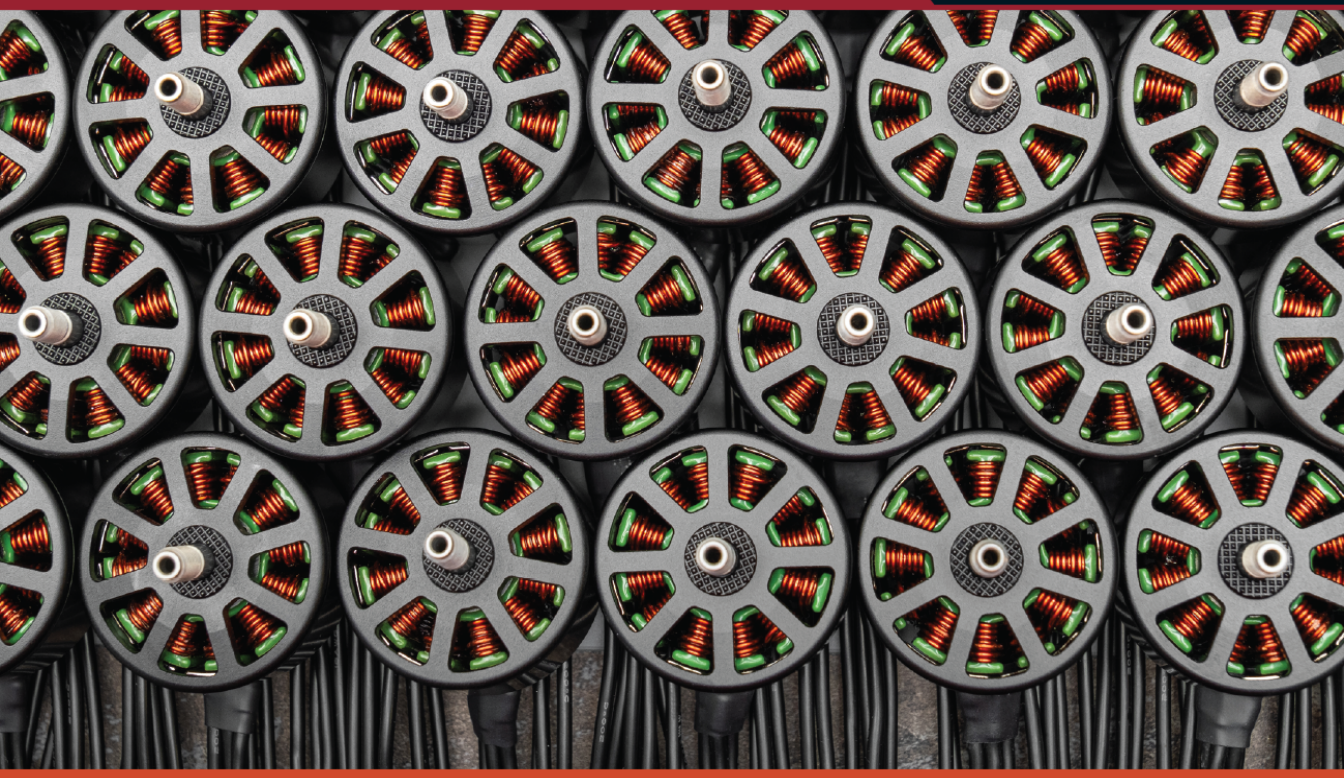
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Discrete Manufacturing with SAP®

Product Development, Production Execution, and Manufacturing Analytics

- Explore SAP's portfolio of solutions for discrete manufacturing
- Walk through discrete product development, production order creation, manufacturing execution, and reporting
- Set up and use SAP S/4HANA, SAP Product Lifecycle Management, and SAP Digital Manufacturing

Himanshu Goel

Rheinwerk Publishing

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Chapter 3

Master Data for Discrete Manufacturing in SAP S/4HANA

SAP S/4HANA provides an end-to-end solution for the manufacturing process that includes a unified, comprehensive, and simplified user experience. It supports enterprise-wide manufacturing collaboration and operations management within a fully integrated environment, offering enriched digital manufacturing capabilities and real-time enterprise analytics to support better decision-making.

The overall landscape for manufacturing is complex, and companies tend to use specialized software products for different functions. Product lifecycle management (PLM) systems are used for the management and governance of master data objects. Tools such as SAP Integrated Business Planning for Supply Chain (SAP IBP) are used for advanced planning. Specialized manufacturing execution systems (MESs) such as SAP Digital Manufacturing are used to act as a bridge between the enterprise resource planning (ERP) system and shop floor machines. However, the core remains SAP S/4HANA as an ERP system because it connects all the systems and this is where all the data is collected. For this reason, SAP S/4HANA is also referred to as a *system of records*.

In this chapter, we'll learn about master data objects that are used in discrete manufacturing in SAP S/4HANA. To run an end-to-end business process, the manufacturing department needs to set up certain master data objects. Let's answer a few questions to understand what master data objects should be created from a production point of view:

- **What needs to be produced?**
  For any finished product or assembly, we need to create a material master record that consists of all key information for the product.
- **What components are needed to produce the finished product/assembly?**
  All the components that are needed to produce a product or an assembly are defined in a bill of materials (BOM).
- **Where does the production happen?**
  The production process is performed in work centers.
- **How is the material produced?**
  The production process is defined in a routing.

In Chapter 2, we discussed that master data can be created in the SAP Product Lifecycle Management (SAP PLM) system and SAP S/4HANA. The global data or engineering data is created in SAP PLM, and the organization-level data is created in SAP S/4HANA.

Business Scenario

The engineering team at Magic Motions creates **Basic data 1**, **Basic data 2**, and **Classification** views in the SAP PLM system. These views are sent to SAP S/4HANA via an interface where they are replicated. The material master is then extended at organizational levels such as plant, sales organization, and so on.

In this chapter, we'll learn about the following master data objects that are important for discrete manufacturing, which will be needed in upcoming chapters for downstream processes:

- **Material master**
  The material master is one of the most essential data objects in any organization. In manufacturing, companies create finished products using semifinished components and raw materials. All information related to materials that a company manufactures, purchases, stores, or sells is maintained in the material master.
- **Bill of materials (BOM)**
  A BOM is a structured list of all the components required to produce a product or an assembly. It specifies the material number for each component, the required quantity, and the unit of measure (UoM). BOMs may be created as single-level or multilevel structures. For example, a BOM can be created for a semifinished assembly, and another BOM can then be created for the finished product that includes the semifinished assembly along with other required parts.
- **Work center**
  A work center is a location or workstation where production activities are carried out. It may represent a machine or a manual work area such as inspection or assembly. Work centers are used in routings and later referenced in production orders to plan and execute operations.
- **Task list**
  A task list defines the sequence of manufacturing steps and contains key operational details, including the operations required to produce a finished or semifinished product, the work center assigned to each operation, and the time required for setup, processing, and labor.
- **Production version**
  A production version defines a specific method for manufacturing a material. For instance, a finished assembly can have two different BOMs (which can be managed in SAP S/4HANA using alternative BOMs). Similarly, there could be two assembly lines where the assembly could take place. The production version defines a unique combination for a BOM and routing to represent a unique manufacturing method.

Now, let's take an imaginary tour of the manufacturing facility at Magic Motions where your favorite scooters are assembled. It has two assembly lines: one for handlebar assembly and

one for final assembly. Let's learn about the first master data object that acts as a foundation for manufacturing: the work center. We'll then discuss the key fields in the material master, BOM, routing, and production version. We'll close with a walkthrough of the relevant configuration instructions.

3.1 Work Center

A *work center* refers to a location or workstation where a specific activity or operation is carried out during the production process. It may consist of a single machine, a group of machines, labor (manual operations, e.g., quality inspection), or a combination of machines and labor. Work centers are used in routings and are subsequently referenced in production orders.

Work centers are usually created just once and rarely changed. This is because usually the machines are set up once and rarely replaced. New production lines can be set up and new work centers can be created, but this doesn't happen very often.

In SAP GUI, users can create a work center by using Transaction CR01, change a work center with Transaction CR02, and display the work center with Transaction CR03. If you're using SAP Fiori, then you can also use the Manage Work Centers app to perform several functions such as create, change, display, replace, and check usage. The app can be used for mass maintenance of capacities and as a report to display work centers based on several filter criteria such as **Person Responsible**, **Work Center Category**, **Usage**, and so on, as displayed in Figure 3.1.

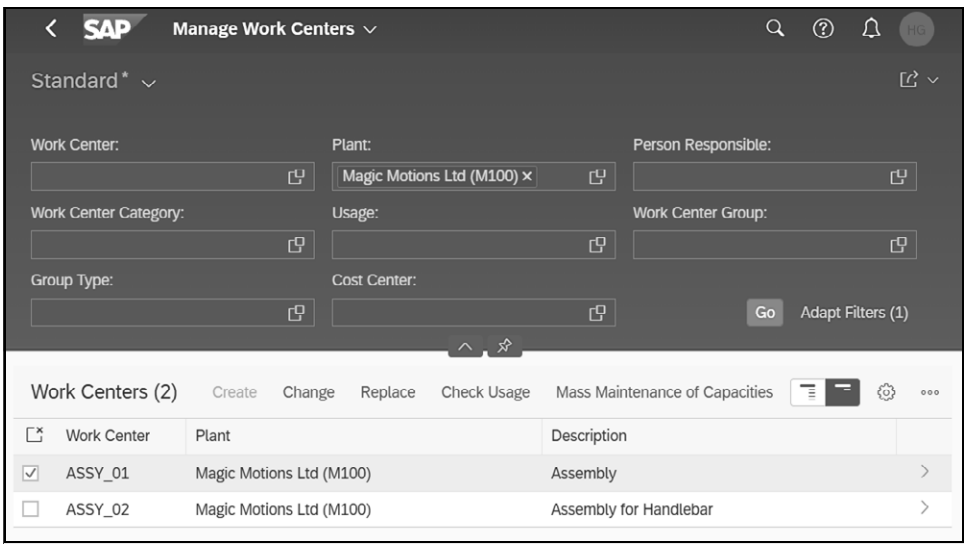


Figure 3.1: Manage Work Centers

We'll explore the key settings for work centers in the following sections.

3.1.1 Initial Screen

To create a new work center, enter the plant, name of the work center, and work center category on the **Create Work Center: Initial Screen**, as shown in Figure 3.2. Let's take a closer look at the work center name and category:

- **Work Center**
  You can assign a unique alphanumeric name to the work center, with a maximum length of eight characters.

  The manufacturing facility of Magic Motions has two assembly lines: one for handlebar assembly and another for final assembly. Each assembly line consists of multiple stations, or work centers, where specific operations are performed. In a real-world scenario, a business would typically create multiple work centers to support scheduling, tracking, and traceability at each stage. However, for simplicity in this book, we've defined only two work centers: **ASSY_01** for final assembly and **ASSY_02** for handlebar assembly.

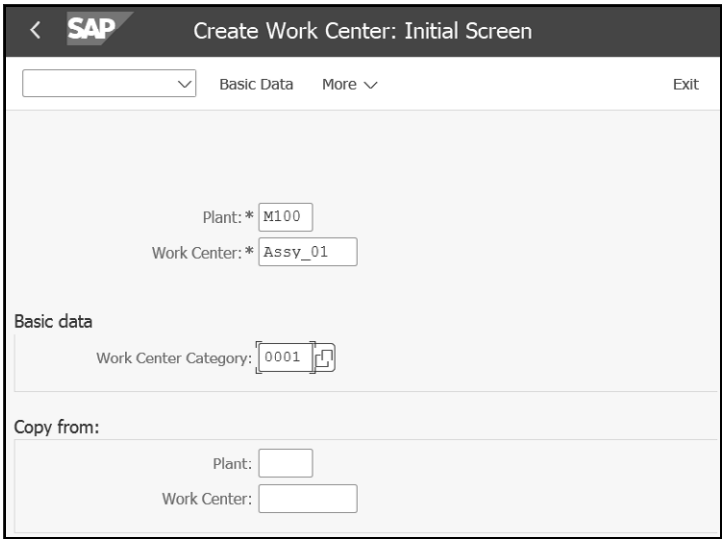


Figure 3.2: Create Work Center: Initial Screen

- **Work Center Category**
  This field determines the kind of data that can be maintained for the work center and the application areas where the work center can be used. It also controls which data fields are available. For example, a work center created under the **Machine** (**0001**) category can be used in maintenance, production, or quality inspection, as shown in Figure 3.3.

In the work center header section, the **Plant** and **Work Center** name are populated because they were entered on the initial screen. Because work center names are typically limited to a maximum of eight characters, the description field is used to provide more meaningful and detailed information about the work center.

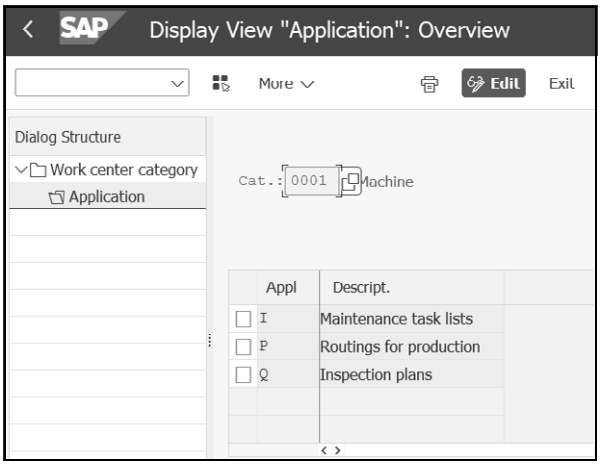


Figure 3.3: Work Center Category Application

For example, we've defined a work center named **ASSY_01**, which indicates Assembly Line 1. However, the description **Final Assembly** clearly specifies that this work center represents the production line where final assembly operations are carried out.

