even when high amount of materials are to be planned through MRP.

4.4. MRP order conversion

In the SAP system, MRP can be configured/customized to have different outputs when executed, such as:

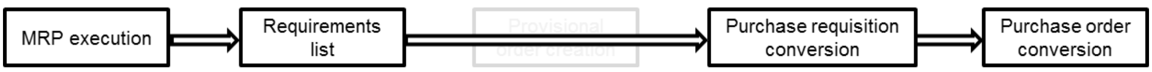
- Provisional orders: These are merely system-generated estimates of material needs based on current MRP parameter settings and current stocks. Once the amount is validated, these provisional orders can be converted into purchase requisitions or purchase orders; otherwise they can be ignored and not processed.

  This configuration is recommended when MRP is implemented for the first time, when material requirements must be monitored closely, or when there is uncertainty about current MRP settings. This configuration tightens the control level and avoids unnecessary purchase requisitions or overstocks.



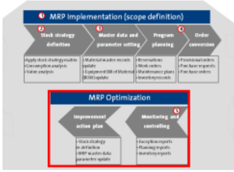
- Purchase requisitions (PR): With this configuration, the system creates purchase requisitions once MRP runs. It can also be customized to allow the modification of final amounts if MRP is run manually.

  This configuration is recommended when MRP is run manually, not automatically, since additional work (e.g. converting provisional orders into PRs) can be avoided by modifying the requested amounts prior to the release of the PR.



- Purchase orders: This configuration will create a purchase order directly once the MRP is run. This reduces the workload since no interim steps or validation processes are required for the material requests.

  This configuration is recommended when materials run through MRP have been properly assessed and the parameter selections are accurate. These materials must have a contract in place where the source of supply (supplier) is available with pre-agreed terms and conditions.



5. MRP monitoring and controlling

This section introduces various analysis reports recommended for controlling materials planning. These reports can help to monitor and control the impact of MRP on materials planning.

It is fundamental that these reports be generated and analyzed with a certain frequency (e.g. monthly) in order to ensure a **sustainable MRP optimization process.**

5.1. MRP list and stock/requirements list

In MRP execution, this is the first report used to analyze the current stock/requirements; this report allows the MRP controller to assess the current planning situation or the result of an MRP execution. The system gathers the various types of materials planning information from the following sources:

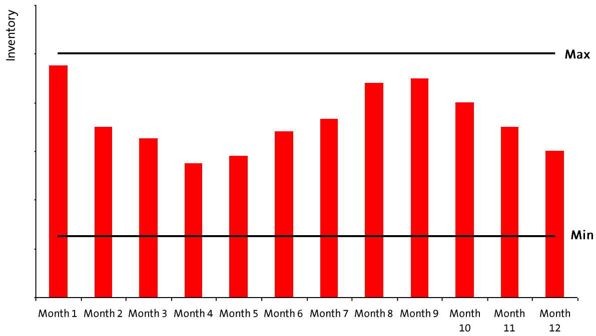
- Planned orders;
- Purchase requisitions;
- Purchase orders;
- Schedule agreements
- Stock reservations; and
- Stock levels.

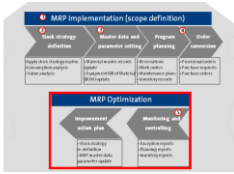
5.2. Maximum-Minimum stock value analysis

This analysis is intended for monitoring and tracking the stock value trend of materials ordered using MRP.

The steps involved in this analysis are as follows:

- Select an analysis period (last 12 rolling months is recommended).
- List all materials, or groups of selected materials, planned through MRP along with the following information:
  - Actual material stock value
  - Actual maximum stock value (upper limit) set in the system
  - Actual minimum or safety stock value (lower limit) set in the system
- Total each of the above values.
- Create a graph that shows the monthly trend of these values as follows:

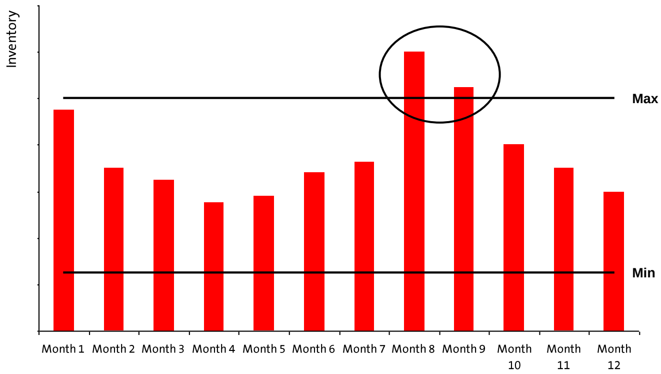




Different scenarios can be found through this analysis:

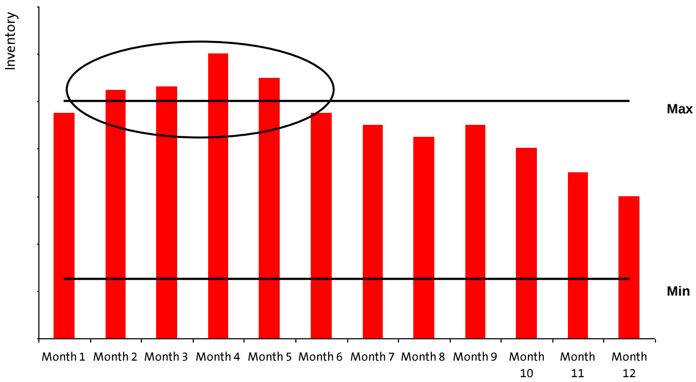
a. Stable between limits (see previous graph): The conclusion may be that the inventory value and MRP settings (max. and min.) have been correctly established. A trend line or series of inventory values that remains between the upper and lower limits indicates that the material MRP parameters are most probably correct and that further improvements can be made by analyzing the maximum levels and adjusting them to match the maximum consumption/demand recorded in the period.

b. Special and justified cases where limits (max. or min.) are reached or in some cases exceeded (e.g. annual plant shutdown period when material stocks may rise above the maximum limit).