Once you've entered the data on the initial screen, press Enter to save the work center details. The work center master consists of multiple tabs, most importantly **Basic Data**, **Default Values**, **Capacities**, **Scheduling**, and **Costing**. Each of these views contains several key fields that play a critical role in downstream processes such as production planning, scheduling, and cost calculation. In the following sections, we'll discuss some of the most important fields within each of these views.

3.1.2 Basic Data View

Let's first discuss the fields in the **Basic Data** view of the work center, as shown in Figure 3.4:

- **Supply Area**
  The production supply area (PSA) functions as a temporary storage location on the shop floor. It acts as a bridge between the warehouse and production and helps in storing components near the specific work center. Components are issued from the warehouse and staged in the PSA before production. From there, they are consumed directly by the production line, helping to minimize waiting time and improve material flow. The PSA plays a key role in Kanban and just-in-time (JIT) outbound processing, and it's also widely used in extended warehouse management (EWM).
- **Usage**
  This key is used to control and define the task lists in which a work center or production resource/tool (PRT) can be applied. The task list usage specifies the type of task list where the work center is permitted, thereby ensuring that it's used only in relevant production scenarios. By maintaining the task list usage, you can restrict or allow the work center to be assigned to specific task list types such as routings, rate routings, or master

recipes. This helps maintain data consistency and process accuracy by preventing incorrect assignment of work centers to inappropriate task lists. Table 3.1 lists the standard task list usage values available.

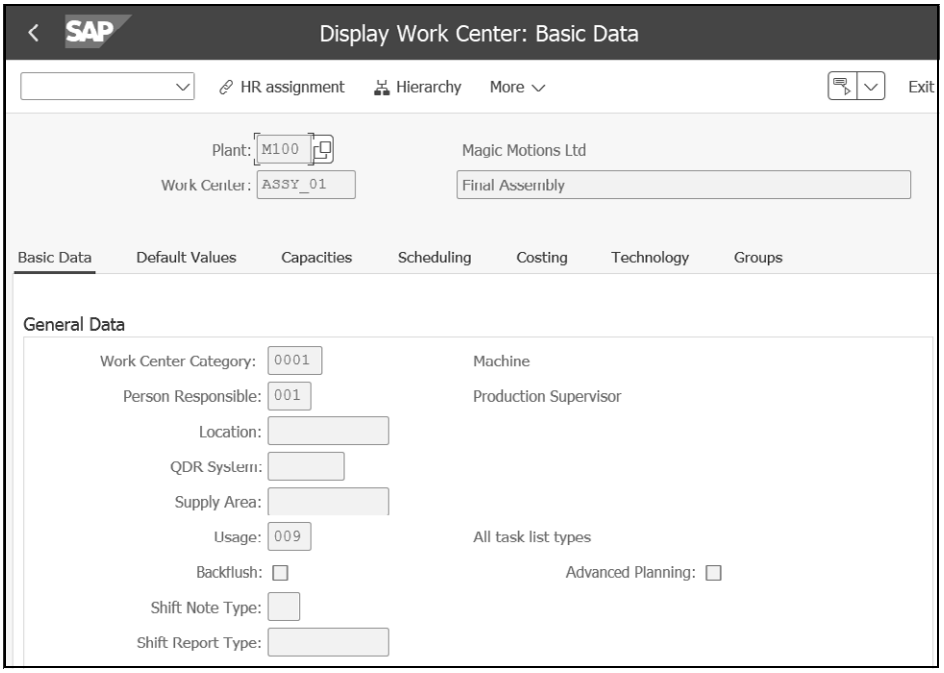


Figure 3.4: Work Center: Basic Data

Usage	Description
000	No task list categories
001	Only routings
002	Only inspection plans
003	Only networks
004	Only maintenance task lists
005	Production rate planning
007	Only rate routings
008	Master recipe + process order
009	All task list types
010	Rough-cut planning

Table 3.1: Task List Usage

- **Backflush**

  Backflush is an automatic goods issue process for a production order that eliminates the need for manual goods issue posting. When **Backflush** is enabled, component consumption is posted automatically during production confirmation.

  The **Backflush** indicator can be maintained in multiple master data objects, and the system determines whether backflush is applied based on a defined priority hierarchy. First, the system checks the routing, where backflush can be activated at the component assignment level. If it isn't defined there, the system then checks the material master, where backflush can either be explicitly activated or set to be determined by the work center. If the material master allows the work center to decide, the system finally checks the work center, where backflush can be enabled. Activating backflush at the work center level is particularly useful when all components consumed at that work center should be backflushed, as it avoids the need to maintain the **Backflush** indicator individually for each material.

- **Standard Value Key**

  Standard values are maintained in work centers to define the planned times for various operations, including processing, setup, and labor. These planned times indicate how long it typically takes to perform each operation.

  When performing an operation at a work center, several activities may be involved. For example, at the start of production, the machine may require setup activities, such as changing cutting tools or adjusting parameters on a computer numerical control (CNC) machine. This is referred to as setup. Other activities can include machine time or labor time, which are used to calculate the cycle time and cost of each operation. Additional activities, such as power, depreciation, and overheads, can also be defined. These activities are often called *parameters*.

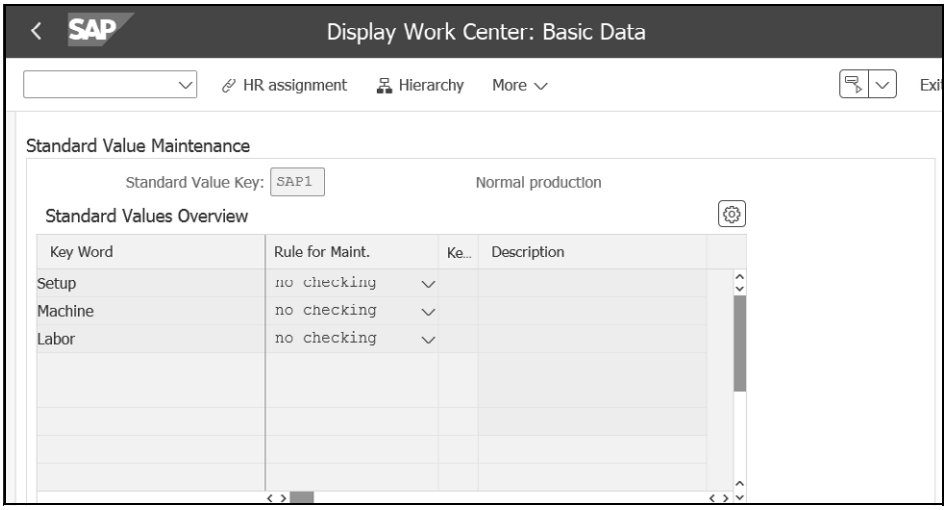


Figure 3.5: Work Center: Standard Value Key

A **Standard Value Key** can include up to six parameters for different activities. These parameters are then assigned in the routing and used for calculating capacity, scheduling, and costing. For example, the standard value key **SAP1**, as shown in Figure 3.5, contains three activities: **Setup**, **Machine**, and **Labor**, which form the basis for planning and cost calculation in production.

You can also create new standard value keys as explained in Section 3.6.2. They can include a maximum of six activities: setup, machine, labor, power, depreciation, and overheads. **Rule for Maint.** is used to control whether it's optional or mandatory to maintain a value for an activity in the operation of a routing. You can select one of these values:

- Blank: **no checking**
- **1: May not be entered**
- **2: Should not be entered**
- **3: Should be entered**
- **4: Must be entered**

3.1.3 Default Values View

Moving on to the **Default Values**, as shown in Figure 3.6, let's discuss some of the key fields in this tab:

- **Control Key**

  A control key defines how an operation is processed and manages several important parameters, including scheduling, capacity requirements, costing, external processing, and confirmation. You can click on search help to display a list of control keys. You can select one of the control keys and then click on the **Detailed information** button to display all the settings of that control key. For example, Figure 3.7 illustrates all the parameters associated with the control key **PP01**. A control key can be assigned directly to an operation in a routing or to a work center. When assigned to a work center, it's automatically carried over to all operations in the routing that use that work center.

  The control key governs several key aspects:

  - **Scheduling** determines whether scheduling is performed for this work center.
  - **Det. Cap. Reqmnts** (determine capacity requirements) controls whether capacity requirement records are generated for operations at this work center.
  - **Cost** specifies whether the activities performed on this work center should be costed.
  - **Automatic GR** ensures that a goods receipt is posted automatically when a confirmation is made. If this option is set, posting a confirmation will trigger the system to post the goods receipt without additional steps.
  - **External Processing** indicates that the operation is handled by an external vendor, also known as operation subcontracting.
  - **Confirmations** define whether an object with this control key requires confirmation, and whether milestone confirmations can be posted for the operation.

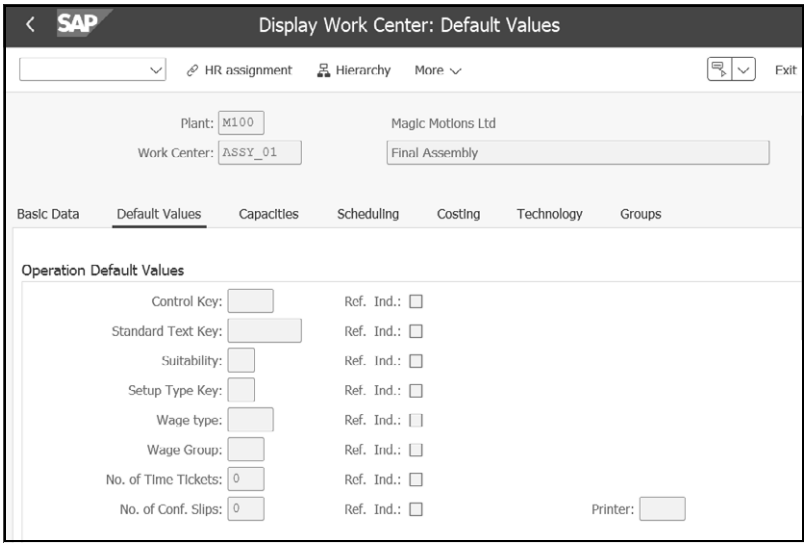


Figure 3.6: Work Center: Default Values

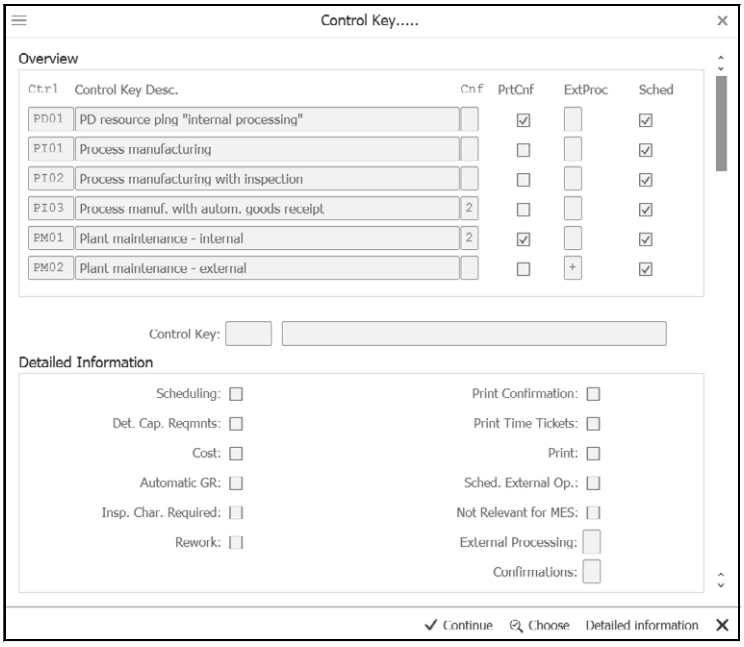


Figure 3.7: Control Key

■ **Standard Text Key**
You can define a standard text key to maintain the frequently used text for operations. The standard text keys are defined in Transaction CA10. These keys can be used in the work center or routing to automatically populate the predefined long texts for an operation, thus reducing manual efforts.

3.1.4 Capacities View

Now, let's move to the **Capacities** view of the work center, where we maintain available capacities, breaks, capacity utilization, and so on, as shown in Figure 3.8. We also maintain the formulas for setup, processing, teardown, and so on. The production order determines the time for an operation from the routing and, based on the formulas in the work center's capacity view, generates the capacity requirement for the work center. SAP comes preconfigured with formulas that can be readily used, as shown in Table 3.2.

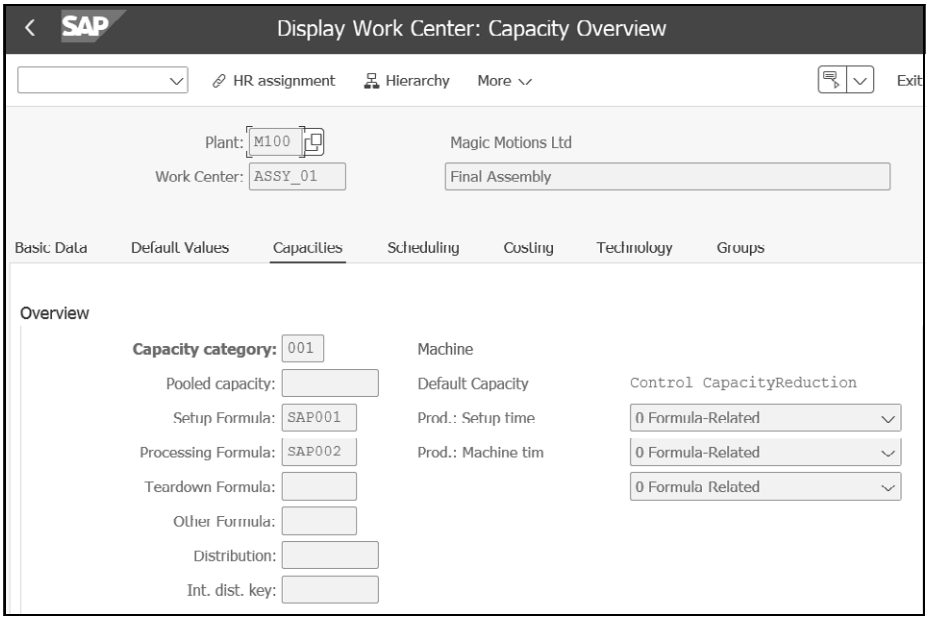


Figure 3.8: Work Center: Capacity Overview

Formula	Formula Description
SAP001	Prod.: Setup time
SAP002	Prod.: Machine time
SAP003	Prod.: Labor time
SAP004	Proj.: Netw/Maint.Time
SAP005	Prod.: Setup rqmts
SAP006	Prod.: Machine rqmts
SAP007	Prod.: Labor rqmts

Table 3.2: Work Center Capacity Formula

Click the **Capacity Header** button in the lower-left corner of the screen (not shown) to navigate to the **Work Center Capacity: Header** screen, as shown in Figure 3.9. On this screen, you can maintain the parameters such as the factory calendar, start and end times, break durations, and capacity utilization. The following parameters are used to determine the capacity of the work center:

- **Factory Calendar**
  A factory calendar is a country-specific definition of a plant's working days, nonworking days, and public holidays. Define the public holidays and add them to a holiday calendar, then assign that calendar to the factory calendar and specify working days (e.g., Monday to Friday). Use Transaction SCAL to maintain public holidays, the holiday calendar, and the factory calendar.

  The factory calendar is assigned to a plant when creating a new plant. You can assign a factory calendar in the work center; otherwise, the system uses the factory calendar maintained at the plant level. It's used for production planning, material requirements planning (MRP), capacity scheduling, delivery deadlines, and calculating working hours. The factory calendar helps in scheduling the production order and skips public holidays.
- **Capacity Base Unit**
  This is the unit in which available capacity is maintained, for example, hours or minutes.
- **Start time**
  This is the start time of the shift for the work center. For example, in Magic Motions, the first shift starts at 07:00 AM on Monday morning.
- **End time**
  This is the end time of the shift for the work center. For example, Magic Motions runs three shifts a day, and the third shift ends at 07:00 AM the next day.
- **Length of breaks**
  This is the duration of total breaks during all shifts in a day. For example, Magic Motions has a break time of 30 minutes during each shift, so the total break is 01:30 hours.
- **Capacity Utilization**
  The capacity utilization rate measures actual output realized against potential output. In practice, operating at 100% capacity is rarely feasible due to factors such as equipment breakdowns, maintenance activities, or uneven resource availability. For most organizations, a capacity utilization rate of approximately 80%–85% is considered optimal. Capacity utilization is calculated using the following formula:

  For example, if a work center has a potential capacity of 500 pieces per day while the average actual production is 450 pieces per day, this leads to a capacity utilization of 90%.

  In SAP, the operating time of a work center is calculated based on the defined start time, end time, break durations, and capacity utilization. In this example, the resulting operating time is 20.25 hours.

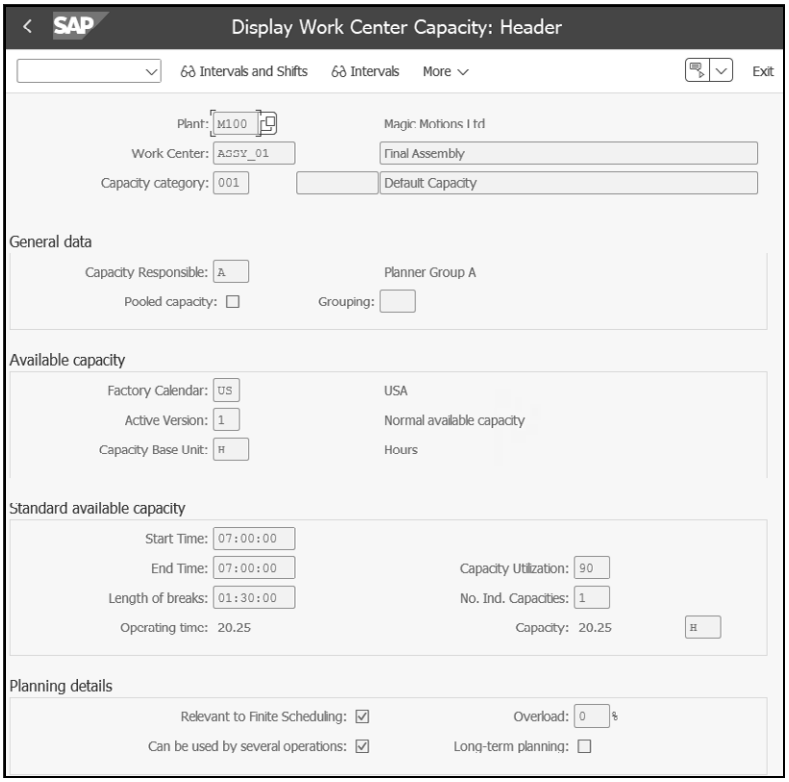


Figure 3.9: Work Center: Capacity Header

- **No. Ind. Capacities (number of individual capacities)**
  The number of individual capacities defines how many identical machines or personnel are available within a work center. This value is used to multiply the available capacity, enabling parallel processing and accurate scheduling by distributing the workload across multiple resources.

  For example, if five identical machines perform the same operation, such as lathe machining, they can be grouped into a single work center named Lathe. By setting the **No. Ind. Capacities** field to **5**, the system treats the work center as having five parallel resources.

  As shown in Figure 3.10, the **Operating time** for the work center is 20.25 hours. Because the **No. Ind. Capacities** is **5**, the total available **Capacity** is calculated as **101.25** hours, which is five times the operating time.
- **Relevant to Finite Scheduling**
  This indicator is quite useful in scheduling and capacity leveling. It ensures that the available capacity and the load of the work center capacity are taken into account during finite scheduling. The capacity availability check only considers the capacity for which finite scheduling is activated.
- **Can be used by several operations**
  This indicator enables usage of the work center capacity for multiple production orders. If parallel processing is enabled, it prevents capacity overload in scheduling when multiple,

smaller, or shared operations use the same machine. Once activated, it allows multiple operations to be dispatched to the same time slot during capacity leveling (Transaction CM25).

Scooters produced by Magic Motions are painted in a high-capacity paint shop, which can handle up to 200 scooters simultaneously. Because the paint shop can process scooters from multiple production orders at the same time, the **Can be used by several operations** indicator is enabled, allowing parallel processing across different orders.

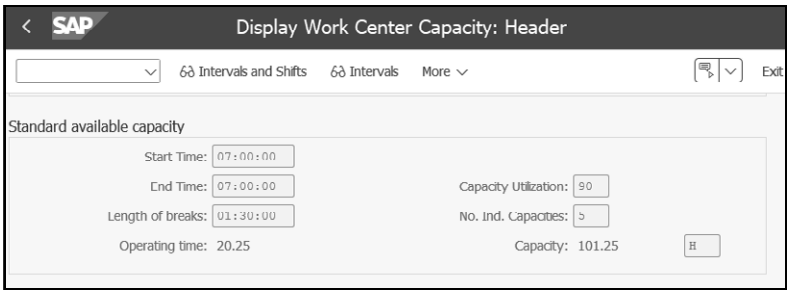


Figure 3.10: Work Center: Standard Available Capacity

- **Overload**
  You can define a permission percentage to allow a work center's available capacity to be temporarily exceeded. For instance, if a work center has a daily capacity of 20 hours and an overload of 5% is permitted, the system calculates the available capacity as 21 hours. The overload setting applies only when using finite scheduling, ensuring the system respects capacity limits during planning.
- **Long-term planning**
  This indicator must be activated if the work center is to be used for planning simulations in long-term planning. Long-term planning is a tool that helps organizations forecast future material requirements and capacity needs over an extended period. By simulating demand for assemblies and raw materials, it allows planners to identify potential bottlenecks, allocate resources efficiently, and make informed decisions about production and procurement.
- **Intervals and Shifts**
  If you click on the **Intervals and Shift** button in the menu bar, it'll navigate you to a new screen where you can define intervals and shifts for a work center to manage, monitor, and adjust the available production hours. This functionality is particularly useful for handling temporary changes in capacity, such as annual shutdowns or short-term production adjustments.

  The shift sequence can be maintained using Transaction OP4A in Transaction SPRO. For example, if a period of low production is anticipated and the business decides to operate two shifts instead of three for two weeks, a new shift sequence can be created and assigned to the work center to reflect this temporary change. Figure 3.11 shows that the business has decided to run two shifts for the period from December 16 to December 31.

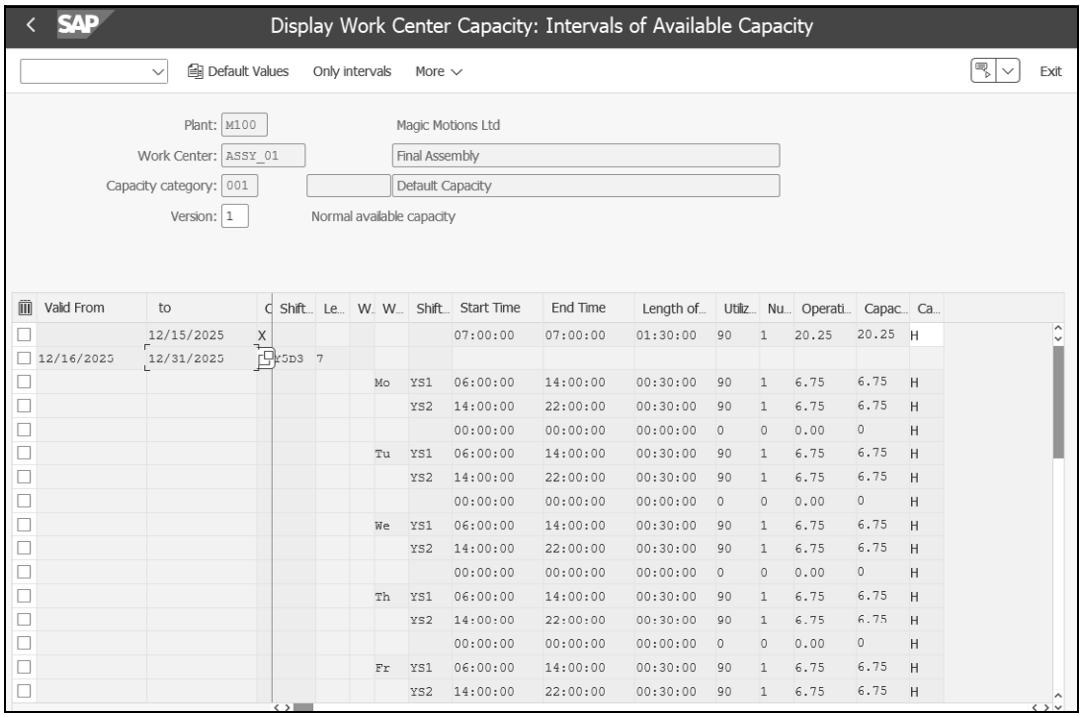


Figure 3.11: Intervals of Available Capacity

3.1.5 Scheduling View

Scheduling is used to determine the start and end dates for an operation at the work center. It uses the data and formulas defined in the **Scheduling** view of the work center. The system calculates the actual duration of the operation using the formula maintained on the scheduling screen of the work center and the duration defined in the routing. You can maintain processing formulas such as setup, processing, or teardown, as shown in Figure 3.12:

- **Duration of Setup**
  The setup time refers to the time required to prepare the machine or the work center for the next production order. You can specify the formula to be used to calculate the setup time of an operation during the scheduling. If a formula isn't maintained, then the system considers the setup time as zero.
- **Processing Duration**
  The processing time of an operation refers to the actual duration required to perform work on a specific quantity of material at a work center. You can specify the formula to be used to calculate the processing time of an operation during scheduling. If a formula isn't maintained, then the system considers the operation processing time as zero.
- **Duration of Teardown**
  Teardown time refers to the time needed to clean or dismantle machinery after a production order is completed and before the next order can begin. You can specify the formula

to be used to calculate the teardown time of an operation during scheduling. If a formula isn't maintained, then the system considers the teardown time as zero.

- **Int. Proc. Duration (internal processing duration)**
  This formula is used to calculate the duration of various types of internal processing during scheduling. It applies to scenarios such as networks, process orders, and maintenance orders.
- **Location Group**
  This key is used to assign a physical location to a work center. It helps identify work centers that are located in the same area on the shop floor and is used to calculate move times between work centers during lead time scheduling.
- **Standard Queue Time**
  This refers to the duration for which an order usually waits at the work center before it's processed.
- **Minimum Queue Time**
  This refers to the shortest duration for which an order must wait at the work center before it's processed.

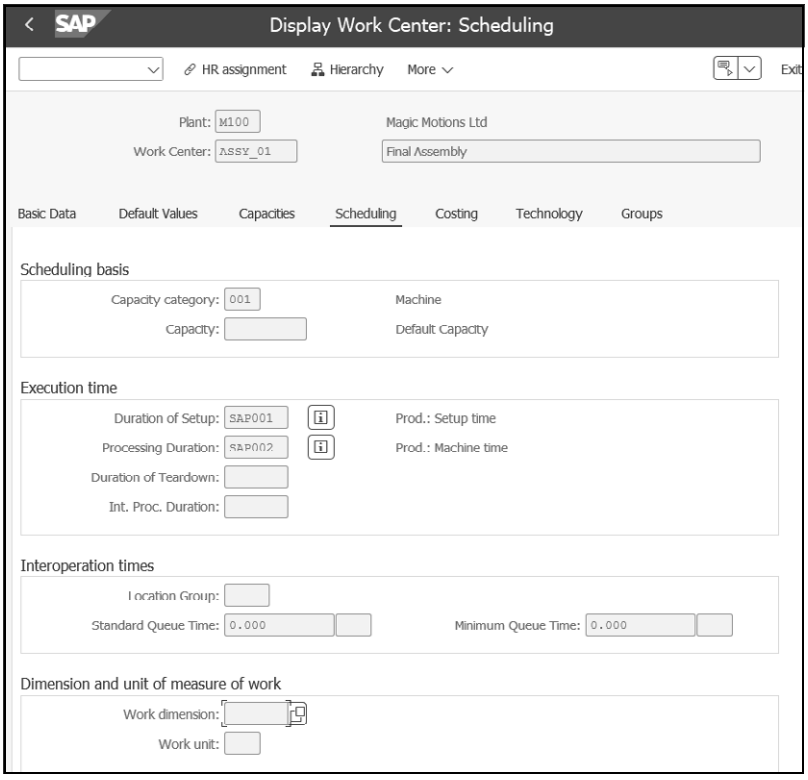


Figure 3.12: Work Center: Scheduling

Note

The **Capacities** view is used to identify the resources required at a work center, including machines and labor, that can operate in parallel. The **Scheduling** view, on the other hand, determines the start and end times of an operation.