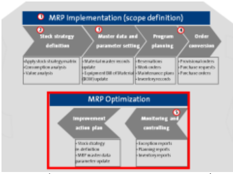
This case may be considered normal and no alarm should be triggered with regard to modification or optimization of the MRP parameters. This scenario may reflect the seasonality of the planned materials. The same period should be analyzed periodically to confirm the seasonality of the materials.

c. Special cases in which the maximum limits have periodically been reached (overstock) without any specific reason (e.g. no planned plant shutdowns in the affected period).

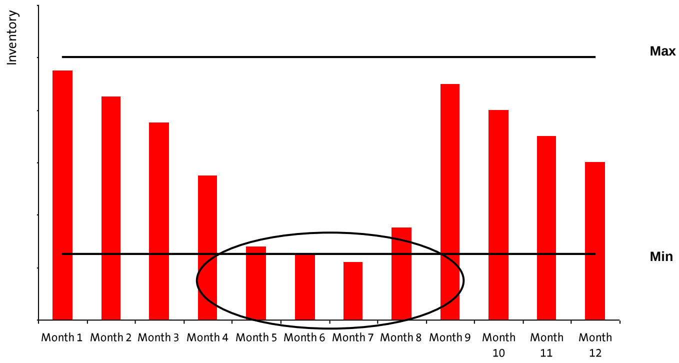


This case should be further analyzed. The possible drivers for the overstocks shown in this case are:

- Manual modification of order quantity setting (above the maximum); or
- Purchase requests done manually and not through MRP.



d. Special cases in which the minimum limits have been occasionally reached (stock-out risk).

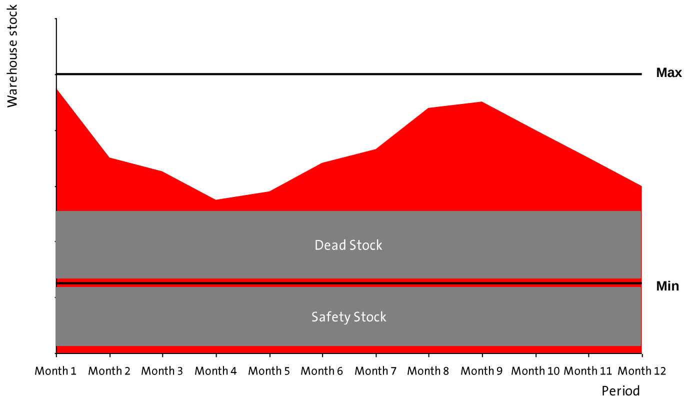


This case should be further analyzed. The possible factors that can influence stocks to fall below the minimum are:

- Unexpected demand (e.g. equipment breakdown);
- Irregular MRP execution; or
- Unreliable lead time setting.

5.3. Dead stock analysis

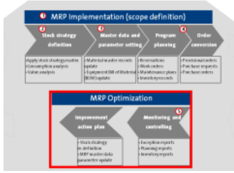
Dead stock analysis relates to that part of the warehouse stock that has not moved for a certain period of time and is above the safety stock limit and below the actual consumption rate or demand (see figure below).



Analysis of the dead stock helps to identify excessively high stock levels and allows important control parameters, such as safety stock, to be recalculated.

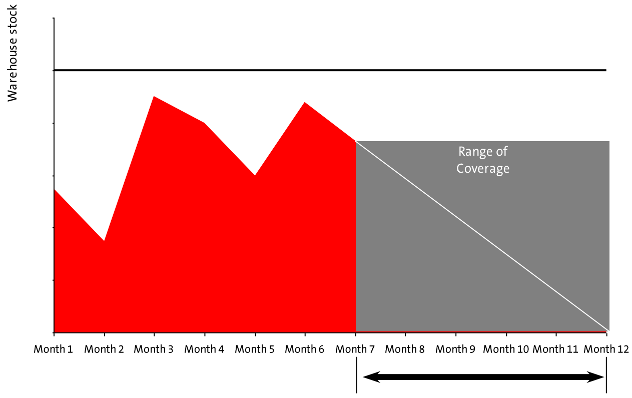
The difference (delta) between dead stock and safety stock can be regarded as a potential target for inventory optimization.

Dead stock generally occurs when slow-moving items are continually replenished even when they are not needed.



5.4. Range of coverage analysis

The range of coverage of a material provides information about the level of warehouse stock in relation to the demand. It indicates how long the warehouse stock will last, based on the average daily requirement. The graph below shows the change in warehouse stock levels over time. The future requirement is subtracted from the current warehouse stock to give the number of days of stock supply.



Analysis based on a range of coverage criteria allows materials with an excessively large range of coverage to be identified. These materials can then be adapted to the consumption rate.