For example, consider a manual inspection operation for scooters. Normally, 50 scooters can be inspected in two hours by one inspector. If you assign two inspectors to the task, the operation can be completed in one hour. In this case, the scheduling time is reduced, but the capacity requirement remains the same, as two people are needed to perform the inspection.

3.1.6 Costing View

The **Costing** tab in a work center is a critical component because it acts as the primary integration point between manufacturing and controlling. This integration ensures that all costs incurred during production (e.g., labor, machinery, and overhead) are accurately captured and assigned to the appropriate cost objects.

For each work center, a cost center must be assigned. This cost center serves as the recipient for all production costs generated at that work center. It ensures that costs are tracked correctly in controlling and can be analyzed for profitability, budgeting, and variance reporting.

A single cost center can be assigned to multiple work centers, which is useful for grouping production costs from similar operations or departments. However, each individual work center can only be assigned one cost center, ensuring that the allocation of costs is unambiguous and traceable. Figure 3.13 shows the **Costing** view of the work center.

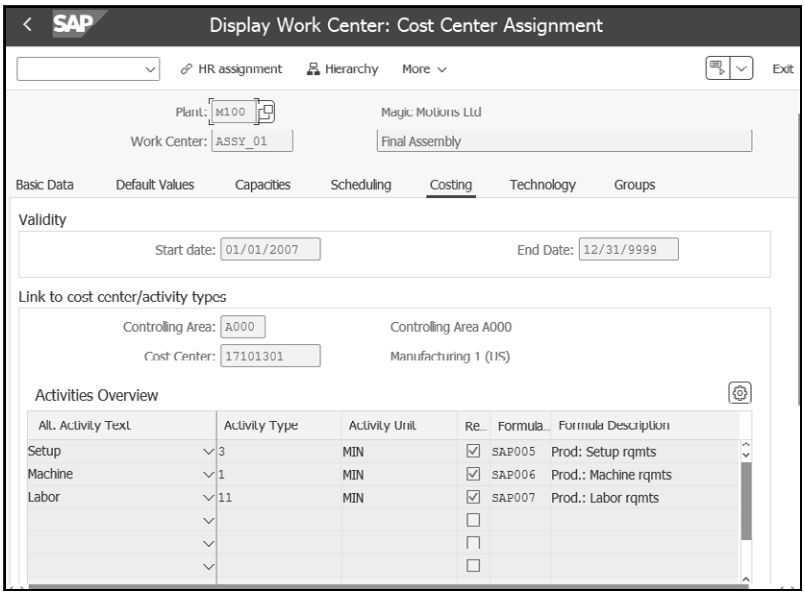


Figure 3.13: Work Center: Costing

Let's discuss some of the key fields of the **Costing** view of the work center:

- **Controlling Area**

  A controlling area is an organizational unit in SAP that allows an enterprise to perform complete cost accounting within a self-contained system. It provides the framework for tracking and managing costs across the organization.

  A controlling area can include one or more company codes, which may operate in different currencies if required. For example, a European company code may use EUR while a US company code uses USD, but both must use the same operational chart of accounts to ensure consistency in reporting and analysis.

  All internal allocation transactions, such as cost center assessments, internal orders, or overhead distributions, are limited to objects within the same controlling area. This ensures that cost allocations are accurately tracked and reported.

  The controlling area helps businesses do the following:

  - Consolidate cost accounting across multiple company codes
  - Maintain consistent reporting structures
  - Control internal cost allocations efficiently

- **Cost Center**

  A cost center is an organizational unit that represents a location or department where costs are incurred. In Magic Motions, the cost centers could include the assembly line, paint shop, quality inspection, maintenance department, and so on.

  You may create multiple cost centers for a single department. For instance, there could be several cost centers for the quality inspection department for each production area, that is, for handlebar assembly, finished assembly, paint shop, and so on. Cost centers help manage and analyze costs effectively and enable the company to identify where the costs are incurred within the organization. It also helps to track the efficiency of each cost center by comparing actual costs with planned costs.

  There are two main types of cost centers:

  - *Operational cost centers*: These provide services directly linked to production or core operations. For example, the scooter assembly line or paint shop are operational cost centers. Costs recorded here are allocated directly to products or services based on cost rates.
  - *Support cost centers*: These provide services indirectly related to core operations, such as IT or HR. Costs from support cost centers are allocated to operational cost centers or specific projects, ensuring accurate costing for production activities.

- **Alt. Activity Text (alternative activity text)**

  The activity text is automatically populated based on the **Standard Value Key** assigned in the **Basic Data** tab of the work center (refer to Section 3.1.2). This activity text lists the parameters **Setup**, **Machine**, and **Labor** that were defined in the **Basic Data** view and is used to establish a link with costing.

- **Activity Type**
  Activity types are used to describe an activity produced by a cost center in a controlling area. The activity types are measured in units of time or quantity.
- **Activity Unit**
  The activity unit represents the time or quantity used to post consumed activity quantities. The system records activity postings using the unit defined in the activity type master data. The unit in the master data can't be changed if dependent data already exists. However, subsequent planned or actual postings can use different units, as long as they are defined as convertible to the unit specified in the master data.
- **Reference**
  If the reference indicator is set, then the system doesn't allow you to change the values defined on the work center in the routing. If there are frequent changes to the costing activities, this indicator must be activated so that the updates to activity types or formula keys in the work center flow automatically to the routings where the work center is used. If the **Reference** indicator is disabled, the default values from the work center aren't copied to the routing.
- **Formula**
  Specify the formula key used to calculate the costs of an activity type performed at a work center (refer to Section 3.1.4).

3.2 Material Master

A material master record is a central library for storing all relevant information from various departments—for instance, the production department maintains data in the **MRP** and **Work Scheduling** views, while sales and marketing teams store sales-related data in the **Sales** views of a material master. Likewise, every logistics department, including purchasing, production, sales, quality, and warehouses, stores relevant data in the material master. The application of the material master isn't limited to logistics functions only; rather, finance and controlling departments also use the material master to store the data that is relevant for them.

In Chapter 2, we created the global data for the material master in the SAP PLM system. The material master was transferred to SAP S/4HANA. Now, we must extend the material master for organization levels such as sales organization, purchasing organization, plant level, warehouse level, and so on.

From the manufacturing point of view, we must understand the four MRP views and the work scheduling view.

3.2.1 MRP 1 View

Let's discuss some of the key fields of the **MRP 1** view of the material master. Figure 3.14 shows the **General Data** and **MRP Procedure** sections in the **MRP 1** view.

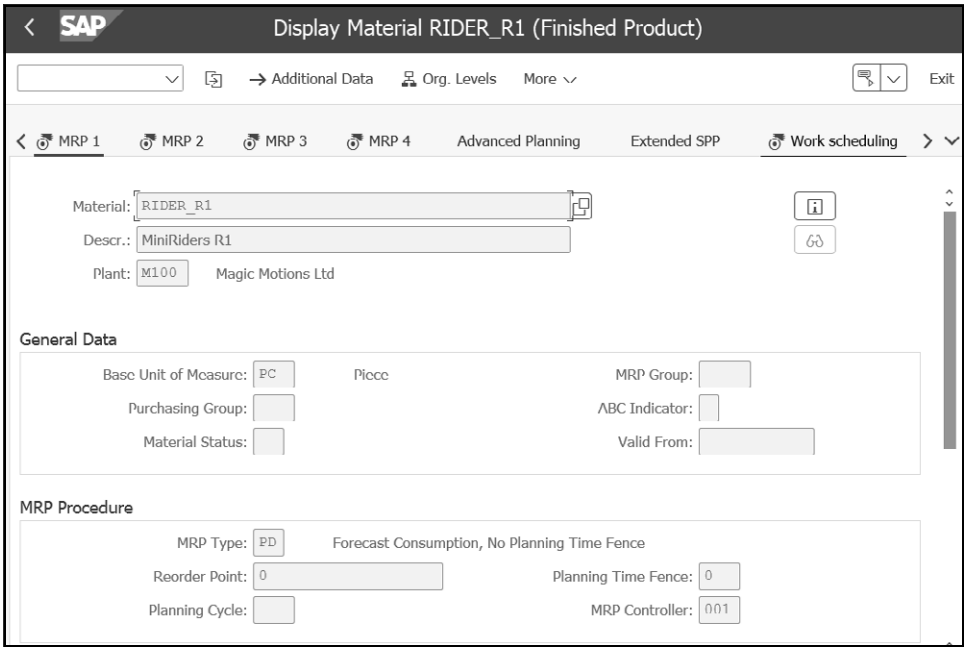


Figure 3.14: Display Material Master: MRP 1 View

Let's start with the **Base Unit of Measure** field. Every material master record requires a base UoM, which serves as the standard unit for inventory management. In other words, all stock quantities are stored and managed using this base unit. While inventory relies on the base UoM, different business functions are free to work in units that best suit their processes—such as a purchasing UoM, production UoM, or sales UoM. Any UoM other than the base unit is referred to as an alternative UoM. SAP S/4HANA comes preconfigured with International Organization for Standardization (ISO) UoM tables, meaning standard conversions (e.g., kilograms to pounds) are already available in the system. However, for nonstandard units, define the conversion factors manually. This includes relationships such as pieces to pallets or cartons, where each alternative UoM must be explicitly linked to the base unit.

The **MRP Group** field plays a critical role, as numerous MRP parameters can be maintained within the MRP group such as the planning strategy group, consumption mode, order types for converting planned orders into production or process orders, and the planning time fence.

Note

Depending on the business process, you can either use MRP plant parameters, which contain similar settings, or MRP groups. MRP plant parameters are defined in Transaction OPPQ and are applicable to all materials of a plant if an MRP group isn't assigned. However, if an MRP group is assigned, then the settings defined in it are taken into account during the MRP run. MRP groups are used when the planning process is more

complex in an organization and the planners want to run MRP with different parameters for different materials. For instance, you can create separate MRP groups for each material type.

Next, the **Purchasing Group** field represents the individual or team responsible for purchasing activities for the material. It applies only to materials that are externally procured.

The **ABC Indicator** field is used to represent the value identified for a material based on the ABC analysis:

- **A** items have high consumption value and are therefore the most critical.
- **B** items have moderate consumption and are of secondary importance.
- **C** items have low consumption and are generally considered least important.

The percentage thresholds for each class can be customized to suit your organization's needs. For example, materials accounting for 60% of total consumption value may be classified as A, those representing 25% as B, and the remaining 15% as C in one organization. However, another organization might classify a material as A if the consumption value accounts for 80% of the total, B accounts for 15%, and C accounts for 5%.

The material classification determines how the materials are treated; some companies prefer to run master production scheduling (MPS) for A-parts. It can also be used to define the frequency for the physical inventory process.

Next, the **Material Status** field determines if the material is restricted to be used in any of the business areas in the plant:

- Materials management (e.g., in purchasing and inventory management)
- Production planning and control
- Plant maintenance
- Warehouse management (WM)
- Costing with a quantity structure

Plant-specific material statuses can be configured based on business requirements, and statuses can be set up so that the material can be restricted to use for certain functions. For example, you can set up statuses such as **In Development**, **Production**, and **Obsolete**. In this case, the material can only be used for production if the status is **Production**.

This brings us to the **MRP Type** field. MRP is one of the most important functions in SAP S/4HANA to ensure that the right materials are available at the right time, in the right quantities.

The most widely used planning approaches are MRP, MPS, and consumption-based planning (CBP), as shown in Figure 3.15. Each serves a distinct purpose and supports different business scenarios. For example, MRP is best for materials with dependent demand and complex BOM structures, MPS is designed for high-impact or resource-critical items that

require tighter control (usually A-parts), while CBP is preferred for materials with predictable usage and minimal planning complexity (usually C-parts). CBP includes three subtypes of planning: reorder-point planning, time-phased planning, and forecast-based planning.

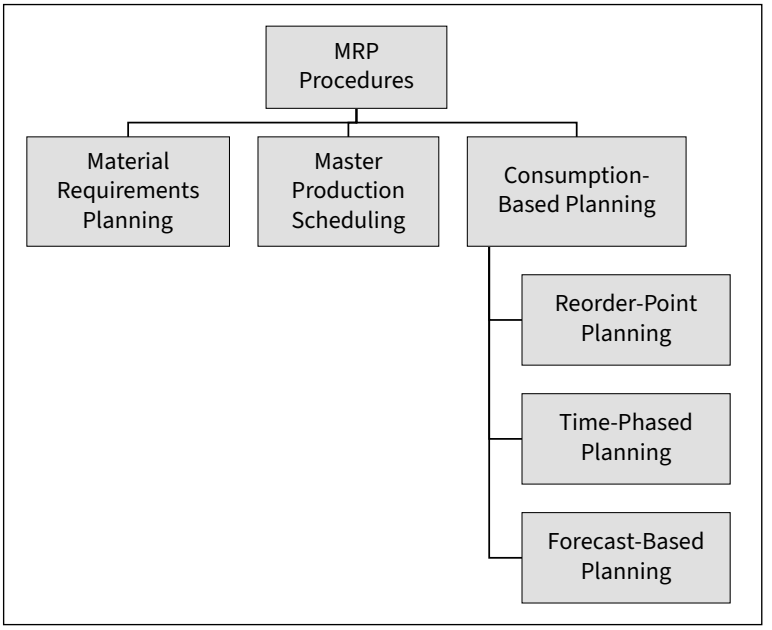


Figure 3.15: MRP Procedures

Let's take a closer look at each type of planning, and their corresponding options in the **MRP Type** field:

- **Material requirements planning (MRP)**
  MRP is a planning engine that determines what materials are required, how much is needed, and when those materials must be available. Its primary objective is to guarantee material availability for production, thereby enabling on-time delivery to customers.