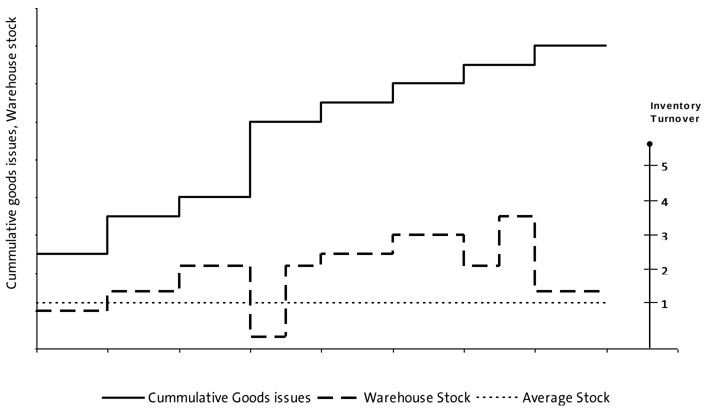
The following formulas can be used to analyze the range of coverage for consumption requirements.

Consumption range of coverage = current stock level/average daily consumption

Stock days' supply = current stock level/average daily requirements.

5.5. Inventory turnover analysis

Inventory turnover indicates how often an average inventory is turned around within a defined period (see figure below).



Inventory turnover is calculated by:

Inventory turnover = stock consumption during the period/average stock in the same period

Conclusions

Materials requirement planning **optimization** is a continuous process that is used to keep materials management up to date and enhance the usage of the MRP system.

Due to the numerous MRP parameters and interactions, it is not easy for the MRP controller, without support from other stakeholders, to define the correct settings. Cross-functional decision making helps to select the right MRP configuration for each material.

Structured analysis and assessment are required to identify and select suitable MRP parameters, allowing OpCos to establish optimized inventory levels.

When choosing the stock strategy and MRP parameters, the following influencing factors are to be considered:

- Prioritize and define the scope in order to start with a well-defined and limited amount of materials in order to gain confidence on usage.
- Once confidence on usage is gained, increasing the number of materials covered by MRP by selected waves, according to area needs.
- The period of time considered for the analysis and the frequency of doing this will determine the sustainability of the MRP parameter setting review.

Through proper material planning and by defining a stock strategy and accurate MRP parameters for each material, a significant contribution can be made toward:

- Improving the Net Working Capital position through sustainable inventory stock level optimization.
- Optimizing inventory service levels, thereby increasing internal stakeholders' confidence in inventory service levels.
- Reducing stock-out risks while optimizing inventory carrying costs

ANNEX 1 Definitions

MRP parameter definitions

The following parameter descriptions and definitions are based on the most common and mandatory SAP parameters to be maintained by the data administrator. The source of these definitions is from the standard SAP R/3 system.

Type of MRP

There are several standard SAP MRP types to be selected. Those that are most likely to be used by Holcim are described:

PD

- Materials with slow rotation and high value (upper left quadrant of the SSM) for which Maintenance normally has sufficient time to plan consumption of the components within work orders. This type will trigger replenishment activities based on reservations generated from work orders.

VB

- Materials with regular consumption (same quantity periodically) and mid-to-high value (upper right quadrant of the SSM). These materials normally have sufficient consumption history, so the reorder point (ROP) can be determined and set manually based on this history. This type will trigger replenishment activities based on ROP levels set manually in the material master.

VM

- This is a variant of VB type of MRP; it differs only in that the ROP is calculated automatically by the system and is not set manually by the user.

V1

- Materials with regular consumption with some moderate deviation (i.e. quantity increased due to plant shutdown) and high value, (upper right quadrant of the SSM). This type will trigger replenishment activities based on ROP levels set manually in the material master and also take into account all the reservations generated from work orders.

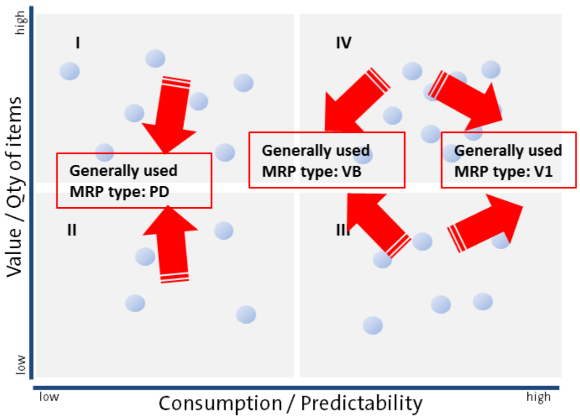
V2

- This is a variant of the V1 type of MRP; it differs only in that the ROP is calculated automatically by the system and is not set manually by the user.

ND

- For those materials for which there is no stock strategy defined due to non-criticality, very low value, low rotation and a self-service storage area where replenishment is triggered by manual methods such as the two-bin system. This setting ignores all the other MRP parameters in SAP. Purchasing activities are triggered via manual requisitions posted in SAP.

Within the Stock Strategy Matrix described in Chapter 2 the main MRP types can be **generally mapped** as follows:



Reorder point (ROP)

This parameter will trigger the corresponding replenishment (provisional order, purchasing request or purchasing order) when the stock level of the material falls below this quantity. This level provides the optimum level of inventory to meet anticipated demand during the time it takes to receive a new order.

A simple method of calculating the reorder level involves the calculation of usage rate per day, lead time and the safety stock. This can be expressed by the following formula:

Reorder point = (Average usage per day x *Lead time (in days)) + Safety stock*

In the SAP parameterization process the ROP value must include the safety stock as shown above.

The following internet links can be used when the ROP can be easily calculated:

ROP calculator 1 ROP calculator 2

Lot size

This parameter reflects the quantity of material to be purchased when a requirement is triggered. In the SAP system, this parameter should be maintained as this determines which lot sizing procedure the system uses to calculate the quantity to be procured. In SAP different lot size procedures are available; they are described as follows:

Lot Size HB: used when replenishment to the maximum stock level is required;
Lot size FX: used when a fixed standard quantity will be ordered in the event of a shortage; and
Lot size EX: used when a lot-for-lot order quantity will be ordered.

- Minimum lot size: Along with the lot size type parameter, the SAP system requires the minimum value for the purchasing lot. When a minimum lot size is required, the value to be set should reflect the minimum procurement quantity that is to be purchased when a purchasing order is released.

Economic order quantity (EOQ)

The economic order quantity is the quantity to order that balances the costs associated with holding stocks against the costs associated with placing an order.

The main stockholding costs are usually related to working capital, whereas the main order costs are usually associated with the transactions necessary to generate the information to place an order
The “Wilson model” proposes the following formula to calculate EOQ in an environment of discrete and dependent demand of items.

$$EOQ = \sqrt{\frac{2A \times S}{C \times i}}$$

A = Annual Usage S = Cost per Order

C = Cost of Item i = Annual Cost to Carry

EOQ is used as the basis for defining lot size.

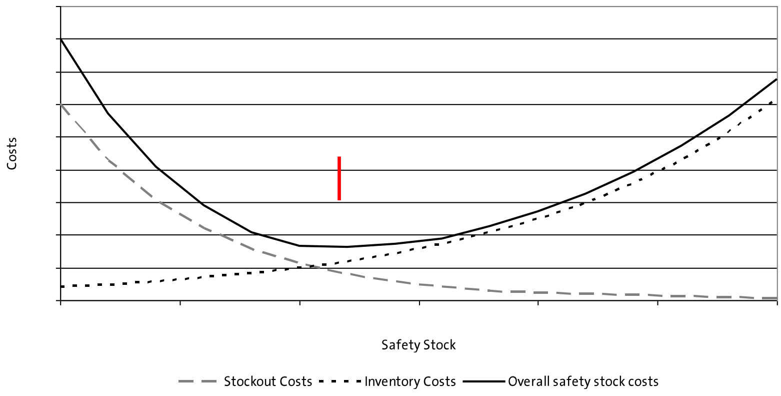
Maximum stock level

This parameter is used to set the maximum desired level of stock for a material. In SAP systems it is mandatory only when the HB lot size parameter has been selected. For the other lot size options, it is not mandatory but it is highly recommended that this field be maintained as it could have an impact on the inventory level held by the company.

Safety stock

The purpose of safety stock is to make up for uncertainties in material planning that would otherwise result in excess consumption during the replenishment lead time. Its role is, therefore, to prevent the occurrence of shortfalls in quantities.

The higher the safety stock level, the higher the inventory cost incurred. However, stock-out costs fall as safety stock rises. Ultimately, the goal is to ensure that the safety stock is at a level that minimizes both the inventory costs and stock-out costs. See figure below



The size of the safety stock depends on the type of inventory policy being used for the material.

A commonly used approach calculates safety stock based on the following factors:

- Demand rate (DR): the average amount of materials consumed per unit of time;
- Lead time (Lt) (see next section);
- Z factor (see table below) related to the Service level: (see definition in Chapter 3). Naturally, when the desired service level is increased, the required safety stock will increase as well; and
- Forecast error (Fe): an estimate of how far actual demand may be from forecast demand, expressed as the standard deviation σ of demand.

The formula to calculate safety stock based on the factors above is as follows:

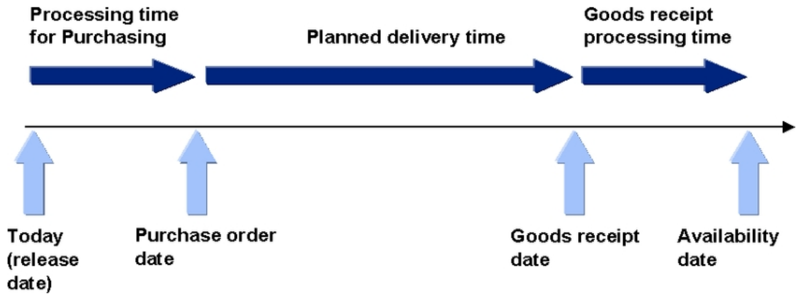
$$\boxed{SS = Z * \sqrt{((Lt * Fe^2) + (DR^2 * \sigma Lt))}}$$

Service Level	**Z Values**
50%	0
75%	0.675
80%	0.85
85%	1.05
90%	1.3
95%	1.6
97%	1.9
98%	2
100%	4

Lead time

For MRP, lead time is one of the most sensitive parameters, as its proper selection or calculation affects the overall planning schedule in the system. Generally, lead time is measured from the time the requirement is triggered to the time the material is received and ready for use. Lead times may change according to seasons or holidays or overall demand for the product.