  MRP evaluates requirements and demand usually originating from sales orders or forecasts, and then it checks whether sufficient material is available in inventory. If the material isn't available in stock, then MRP generates procurement proposals: purchase requisitions for externally sourced materials and planned orders for materials produced in-house. MRP ensures that shortages are avoided while maintaining optimum inventory levels. SAP provides several options in the **MRP Type** field:
  - **PD**: Standard MRP
  - **P1**: MRP with fixing type 1
  - **P2**: MRP with fixing type 2
  - **P3**: MRP with fixing type 3
  - **P4**: MRP with fixing type 4

The MRP types **P1**–**P4** are known as firming (or fixing) types. These types control how order proposals are treated within a planning time fence. The fixing type determines whether planned orders can be changed, rescheduled, or firmed automatically during planning runs. This provides planners with stability in short-term schedules while still allowing flexibility in the longer term.

- **Master production scheduling (MPS)**
  MPS follows the same fundamental logic as MRP but focuses on a select group of critical materials. These are typically high-value items, bottleneck components, or products that strongly influence profitability or consume key resources. Usually, companies run ABC classification to identify the A-parts and run MPS to plan these materials. Instead of being planned together with all the other materials, they are scheduled separately and with greater attention. SAP supports five options for the **MRP Type** field, each with a specific fixing type:
  - **M0**: MPS with fixing type 0
  - **M1**: MPS with fixing type 1
  - **M2**: MPS with fixing type 2
  - **M3**: MPS with fixing type 3
  - **M4**: MPS with fixing type 4

  These fixing types define how order proposals are protected within the planning time fence, similar to the firming logic in MRP.
- **Consumption-based planning (CBP)**
  While MRP and MPS rely on actual demand elements, CBP uses historical consumption data to predict future demands. Instead of responding to sales orders or dependent requirements, CBP extrapolates past usage patterns through forecasting or static planning rules. Demand elements such as customer orders or planned independent requirements (PIRs) don't directly influence planning. CBP could be quite useful for low-value items such as spare parts, packaging materials, or materials with stable and predictable usage. CBP in SAP S/4HANA is divided into three main categories:
  - Reorder-point planning: Procurement is triggered when the available stock (plant stock plus firmed receipts) falls below a predefined reorder point. This method is simple and effective for materials with consistent demand. You may use one of the following MRP types for reorder-point planning:
    - **V1**: Manual reorder point with external requirements
    - **V2**: Automatic reorder point with external requirements
    - **VB**: Manual reorder-point planning
  - Forecast-based planning: In this method, future requirements are calculated using forecast models based on historical consumption. This is suitable for materials with regular usage patterns that can be statistically predicted. MRP type **VV** (forecast-based planning) is used to plan materials based on forecasts.

- Time-phased planning: Time-phased planning is ideal when materials are procured or delivered at fixed intervals. For example, if a vendor delivers once per week, requirements are accumulated for that period and ordered accordingly. You may choose one of the following MRP types:
  - **R1**: Time-phased planning
  - **R2**: Time-phased planning with automatic reorder point
  - **RR**: Time-phased replenishment with dynamic target stock
  - **RS**: Time-phased replenishment planning

■ **Demand-driven replenishment (DDMRP)**
DDMRP is a relatively new methodology that is designed to optimize inventory and materials planning, and it was introduced in SAP S/4HANA (starting from 1709). It helps to reduce inventory and improve service levels by using strategic, color-coded inventory buffers (red, yellow, green) rather than relying solely on forecasts. It uses a pull-based system to manage material flow based on actual consumption.

Now, let's move on to the next fields in the **MRP 1** view, referring back to Figure 3.14. The **MRP Controller** field is a key used to identify a person or a group of people responsible for planning the material. This key isn't used to group materials based on product type.

The **Lot-Sizing Procedure** indicator helps in determining the lot size (or the quantity to be procured/produced) during the net requirement calculation in the planning run. This means the MRP run will calculate the exact order quantity based on the lot size. The lot sizes are divided into three major types, that is, static lot size, period lot size, and optimum lot size. Figure 3.16 shows the **Lot-Size Data** section of the **MRP 1** view of the material master.

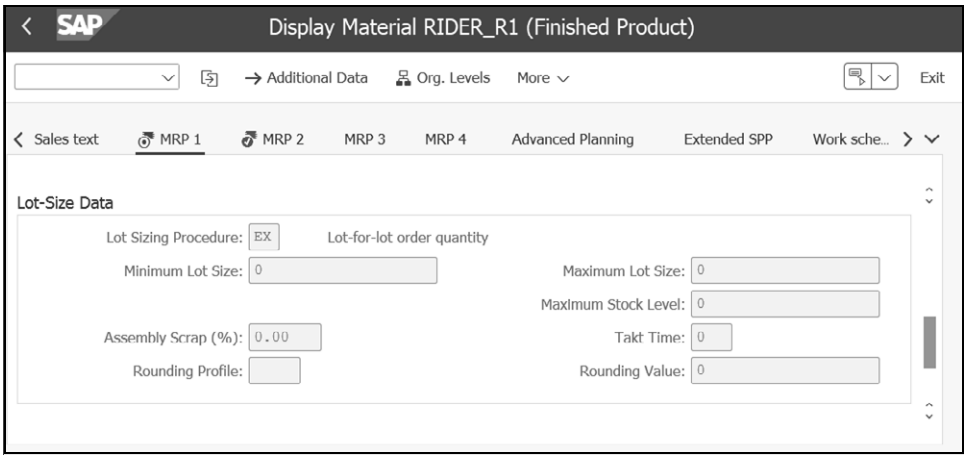


Figure 3.16: Display Material: Lot-Size Data

The lot-sizing procedures are categorized into three broad categories:

■ **Static lot size**
The procurement quantity is calculated based on the specified quantity in the material master. You can select the lot-sizing procedure **FX** (**Fix Order Quantity**) and maintain the

quantity in the **Fix Lot** field, and the system will create the order for the lot size as specified. The lot-size indicator **EX** (**Lot for lot order quantity**) is used to create an order for the quantity that is an outcome of the net requirement calculation, which would consider the demand/requirement and reduce the available stock. Similarly, you can use lot size to replenish the stock up to the maximum stock level.

- **Period lot size**
  You can cumulate the requirement for a specified time interval. For example, you can group the demand for a time bucket (days, week, or month) and the system will generate orders (planned orders/purchase requisitions) accordingly. You can select one of the lot sizes such as **MB** (monthly lot size), **WB** (weekly lot size), and **TB** (daily lot size).
- **Optimum lot size**
  As the name suggests, this lot-sizing procedure aims to create optimal lots by minimizing costs such as lot-size-independent costs (setup or order costs) and storage costs. Some of the most common lot sizes are part period balancing, dynamic lot size, and Groff reorder procedure.

The lot-sizing procedure that has been selected influences the **MRP 1** view screen of the material master. Based on which lot-sizing procedure is selected, the **MRP 1** screen may show one of the following fields in the lot size data section of the **MRP 1** view:

- **Minimum Lot Size**
  Defines the minimum order quantity permitted for a procurement element (planned order or purchase requisition). If the output of the net requirement calculation is less than this value, then the system automatically rounds up the order quantity to the value defined in this field. This is usually used for low-value parts, which are usually supplied in a minimum lot size due to batch constraints, packaging constraints, and so on.
- **Maximum Lot Size**
  Defines the maximum order quantity permitted for a procurement element (planned order or purchase requisition). If the output of the net requirement calculation exceeds this value, the system will automatically split the quantity into multiple orders so that each order doesn't exceed the value defined in this field. This is usually used when there are production, storage, transportation, or supplier capacity constraints that limit the maximum quantity that can be ordered at one time.
- **Maximum Stock Level**
  This field defines the maximum quantity of stock that should be available for a material. During MRP, the system plans procurement proposals (planned orders or purchase requisitions) in such a way that the projected available stock doesn't exceed the value maintained in this field. It's typically used to control inventory levels due to storage capacity, shelf-life limitations, or inventory carrying cost considerations. It's used in conjunction with the lot-sizing procedure **HB** (**Replenish to maximum stock level**).
- **Assembly Scrap**
  During the production of assembly materials, some scrap is usually generated. You can maintain a scrap percentage so that it's factored into the lot size calculation. For

example, if the assembly scrap is set to 10% and the requirement is 100 pcs, the system will create a procurement or production order for 110 pcs, ensuring the requirement is met despite the scrap. Maintaining assembly scrap also helps improve the planning of component requirements.

3.2.2 MRP 2 View

Now that we've learned about the fields in **MRP 1** view, let's go to the **MRP 2** view (see Figure 3.17) and understand some of the key fields:

- **Procurement Type**

  The procurement type determines how a material is sourced—whether it's manufactured in-house or purchased from a vendor. You can select one of the following procurement types: **E** (in-house production), **F** (external procurement), **X** (both procurement types), and blank (no procurement).

  If the material is externally procured, the MRP run generates a purchase requisition. If it's produced internally, the system creates a planned order. For certain materials that are usually produced in-house but may occasionally need to be purchased due to capacity limitations, both procurement options can be used. In this case, the system generates a planned order during MRP, and the MRP controller can decide whether to convert it into a production order for in-house manufacturing. If in-house capacity is insufficient, the planned order can instead be converted into a purchase requisition, which can then be turned into a purchase order for external procurement.

- **Special Procurement**

  The procurement type of a material is usually determined by its material type and defines how the material is procured. For scenarios not covered by standard procurement types—such as when materials aren't produced in the plants where they are needed—you can create special procurement types. Each special procurement type is based on an existing procurement type and can be assigned to materials in the material master.

  SAP S/4HANA standard comes preconfigured with several special procurement types under **Procurement Type E** (in-house production) such as 50 (phantom assembly), 52 (direct production/collective order), 60 (phantom in planning), 70 (withdrawal from alternative plant), and 80 (production in alternative plant). The phantom assembly can be used to logically group materials for planning purposes, mostly from an engineering perspective. Phantom assemblies aren't physically produced, and dependent requirements are passed directly to lower BOM levels. Similarly, production in another plant is used when a material is produced in a plant different from the one where the demand is initiated. Special procurement types can be created for all combinations of the planning plant (the plant needing the material) and alternative plant (the plant producing the material). Likewise, withdrawal from an alternative plant is used when a material is withdrawn from a plant other than the one requiring it, and special procurement types can be defined for all combinations of planning and alternative plants.

Under **Procurement Type F** (external procurement), several special procurement types are available such as 10 (consignment), 20 (external procurement), 30 (subcontracting), 40 (stock transfer [**proc.from alter.plant**]), and 45 (stock transfer from plant to MRP area). The consignment is a process where the supplier provides materials at the customer site, with costs incurred by the supplier, and is used when a material is procured externally via a consignment order. Subcontracting occurs when a supplier receives material components and produces the required assemblies externally, and this special procurement type is used when a material is procured via subcontracting. Stock transfer is applied when a material is procured from a different plant than the one requiring it; the planning plant determines the material requirement while the alternative plant supplies it. Special procurement types can also be created for all necessary combinations of planning and alternative plants. Withdrawal from an alternative plant in external procurement follows the same logic as in in-house production, allowing for combinations of planning and alternative plants to be defined as needed.

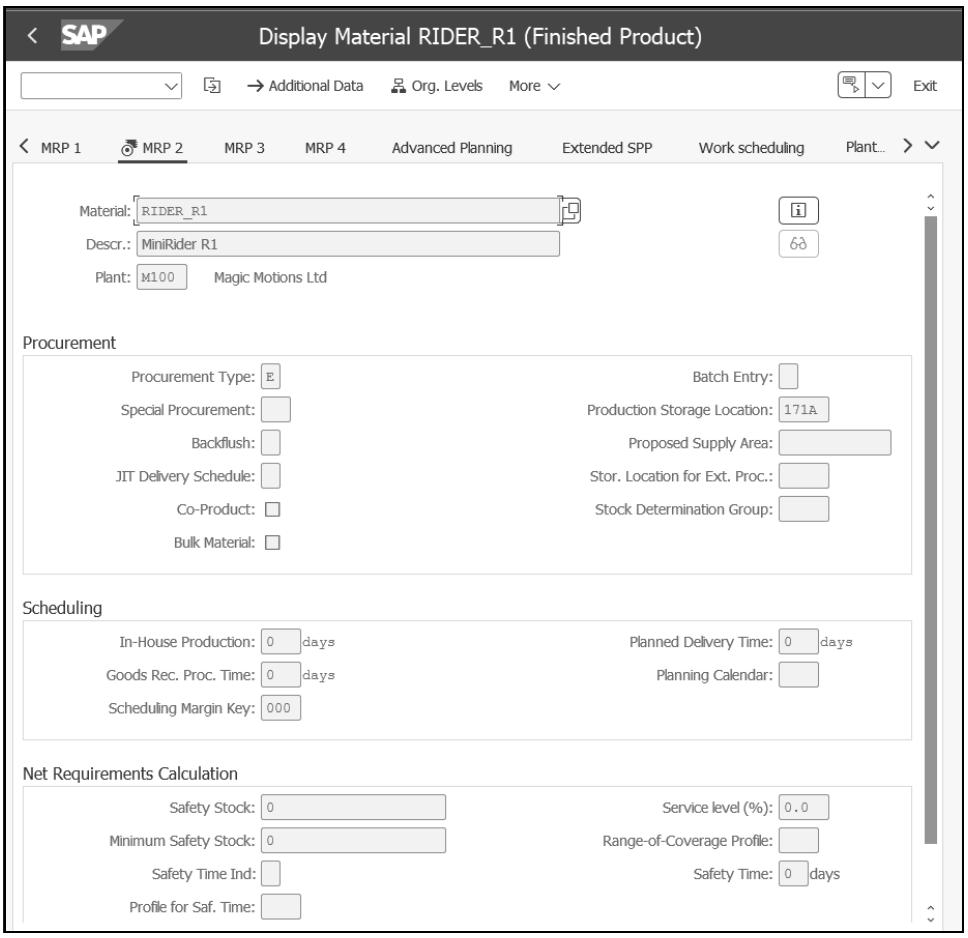


Figure 3.17: Display Material: MRP 2 View

- **Backflush**

  Backflush refers to the automatic posting of goods issues to a production order, allowing you to skip the manual goods issue process. The **Backflush** indicator can be set in multiple master data objects, with the system determining the applicable setting based on the following hierarchy. In routing, backflush can be activated for a component in its component assignment. In the material master, you can enable backflush directly or leave the decision to the work center. If the work center is chosen in the material master, backflush can be activated at the work center level. This is especially useful when you want to backflush all components consumed in a work center, avoiding the need to activate backflush individually for each material.