It is recommended that the lead time calculation be included in the different components shown and described below:



Processing time for purchasing

This is the time required to convert a purchase requisition into a purchase order (including all internal approvals) and issue it to the supplier. The time required is measured in working days according to the OpCo calendar.

Planned delivery time

This parameter is the time that it takes for a material to be received by the purchasing organization from the day of the purchase order. Enter the number of days it normally takes to get delivery of the material in this parameter. This time plus the processing time plus the goods receipt processing time equals the overall lead time.

Goods receipt processing time

This parameter is the time that it takes for a warehouse or purchasing organization to process the receipt of materials in the system in order for them to be shown as part of the inventory or the material to be shown as ready for issuing to the plant. This parameter usually is set as 1 day. In most of the systems, goods receipts should be processed within 24 hours from the reception date.

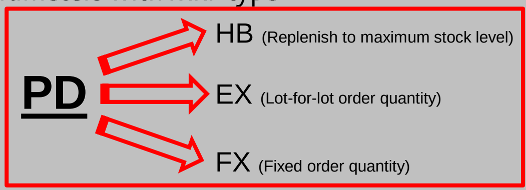
ANNEX 2 Parameter Setting

Recommended parameter settings for different scenarios

MRP parameters can be combined to establish the behavior and material variance in inventory management. Below are recommendations and considerations to understand MRP behavior in SAP systems.

These tables are based on the SAP system using as a comparison basis the MRP type combined with the lot size parameter and the parameters required to be set by the system according to the **combination.**

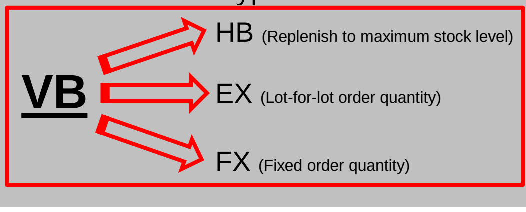
Details on combination of parameters with MRP type[7]



Lot Size	Description	Other Parameters
HB Replenish to Maximum Stock Level	• MRP considers current stock, safety stock, outstanding purchase orders, firm planned orders, reservations and the timing of planned items. • The net requirements calculation is carried out each time there has been a change in the available stock. • The resulting planned order will be sufficient to cover all known requirements, including safety stock, up to the maximum stock level. • The order is triggered when the available quantity is negative, meaning the requirement quantities are greater than expected receipts and stock quantity.	Maximum Stock Level is required by the system as mandatory Safety stock greater than zero is desired
EX Lot-for-Lot Order Quantity	• MRP considers current stock, safety stock, outstanding purchase orders, firm planned orders, reservations and the timing of planned items. • The net requirements calculation is carried out each time there has been a change in the available stock level, which considers safety stock. • The resulting planned order will be sufficient to cover all known requirements, including safety stock. The resulting uncommitted stock will equal the safety stock level. • The order is triggered when the available quantity is negative, meaning the requirement quantities are greater than expected receipts and stock quantity.	Safety stock is desired
FX Fixed Order Quantity	• MRP considers current stock, safety stock, outstanding purchase orders, firm planned orders, reservations and the timing of planned items. • The net requirements calculation is carried out every time there has been a change in the available stock. The resulting planned order will be sufficient to cover all known requirements, including safety stock. The system will propose orders in multiples of the fixed lot size. • The order is triggered when the available quantity is negative, meaning the requirement quantities are greater than expected receipts and stock quantity.	Fixed lot size is required Safety stock greater than zero desired

[7] Source: SAP R/3 MRP manual.

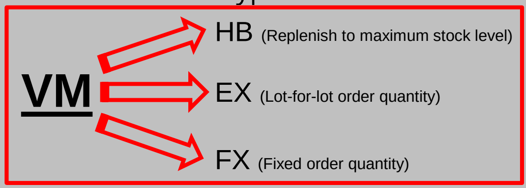
Details on combination of parameters with MRP type[8]



Lot Size	Description	Other Parameters
HB Replenish to Maximum Stock Level	• MRP considers current stock, safety stock, outstanding purchase orders and firm planned orders. • Reservations from plant maintenance and the timing of planned items are NOT considered. • The net requirements calculation is only carried out once the available stock level has fallen below the ROP. In this case, available stock does not consider safety stock. • The resulting planned order will be sufficient to cover the shortage to the maximum stock level.	Reorder point required Maximum stock level required Safety stock is required
EX Lot-for-Lot Order Quantity	• MRP considers current stock, outstanding purchase orders and firm planned orders. • Reservations from plant maintenance and the timing of planned items are NOT considered. • The net requirements calculation is only carried out once the available stock level has fallen below the ROP. In this case, available stock does not consider safety stock. • The resulting planned order will be sufficient to cover the shortage from the reorder point.	Reorder point required Safety stock greater than zero desired
FX Fixed Order Quantity	• MRP considers current stock, outstanding purchase orders and firm planned orders. • Reservations from plant maintenance and the timing of planned items are NOT considered. • The net requirements calculation is only carried out once the available stock level has fallen below the ROP. In this case, available stock does not consider safety stock. • The resulting planned order will be sufficient to cover the shortage from the reorder point. In this case, the system will propose orders in multiples of the fixed lot size.	Fixed lot size is required Reorder point required Safety stock greater than zero desired

[8] Source: SAP R/3 MRP manual.