  It's recommended to use backflush for components that are of low value, don't require precise batch traceability, are used in large quantities, or are difficult to count manually.

Caution

Just because backflush automates the process and eliminates manual efforts doesn't necessarily always mean it's the best solution. There are several scenarios where backflush might not be the right choice. For instance, if there's variance in component consumption, backflush isn't advisable. It works best when the component-to-product ratio is fixed—for example, two tires are needed to assemble a bicycle. In industries such as fast-moving consumer goods (FMCG) or pharmaceuticals, where component consumption can vary for each product or lot, manual goods issue should be used to capture the actual consumption. In addition, if batch consumption varies, automatic batch determination (based on first in, first out [FIFO], last in, first out [LIFO], etc.) may not meet specific business requirements. In cases where a particular batch must be used, manual goods issue provides the necessary flexibility to select the correct batch at the time of goods issue. Likewise, for production processes with long lead times, where operations take several days, components are effectively consumed during confirmation. This can lead to inventory variances, as raw materials are actually consumed at the start of the process, making it preferable to post the goods issue at the beginning rather than relying on backflush.

- **Batch Entry**

  This field is used to specify how the batches of components are determined in a production/process order. You have the following options:

  - Blank: Batch in goods issue; no confirmation required
  - **1**: Manual batch determination required upon release of order
  - **2**: Batch not required in production/process order; confirmation required
  - **3**: Automatic batch determination upon release of order

- **Production Storage Location**

  For an in-house produced material, finished goods are posted at goods receipt in the production storage location, while for a component, the backflush is posted in the issuing storage location.

- **In-House Production**
  This field defines the lead time required for production. Typically, the manufacturing lead time is calculated as the sum of the in-house production time and the goods receipt processing time. It's maintained in workdays and is used during a planning run to determine the basic dates for planned orders. The in-house production time is independent of lot size, meaning the planned dates remain the same regardless of the quantity being produced.
- **Planned Delivery Time**
  This field is used to maintain the lead time that is needed for procuring the materials from the vendor. Normally, purchasing lead time is the sum of planned delivery time and goods receipt processing time. This is maintained in workdays and specifies the time from when it's ordered until it's received in the warehouse. Like in-house production time, it helps the material controller plan the components effectively, as planned delivery time is calculated in the purchase requisition.
- **Goods Rec. Proc. Time**
  This is the time needed for quality inspection and placing the materials in the warehouse once the stock is received. Goods receipt processing time is also considered to calculate the total replenishment lead time.
- **Scheduling Margin Key**
  This key is used to determine floats or buffer time that should be considered during lead time scheduling. The floats are generally used for administrative activities or to compensate for interruptions during production. Float before production or after production can be used as a buffer for unforeseen interruptions. Float before production is used to compensate for any delays in material staging of components or delays caused due to capacity constraints. The float after production can be used to compensate for unexpected interruptions or delays during production.
- **Safety Stock**
  This is the quantity of the material that should always be in stock to mitigate the risk of running out of stock during uncertain times. Safety stock acts as a buffer to meet unexpected high demands from the customer or to continue production even if there's an interruption in delivery from the vendor. It can be maintained manually using manual reorder point planning or it can be determined automatically using automatic reorder point planning or forecast-based planning.
- **Minimum Safety Stock**
  The minimum safety stock specifies the lowest level of safety stock that should be maintained for a material at any time. If the calculated safety stock falls below this threshold, the system automatically sets the safety stock to this minimum value.
- **Range-of-Coverage Profile**
  This defines how many days of future demand the stock should cover. It helps MRP calculate dynamic safety stock by setting minimum, maximum, and target stock levels. This ensures enough inventory is available to avoid stockouts without creating excess stock.

The calculation is based on average daily demand and adjusts safety stock according to expected requirements over a defined period.

3.2.3 MRP 3 View

Now, let's move to understand some of the key fields in the **MRP 3** view of the material master, as shown in Figure 3.18.

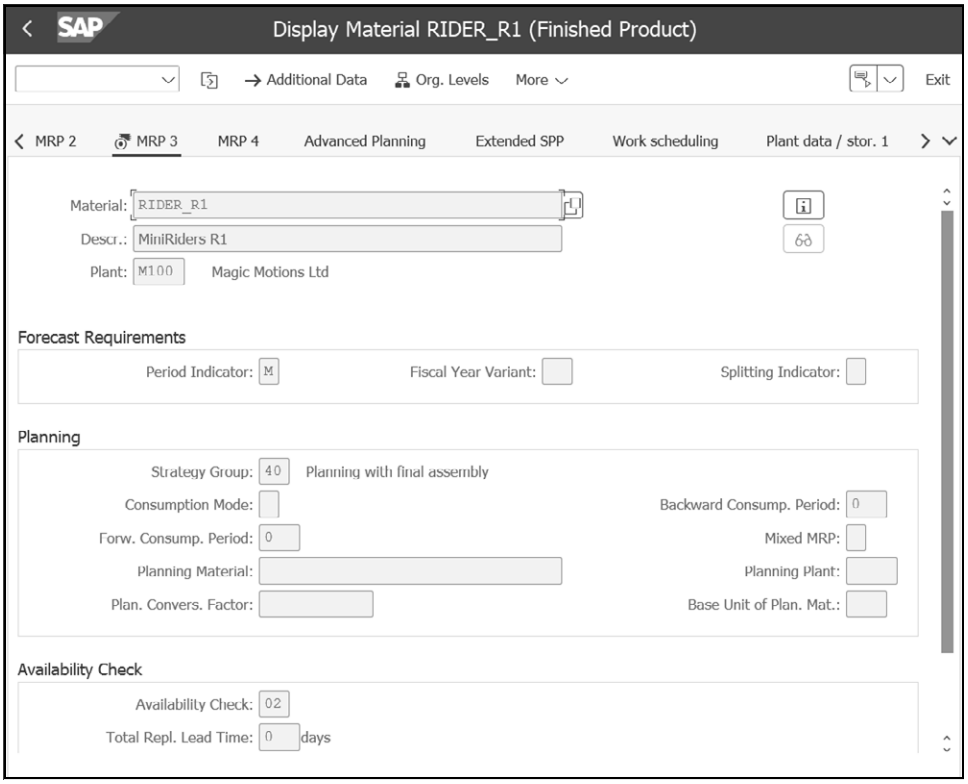


Figure 3.18: Display Material: MRP 3 View

Let's start with the **Strategy Group** field. A strategy group is used to group together all the planning strategies that can be used for a material. However, in most cases, only one planning strategy is used for a material.

The planning strategy is used to determine how a material is planned for production. The planning strategy indicates if the material is produced in a make-to-stock or make-to-order environment. Depending on the strategy you choose (i.e., if production takes place based on sales orders or forecasts), you can also combine planning strategies within a planning strategy group. This means that you could select the planning strategy **Planning with final assembly** (**40**) for a finished product, but you can still select a different strategy, such as **Planning at assembly level** (**70**), for a subassembly in the BOM of this finished product.

Let's explore some of the key make-to-order and make-to-stock strategies:

- **Make-to-order**
  The materials are produced for a specific sales order only and the PIRs aren't taken into account. The production is executed for a sales order and each production order has a direct assignment to the sales order. The cost of production is settled on the sales order. The most common make-to-order planning strategies are **20** and **50**. Let's take a closer look at each:
  - **20 Make-to-order production**: Strategy **20** is designed for true make-to-order environments, where production is initiated directly by customer sales orders rather than forecasts. Each order drives its own procurement and manufacturing activities, ensuring that products are built specifically to meet individual customer requirements. Key characteristics of strategy **20** include the following:
    - Each sales order item is managed separately, appearing in its own individual segment within the stock/requirements list and the MRP list.
    - Customer requirements are reduced upon goods issue to the respective sales order, ensuring accurate order tracking.
    - The individual/collective requirements indicator (**MRP 4** view) determines whether lower-level components are planned and procured specifically for the sales order (individual requirements) or collectively with other demands.
  - **50 Planning without final assembly**: This is a make-to-order strategy where subassemblies and components are produced or procured based on forecasted demands (PIRs) in anticipation of a customer order. However, the production for final assembly is strictly triggered only after a sales order is received. Key characteristics of strategy **50** include the following:
    - The production of subassemblies and procurement of components are triggered based on forecast (PIRs).
    - The production for final assembly is triggered based on actual customer sales orders.
    - Nonconvertible planned orders are created as a result of MRP runs for the final assembly. These planned orders are created with order type **VP** (valuation/planning), which can't be converted into production orders.
    - When a sales order arrives, it consumes the **VP** PIR, and a new customer-specific planned order is generated for the final assembly that can be converted into a production order.
    - The individual/collective requirements indicator must be set to **2** (collective) for lower-level components to pool component demand.
- **Make-to-stock**
  The materials are produced based on the forecast only, and any demand coming from sales orders isn't considered. Demand management plays a vital role in make-to-stock production because MRP plans the production against the PIRs. The cost of production is

settled on the material. The most common make-to-stock planning strategies are **10**, **11**, and **40**.

Let's learn about some of the make-to-stock strategies and how the materials are planned using them:

- **10 Make-to-Stock**: Strategy **10** is designed specifically for pure make-to-stock environments, where production is driven entirely by forecasted demand rather than actual sales orders. In this approach, customer requirements don't influence the production process. Instead, manufacturing is executed based on planned demand, which is transferred through a demand program or entered manually as PIRs.

  During the MRP run, available warehouse stock is considered in the net requirements calculation to determine procurement or production quantities. Because of this logic, strategy 10 is also known as net requirements planning. Key characteristics of strategy **10** include the following:

  - Sales orders are displayed for informational purposes only. They neither consume PIRs nor impact the demand program. As a result, sales orders don't influence the production plan.
  - Plant and warehouse stock are taken into account during planning, and order quantities are adjusted accordingly.
  - PIRs aren't consumed by customer requirements (e.g., sales orders or scheduling agreements) because customer demand isn't directly relevant in a pure make-to-stock scenario.
  - PIRs are consumed at the time of post goods issue (PGI) for sales order deliveries.
  - This strategy is commonly applied in repetitive manufacturing environments, where production is continuous and forecast-driven.

- **11 Gross requirements planning – MTS**: Strategy **11** is intended for pure make-to-stock environments where production is driven exclusively by forecasted demand. In this strategy, sales orders don't influence production planning. Manufacturing quantities are determined based on the demand program or manually maintained PIRs.

  Unlike other planning strategies, existing plant or warehouse stock isn't considered during the net requirements calculation in the MRP run. Production is therefore executed strictly according to the forecast, regardless of current inventory levels. For this reason, strategy **11** is also categorized under net requirements planning. Key characteristics of strategy **11** include the following:

  - Sales orders are displayed for reference purposes only. They don't consume PIRs or modify the demand plan, and therefore have no impact on the production program.
  - Plant and warehouse stock aren't taken into account during planning and don't affect production quantities.
  - PIRs are reduced at the time of goods receipt for the production order, rather than during sales order processing.

- **40 Planning with final assembly**: Strategy **40** is a unique strategy used in make-to-stock environments where both forecast and actual customer demand are considered during planning. Production is initially driven by forecasted demand through PIRs. However, sales orders consume these PIRs, which influences the final production plan because it avoids duplicate demands. Key characteristics of strategy **40** include the following:
  - Planning takes place at the finished goods level, ensuring availability of completed products.
  - Sales orders are relevant for planning and consume PIRs, aligning forecast with actual demand.
  - If sales order quantities exceed the forecast, the system generates additional procurement or production proposals to cover the excess demand.
  - If sales order quantities are lower than the forecast, the remaining quantity is planned into stock.
  - The strategy supports faster response to customer requirements, as production is already prepared at the finished product stage.

■ **Assemble-to-order**

A product is assembled only when the sales order is received. The assemble-to-order environment is used in industries where a lot of finished assemblies are produced using the same components and semifinished assemblies. This gives you the flexibility to procure the key components and produce semifinished assemblies in a make-to-stock environment while the final assemblies are only produced once the customer orders are received. Let's look at the planning without final assembly strategy:

- **50 Planning without final assembly**: Strategy **50** is a specialized make-to-order approach typically used when the primary value-added activity occurs during final assembly. In this strategy, component procurement and subassembly production are planned in advance based on forecasted demand. However, final assembly of the finished product is only triggered once a sales order is received. This strategy is commonly used in industries where core semifinished assemblies are standardized, and product differentiation occurs primarily during the final assembly stage. Key characteristics of strategy **50** include the following:
  - PIRs are maintained at the finished product level to forecast demand.
  - During MRP, the system generates nonconvertible planned orders (order type **VP**) for the finished product based on PIRs. These planned orders create dependent requirements for lower-level components.
  - Subassemblies and components are produced or procured in advance, ensuring readiness for final assembly.
  - Once a sales order is received, the subsequent MRP run generates convertible planned orders for the finished product, allowing final assembly to proceed.

Now, let's return to the next fields shown earlier in Figure 3.18. The **Consumption Mode** key is used to determine how the forecasts are consumed by the demands. It determines how the demands (sales orders, dependent requirements, or material reservations) would consume forecasts (PIRs) on the time axis. You can use backward consumption to consume forecasts that fall earlier than the requirement date of demands or forward consumption to consume forecasts that fall after the requirement date of demands.

Figure 3.19 shows how the PIRs are consumed by customer requirements in backward and forward consumption modes. Let's take a closer look at these methods of consumption:

- **Backward Consump. Period**
  If you're using backward consumption, then you can specify the period for which PIRs are consumed by sales orders, dependent requirements, or material reservations. The backward period is calculated from the current date.
- **Forw. Consump. Period**
  If you're using forward consumption, then you can specify the period for which PIRs are consumed by sales orders, dependent requirements, or material reservations. The forward period is calculated from the current date.

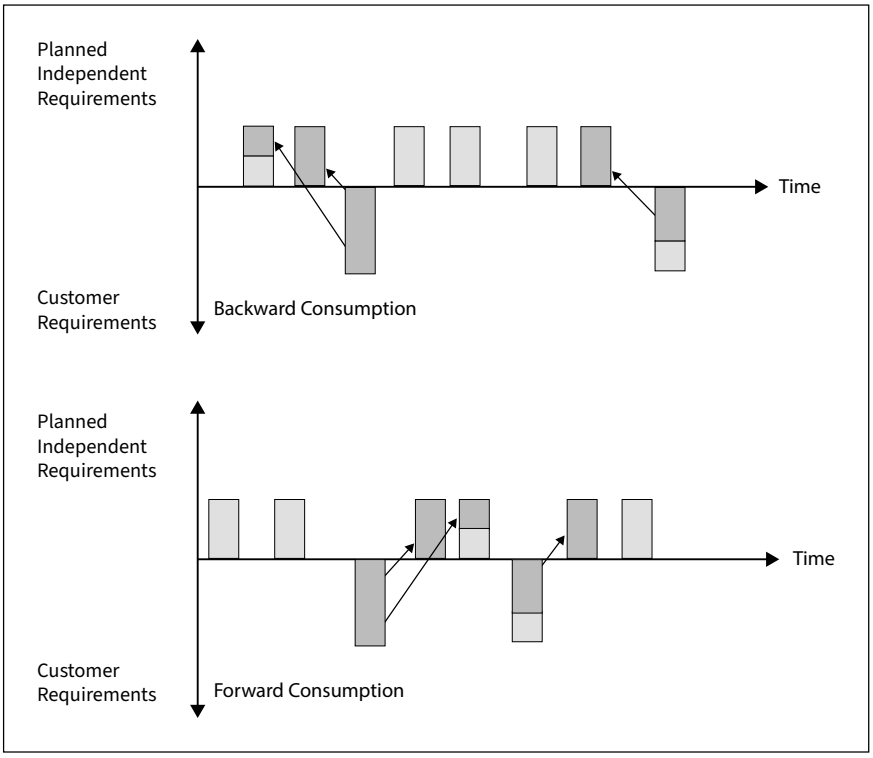


Figure 3.19: Consumption Mode

Finally, the **Availability Check** field determines whether a material would be available to meet demands. You can assign checking groups such as **01** for grouping daily requirements

and **02** for individual requirements. The checking group works in conjunction with the checking rule to define the scope of the check. It evaluates several factors, including current stock levels in the warehouse, upcoming production through planned orders, and any planned purchases via purchase requisitions. Available-to-promise (ATP) also considers confirmed delivery schedules from vendors and incorporates the necessary lead times for producing or procuring the materials, ensuring accurate availability confirmation.

3.2.4 MRP 4 View

Let's learn more about the **MRP 4** view of the material master, as shown in Figure 3.20.

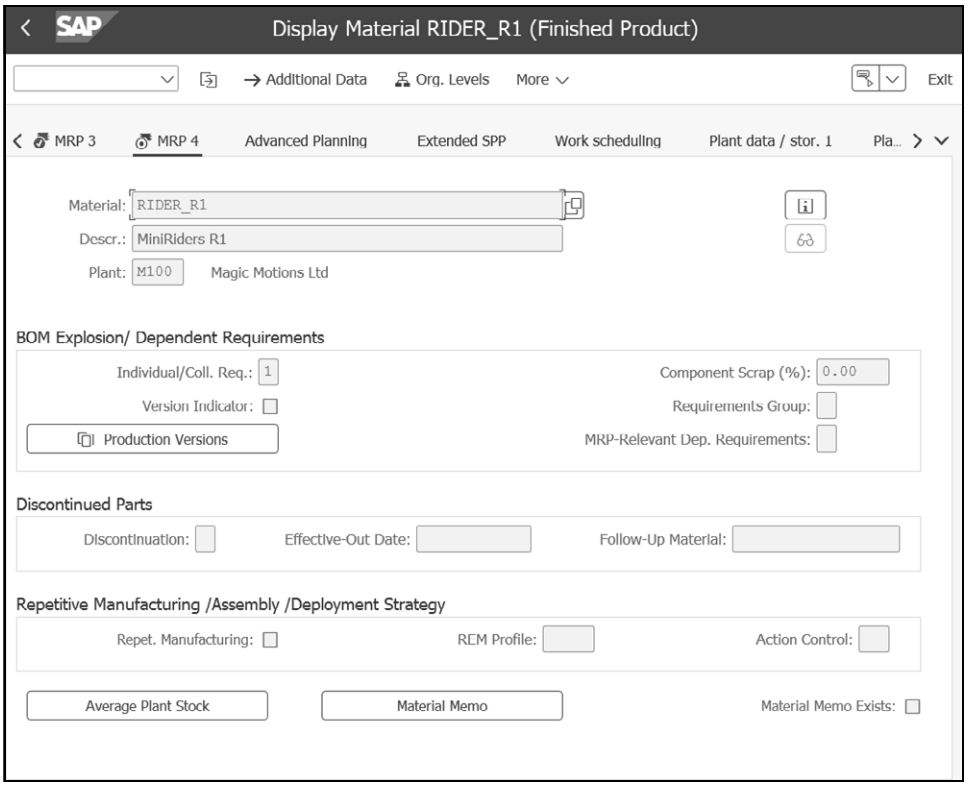


Figure 3.20: Display Material: MRP 4 View

Let's discuss some of the key options in this view:

- **Individual/Coll. Req.**
  This indicator controls how the dependent requirements for components are planned during the MRP run. The indicator **1** (individual) plans the components separately for each sales order or requirement. This helps to link each order to respective customer orders. The indicator 2 (collective) groups the requirements for a material and creates a cumulative order. If the indicator is blank, then the settings are inherited from the parent material.

- **Production Versions**
  A production version specifies a particular method for manufacturing a material. For example, a finished product might have multiple BOMs (managed in SAP S/4HANA using alternative BOMs) or be produced on different assembly lines. The production version defines a unique combination of BOM and routing, representing a distinct manufacturing process. The **Production Versions** button is used to create these versions, each of which includes details such as the valid date range, lot size range, and status for the material. In SAP S/4HANA, defining a production version is mandatory.
- **Repet. Manufacturing**
  If you're operating in a repetitive manufacturing environment and you want to produce the materials using repetitive manufacturing, then you activate it using this checkbox. When activating repetitive manufacturing, the **REM Profile** must also be assigned.
- **REM Profile**
  If repetitive manufacturing is activated, then you assign a repetitive manufacturing profile, which decides certain parameters based on the customization in the Implementation Guide (IMG): **Production • Repetitive Manufacturing • Control • Define Repetitive Manufacturing Profiles**:
  - Order type determines if a material is produced in a make-to-stock or make-to-order environment.
  - Control parameters are used for reporting point, error correction, planned order reduction, and so on.
  - Movement types are used for goods receipt, goods issue, scrap, and so on.

3.2.5 Work Scheduling View

Now, let's move to the **Work scheduling** view, which is mandatory to maintain for discrete manufacturing. This view contains production-relevant information and is essential to maintain if you're operating in the discrete/process industry.

Figure 3.21 shows the **Work scheduling** view of the material master. Let's walk through the key fields:

- **Prodn. Supervisor**
  This is an identifier for a person or a group of people who are responsible for the production of the material. A production scheduling profile can be assigned to a production supervisor (in the customization) based on which the scheduling parameters are determined, as detailed in the next field.
- **Prod. Sched. Profile**
  This is used to control how some of the business functions are triggered in the production order or process order. Production scheduling profiles are defined in customization (Section 3.6.1) and can be assigned to a production supervisor or material. It can control several activities:

- An order can be released automatically at the time of order creation.
- The shop floor papers can be printed and scheduled automatically at the time of order release.
- Automatic goods receipt can be triggered during order confirmation.

You can specify an overall profile for capacity leveling to define order types to be selected while converting planned orders to production orders. Different order types can be defined for make-to-stock, make-to-order, and engineer-to-order environments.

■ **Serial No. Profile**

In discrete manufacturing, it's common for each of the materials produced to have a unique identification number, for example, a chassis number for a vehicle or an International Mobile Equipment Identity (IMEI) number for a cell phone device. The serial number profile is defined in customization (Transaction OIS2) to define certain parameters about how the serial numbers are created. If the business is into serial production, then a serial number profile must be assigned to the material. Based on the configuration settings, serial numbers are created at the time of goods receipt.

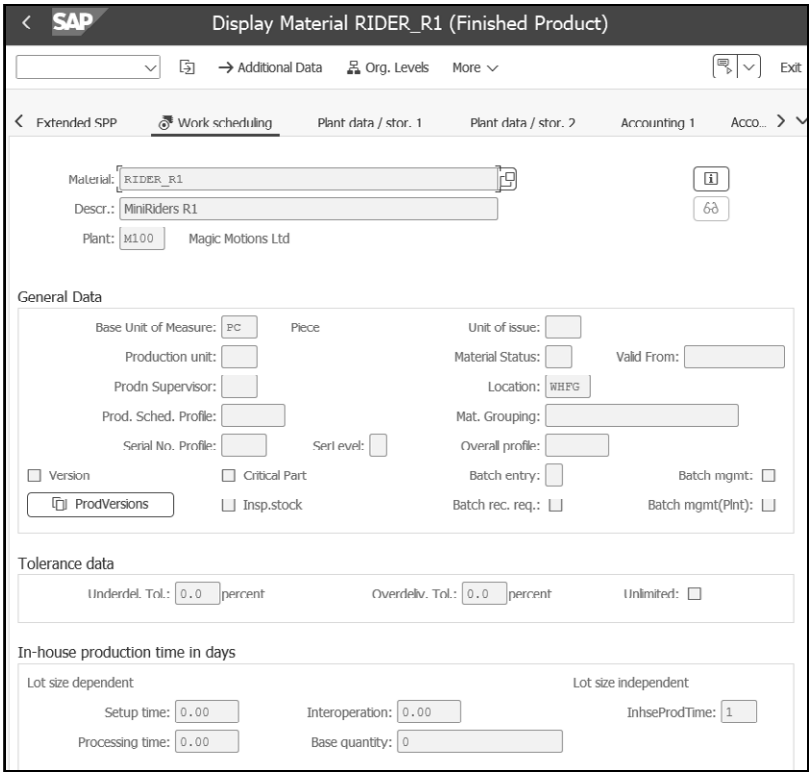


Figure 3.21: Material Master: Work Scheduling

■ **SerLevel**

You can define the serialization level, which is the level at which a serial number must be unique. If uniqueness is set at the material level, the system validates the combination of

material and serial number, allowing the same serial number to be used for different materials. However, if you require serial numbers to be unique across the entire client, activate indicator **1**. This ensures that no two materials can share the same serial number. When using this setting, indicator **1** must be maintained in every material master record.

- **Batch entry**
  This field defines how component batches are determined in a production or process order. Batches can be assigned manually in the order before it's released, determined automatically at the time of order release, or determined when the goods issue is posted. Alternatively, batches may be required to be entered in the order before posting the goods issue, without needing to be specified prior to order release.
- **Batch rec. req.**
  This indicator is relevant only for operations in the process industry. When it's selected in the material master, the system verifies whether the batch record has been approved before allowing certain postings. Specifically, it controls whether a usage decision can be made for an inspection lot originating from a goods receipt from production, and whether a batch status can be changed from restricted to unrestricted.
- **Batch mgmt**
  This indicator can be used to activate batch management at the client level.
- **Batch mgmt(Plnt)**
  The indicator can be used to activate batch management for a material at the plant level.
- **Underdeliv. Tol.**
  At times, it's not possible to produce the exact order quantity, so the produced quantity might fall short of the production quantity. The underdelivery tolerance allows you to define the minimum quantity that can be accepted against an order. For example, if the order quantity is 100 and the underdelivery tolerance is set to 5%, the system won't permit a goods receipt for less than 95.
- **Overdeliv. Tol.**
  When the produced quantity exceeds the production order quantity, the system allows goods receipt only within the defined overdelivery tolerance. This tolerance specifies the maximum quantity that can be accepted against the order. For example, if the order quantity is 100 and the overdelivery tolerance is set to 5%, the system won't permit a goods receipt greater than 105.
- **Unlimited**
  This indicator is used to define that there are no limits on either overdelivery or underdelivery. When it's selected, the system allows goods receipt to be posted for any quantity.