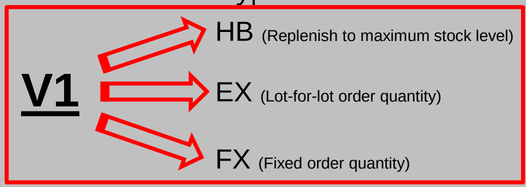
Details on combination of parameters with MRP type[9]



Lot Size	Description	Other Parameters
HB Replenish to Maximum Stock Level	• MRP considers current stock, safety stock, outstanding purchase orders and firm planned orders. • Reservations from plant maintenance and the timing of planned items are NOT considered. • The net requirements calculation is only carried out once the available stock level has fallen below the ROP. In this case, available stock does not consider safety stock. • <u>The resulting planned order will be sufficient to cover the shortage to the maximum stock level.</u>	Reorder point automatically calculated by the system Maximum stock level required Safety stock greater than zero desired
EX Lot-for-Lot Order Quantity	• MRP considers current stock, outstanding purchase orders and firm planned orders. • Reservations from plant maintenance and the timing of planned items are NOT considered. • The net requirements calculation is only carried out once the available stock level has fallen below the ROP. In this case, available stock does not consider safety stock. • <u>The resulting planned order will be sufficient to cover the shortage from the reorder point.</u>	Reorder point automatically calculated by the system Safety stock greater than zero desired
FX Fixed Order Quantity	• MRP considers current stock, outstanding purchase orders and firmed planned orders. • Reservations from plant maintenance and the timing of planned items are NOT considered. • The net requirements calculation is only carried out once the available stock level has fallen below the ROP. In this case, available stock does not consider safety stock. • <u>The resulting planned order will be sufficient to cover the shortage from the reorder point. In this case, the system will propose orders in multiples of the fixed lot size.</u>	Fixed lot size is required Reorder point automatically calculated by the system Safety stock greater than zero desired

[9] Source: SAP R/3 MRP manual.

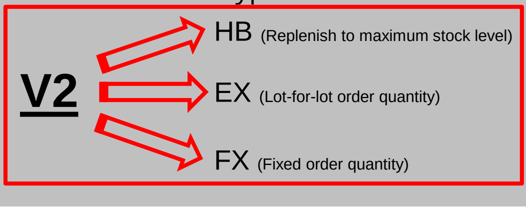
Details on combination of parameters with MRP type[10]



Lot Size	Description	Other Parameters
HB Replenish to Maximum Stock Level	• MRP order proposal considers current stock, safety stock, outstanding purchase orders, firm planned orders, and reservations providing that configurations of this MRP type are set to consider maintenance planning. • The timing of the planned items is not considered. • The planned order will be sufficient to cover the shortage to the maximum stock level. • The net requirements calculation is only carried out once the available stock level has fallen below the reorder point. In this case, available stock does not consider safety stock.	Reorder point required Maximum stock level required Safety stock greater than zero desired
EX Lot-for-Lot Order Quantity	• MRP order proposal considers current stock, outstanding purchase orders, firm planned orders, and reservations providing that configurations of this MRP type are set to consider maintenance planning. • The timing of the planned items is not considered. • The planned order will be sufficient to cover the shortage from the reorder point. • The net requirements calculation is only carried out once the available stock level has fallen below the reorder point. In this case, available stock does not consider safety stock.	Reorder point required Safety stock greater than zero desired
FX Fixed Order Quantity	• MRP order proposal considers current stock, outstanding purchase orders, firm planned orders, and reservations providing that configurations of this MRP type are set to consider maintenance planning. • The timing of the planned items is not considered. • The planned order will be sufficient to cover the shortage from the reorder point. In this case, the system will propose orders in multiples of the fixed lot size. • The net requirements calculation is only carried out once the available stock level has fallen below the reorder point. In this case, available stock does not consider safety stock.	Fixed lot size is required Reorder point required Safety stock greater than zero desired

[10] Source: SAP R/3 MRP manual.

Details on combination of parameters with MRP type [11]



Lot Size	Description	Other Parameters
HB Replenish to Maximum Stock Level	• MRP order proposal considers current stock, safety stock, outstanding purchase orders, firm planned orders, and reservations providing that configurations of this MRP type are set to consider maintenance planning. • The timing of the planned items is not considered. • The planned order will be sufficient to cover the shortage to the maximum stock level. • The net requirements calculation is only carried out once the available stock level has fallen below the reorder point. In this case, available stock does not consider safety stock.	Reorder point automatically calculated by the system Maximum stock level required Safety stock greater than zero desired
EX Lot-for-Lot Order Quantity	• MRP order proposal considers current stock, outstanding purchase orders, firm planned orders and reservations providing that configurations of this MRP type are set to consider maintenance planning. • The timing of the planned items is not considered. • The planned order will be sufficient to cover the shortage from the reorder point. • The net requirements calculation is only carried out once the available stock level has fallen below the reorder point. In this case, available stock does not consider safety stock.	Reorder point automatically calculated by the system Safety stock greater than zero desired
FX Fixed Order Quantity	• MRP order proposal considers current stock, outstanding purchase orders, firm planned orders and reservations providing that configurations of this MRP type are set to consider maintenance planning. • The timing of the planned items is not considered. • The planned order will be sufficient to cover the shortage from the reorder point. In this case, the system will propose orders in multiples of the fixed lot size. • The net requirements calculation is only carried out once the available stock level has fallen below the reorder point. In this case, available stock does not consider safety stock.	Fixed lot Size is required Reorder point automatically calculated by the system Safety stock greater than zero desired

Details on combination of parameters with MRP type **"ND"**[10]

Lot Size	Description	Other Parameters
HB Replenish to Maximum Stock Level	MRP has no impact. Manual requisition must be created.	Any entry in the other fields is ignored
EX Lot-for-Lot Order Quantity	MRP has no impact. Manual requisition must be created.	Any entry in the other fields is ignored
FX Fixed Order Quantity	MRP has no impact. Manual requisition must be created.	Any entry in the other fields is ignored

[11] Source: SAP R/3 MRP manual.

ANNEX 3 REORDER POLICIES

Reorder policies

The reorder policies are defined by the combination of the following characteristics:

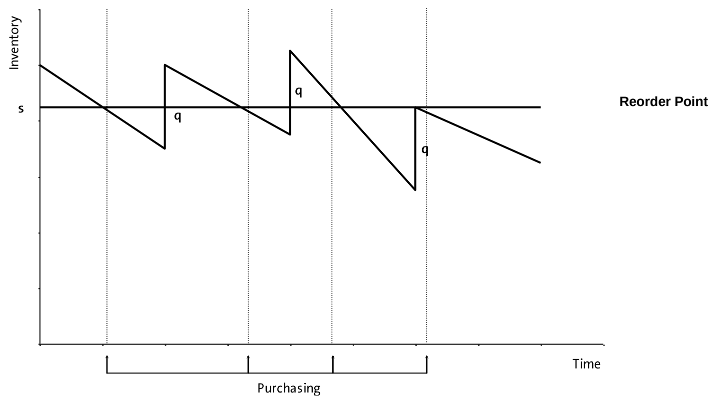
- Purchase order quantity (**q**);
- Purchase order period (**t**);
- Purchase order limit or reorder points (**s**);
- Target stock (**S**); and
- Service level.

Reorder policies depend on the reorder methods selected and are used for inventory control and for the definition of the replenishment type.

Reorder point

This procedure is used for determining the order date and purchase order quantity. The reorder point depends on typical consumption and on the safety stock. Ideally, the ordered materials arrive when the safety stock level has been reached.

a) **s,q Policy:** for this policy, the PO quantity (q) is fixed, and the PO period (t) is variable (see figure below).

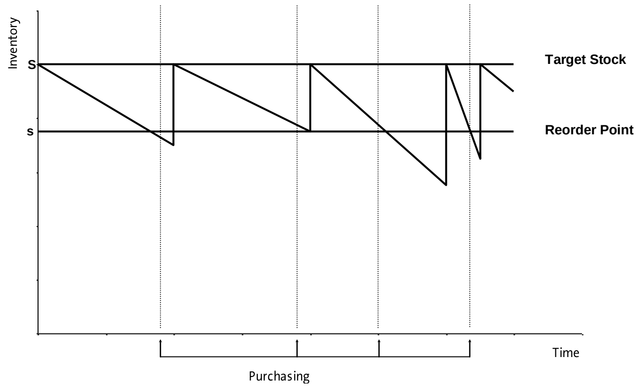


This policy takes requirement fluctuations into account; hence, stock-outs normally do not occur whereas inventory carrying costs[12] remain low. However, the materials planning effort associated with this policy is usually high, requiring continual stock checks among other tasks.

This policy applies normally for maintenance, repair and operations (MRO) materials with independent demand patterns. As described in Chapter 2, this policy will be applied mostly to materials with high consumption rate and high value.

[12] These includes warehousing costs such as rent, utilities and salaries, financial costs such as opportunity cost, and inventory costs related to perishability, shrinkage and insurance.

b) **s,S Policy:** in this variant, the PO quantity and the PO period are variable. The maximum stock level is, however, fixed as it is the reorder point (see figure below).



This policy requires continual stock checks; however, the carrying costs are controlled as maximum stock levels are defined.

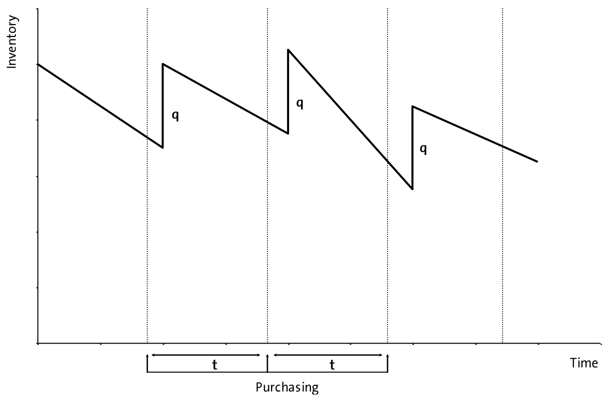
This policy also applies for maintenance, repair and operations (MRO) materials, where a maximum stock level can be set and afforded.

Time phased

This is a consumption-oriented reordering procedure. A date prompts the system to trigger the creation of a purchase order within a constant time interval (i.e. cyclical) in which the PO quantity is either fixed or variable.

The following are two common alternative policies to be selected with this reorder method:

a) **t,q Policy:** the replenishment order is created within a fixed period (t0) and for a fixed quantity (q0) (see figure below).



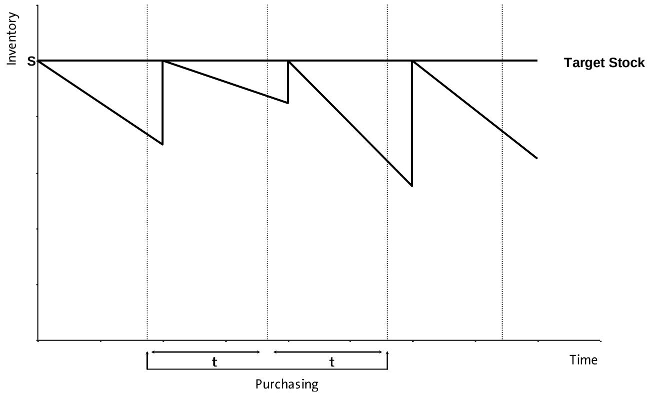
The material planning effort associated with the t,q policy is generally low. Beyond normal inventory levels the warehouse stock levels do not need to be checked continuously. However, if demand fluctuates (e.g. high material demand due to production peaks) this may result in stock-out situations or high storage costs (overstock). These situations can be minimized by setting reasonable service level and lead time parameters.

This t,q policy is generally recommended for raw materials and semi-finished products for which the requirements remain constant over a long period of time.

This policy has the following disadvantages:

- Stock shortfalls that can arise if demand exceeds normal levels, thus causing higher stock-out costs; and
- Risk of overstock due to fixed replenishment quantities.

b) **t,S Policy:** for this policy the replenishment order is created within fixed time cycles (t0) but with variable quantities (qi). As a prerequisite, maximum stock levels should be defined. After t0 time units, replenishment of materials occurs to fill the maximum target stock (S) level (see figure below).



This policy counteracts the risk of overstocks; however, because there is no reorder point to trigger the replenishment, stock-outs may occur.

This policy is recommended for categories for which several low-value materials are procured (like some allocated in PCS Segments 03 and 04) or for which inventories are controlled by the suppliers (vendor managed inventory) and those materials are part of a self-service area.

Some of the advantages of this policy are:

- Controlled carrying costs due to stock level settings; and
- Collective replenishment can be triggered for similar materials.

Some specific disadvantages for this policy are:

- Risk of stock-outs when demand exceeds expected level.

Summary of reorder policies

For high-value, low-consumption and critical materials, correct replenishment planning should be executed through the utilization of BOMs and maintenance planning (see Chapter 2).

For materials with high value and high rotation, the proper usage of an MRP in combination with the reorder policies described below is preferred.

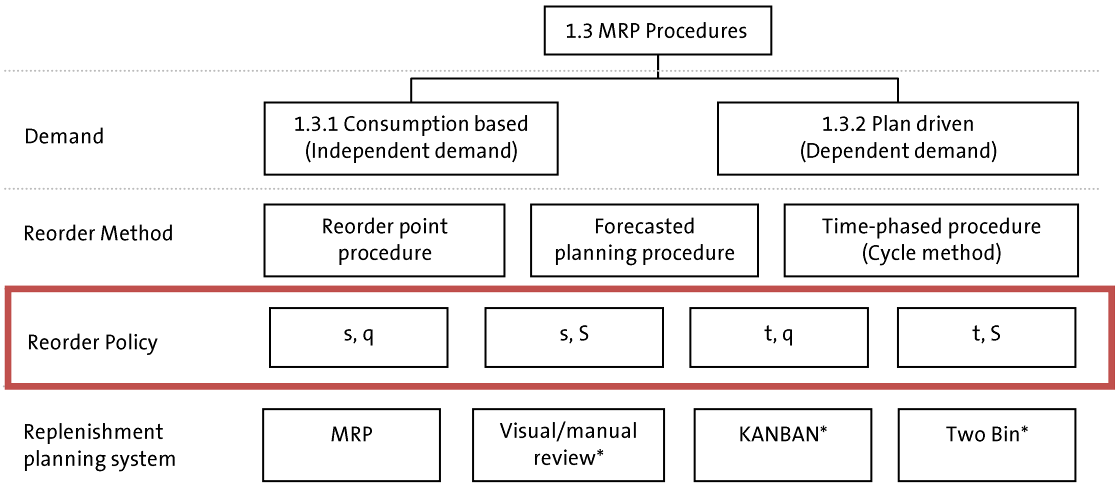
		Replenish quantity (q)	Replenish period (t)	Replenish limit/reorder point (s)	Maximum stock (S)
Reorder Point Method	s,q policy	Variable	Fixed	Fixed	Variable
	s,S policy	Variable	Variable	Fixed	Fixed

The reorder cycle method, in which order quantities and lead times are easier to calculate and set, is more suitable for materials for which demand or consumption is stable (e.g. raw materials, fuels) or for low-value materials with low consumption (see Chapter 2: Stock strategy).

		Replenish quantity (q)	Replenish period (t)	Replenish limit/reorder point (s)	Maximum stock (S)
Reorder Cycle Method	t,q policy	Fixed	Fixed	None	None
	t,S policy	Fixed	Variable	None	Fixed

For all the mentioned reorder policies it is recommended that the service level parameter is maintained in order to define the correct safety stock required.

The reorder policies can be added to the chart described in Section 1.3 of this document.



* Definitions can be found in the Inventory Management BPR

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