3.3 Bill of Materials

We've covered the views and corresponding fields in the material master that are relevant to manufacturing. We must create the material master for all assemblies, including

semifinished assemblies and raw materials. Now, let's move to the next step, which is to create manufacturing bills of materials (MBOMs) for the scooter assembly.

As mentioned at the beginning of the chapter, a BOM is a detailed and structured list of the components or subassemblies required to manufacture a product. It identifies every component by its material number and lists key data such as the required quantity and UoM, among other details. A company such as Magic Motions requires a wide range of components—such as the Deck (or Footboard), Handlebar Assembly, Front Fork, Wheels, Bearings, Steering Mechanism, Brake Assembly, Fasteners, and so on—to assemble the scooter. Table 3.3 shows all the components that are needed to produce a material; however, as compared to the engineering bill of materials (EBOM), there's a slight variation. A subassembly for Handlebar Assembly has been created in the BOM for the final assembly that contains components T-bar, Grips, and Handle Clamp. Thus, Table 3.3 shows a multilevel MBOM.

Level	Item No.	Component Number	Component Description	Qty per Unit	Unit of Measure
1	1	R1_SFG_01	Handlebar Assembly	1	PCs
1	2	R1_RM_01	Deck (Footboard)	1	PCs
1	3	R1_RM_02	Front Fork	1	PCs
1	4	R1_RM_03	Front Wheel	1	PCs
1	5	R1_RM_04	Rear Wheel	1	PCs
1	6	R1_RM_05	Bearings	2	Sets
1	7	R1_RM_06	Steering Mechanism	1	PCs
1	8	R1_RM_07	Brake Assembly	1	PCs
1	9	R1_RM_08	Fasteners	1	Sets
1	10	R1_RM_09	Grip Tape/Foot Pad	1	PCs
		R1_SFG_01	Handlebar Assembly		
2	1	R1_RM_10	T-bar	1	PCs
2	2	R1_RM_11	Grips	1	PCs
2	3	R1_RM_12	Handle Clamp	1	PCs

Table 3.3: MBOM for Magic Motions

Chapter 2, Section 2.3, explains the EBOM and covers all the BOM details. Because the creation and maintenance of BOMs is the same for EBOMs and MBOMs, you can refer to Section 2.3 to create the MBOM. At Magic Motions, the manufacturing team must create an MBOM.

Figure 3.22 shows the initial screen for creating a BOM. When creating an MBOM, enter the material, select the **BOM Usage** as **1** (**Production**), and maintain the **Plant** field. If a product can be created by using several combinations of the components, then alternative BOMs can be created. The **Change Number** field (engineering change number) can be used to create or change BOMs, as well as track and manage the change history of a BOM.

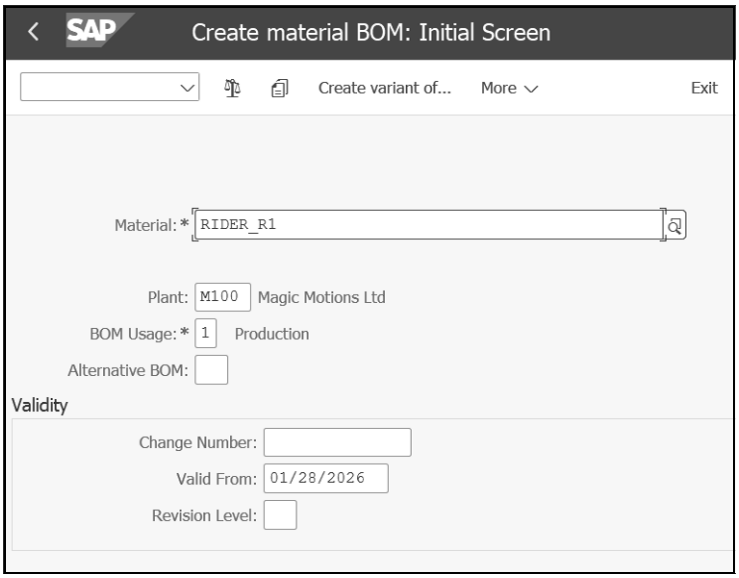


Figure 3.22: Create Material BOM: Initial Screen

In Chapter 2, Section 2.3, we've explained the BOM header as well as the BOM item. Let's learn about some of the fields that weren't covered there because they are more relevant to the MBOM:

- **Asm (assembly)**
  When a component is a semifinished assembly with its own BOM, the system automatically assigns the **Asm** indicator. This is typically used in multilevel BOM structures. If you double-click the indicator in change or display mode, the system will navigate directly to the BOM of the corresponding semifinished assembly. Figure 3.23 shows that the first component **R1_SFG_01** (**Handlebar Assembly**) has the indicator **Asm**, which represents that the Handlebar Assembly has a BOM of its own.
- **SIs (subitems)**
  A subitem isn't an actual component; rather, it indicates the specific position where a component should be installed within an assembly or subassembly. In other words, subitems help identify exactly where to place components during the production/assembly process. This functionality is especially useful for assembly-oriented industries such as vehicles, machinery, and computers. Once subitems are maintained, the **SIs** are automatically set by the system.

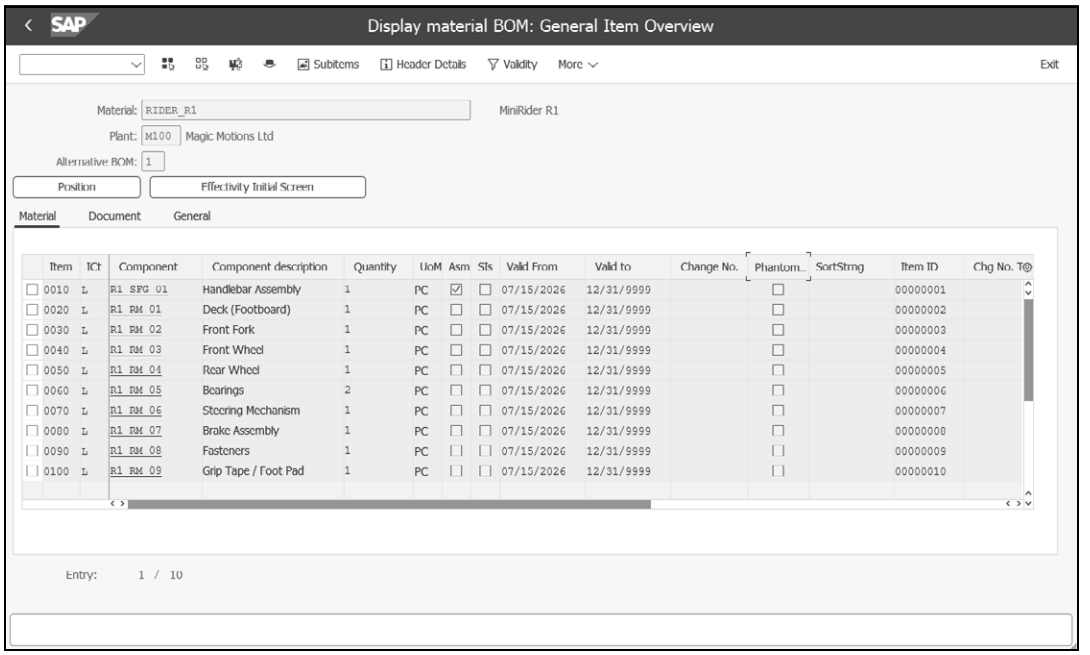


Figure 3.23: Material BOM: Item Overview

This scenario is particularly relevant for the electrical and electronics industry, where it's critical to store reference points in SAP and transmit this information to the manufacturing execution system (MES). Reference points mark the exact location where a component, such as a capacitor or relay, should be placed on the printed circuit board (PCB). Because the same component can be used at multiple locations, a single component may have multiple reference points. Therefore, it's essential to store all reference points for each component in SAP S/4HANA. Subitems can be maintained by selecting the **Subitem Overview** button.

- **Valid From/Valid to**

  The **Valid From** field indicates the date from which the component becomes valid. By default, the system sets the current date (the date the BOM is created) as the valid-from date. When a new component is added to an existing BOM, the system automatically assigns the current date as the valid-from date for that component. If a **Change Number** is used, the valid-from date is taken from the **Change Number** instead.

  The **Valid to** field specifies the date until which the component remains valid. By default, the system sets the valid-to date as 12/31/9999. If a component is replaced with another, the valid-to date is updated accordingly to reflect the change.

- **Change No. (change number)**

  Change numbers can be used to create or change a BOM and to control the valid-from date for the BOM header or components. They are also used to keep track of the changes made to the BOM and document its change history.

- **Phantom Assembly**

  A phantom assembly is a logical grouping of components that is used to represent a non-stocked, intermediate assembly. It isn't produced or stocked as a separate material and is used for planning components only. The components are directly consumed by the parent assembly during production. Phantom assemblies are used to simplify the BOM structure and avoid unnecessary intermediate production steps. A BOM item marked as **Phantom** is automatically exploded during production or planning, and the components are planned for procurement.

  For example, if a computer has a Motherboard Assembly consisting of resistors, capacitors, and chips, you can mark the Motherboard assembly as a phantom item so that you don't need to stock the motherboard separately. It helps to plan all components such as resistors, capacitors, and chips, but eliminates an additional production order execution process in the system. The components are directly consumed during the production of the computer.

- **Co-Products**

  During a manufacturing process, sometimes more than one product can be produced: the primary product and one or more secondary coproducts. The secondary products are referred to as coproducts.

  Activate the **Co-Product** indicator in the **MRP 2** view of the material master and define the coproduct with a negative quantity in the BOM. You also define the apportionment structure in the material master. It's used to allocate the total costs of the manufacturing process to the primary product and coproduct.

  You can define different settlement receivers for the main product and the coproduct(s). The production order is created for the primary product and coproducts are produced in conjunction with the main product during a shared manufacturing process.

  The system creates a separate order item in the production order for each coproduct. This means that it's possible to display actual costs at the coproduct level. The goods receipts are posted simultaneously for the main product as well as coproduct(s).

- **By-Product**

  A byproduct is produced while producing a primary product. As opposed to coproducts, byproducts are low-value products, so the system doesn't create a separate order item for a byproduct. The byproducts are defined with a negative quantity in the BOM. Their material valuation is determined by the price specified by price control in the material master.

  Coproducts have a significantly high value while the byproducts have low or incidental value. Coproducts are planned and scheduled along with the primary products, while byproducts are generally not planned. Coproducts share the production costs based on an apportionment structure while the byproducts are typically recorded at zero or nominal cost. The value is usually credited to the main product's cost.

For example, the metal chips produced as an output of machining a steel component have a significantly high value and can be considered a coproduct because they can be sold to generate revenue. Because the wood residue generated during wood processing can't be sold, it has a low or even zero value, and is treated as a byproduct.

- **Recursive Allowed**
  A recursive BOM is a unique manufacturing process where a material is assigned as a header material as well as a component in the BOM. Activate the **Recursive Allowed** checkbox for the component in the BOM item details. Failure to do so might lead to an MRP error as it keeps on running in an infinite loop. This kind of scenario is usually applicable in process industries such as the manufacturing of yogurt. However, this can also be used in discrete manufacturing, for instance, to rework a defective metal sheet. In this case, you create a production order for the metal sheet with the component listed as Metal Sheet (both metal sheets have the same material number).

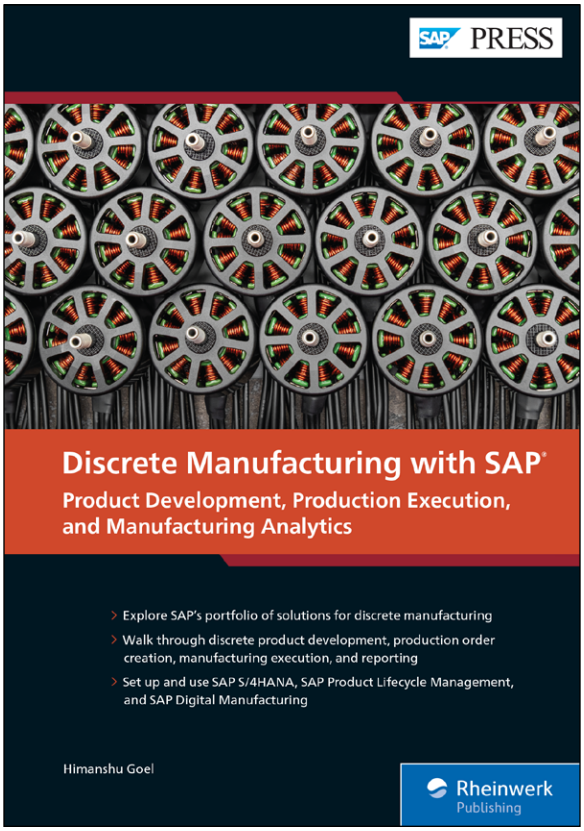
3.4 Routing

In simple terms, a routing is nothing but the manufacturing process. In SAP S/4HANA, a routing contains a structured sequence of manufacturing operations that converts the raw materials into a finished or semifinished product. It's a key master data object for manufacturing and provides detailed operational information, including the following:

- Operations required to manufacture the finished or semifinished assembly
- Work centers where each operation is performed
- Setup times, machine changeover times, and operation durations
- Materials consumed at each operation
- PRTs required for execution

In SAP GUI, users can create a routing by using Transaction CA01, change a routing with Transaction CA02, and display the routing with Transaction CA03. If you're using SAP Fiori, then you can also use the Manage Routings app to perform several functions such as create, edit, and display routings. You can use this app to search and create a new routing group and group counter from scratch or by copying an existing routing. It also allows you to create new routing versions as well as rework routings. You can plan the operations and operation activities to be carried out during production and use the app as a report to display a list of routings based on several filter criteria, as displayed in Figure 3.24.

We'll explore the key settings for routings in the following sections.



Himanshu Goel

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The Author

Himanshu Goel is a seasoned SAP professional with more than 20 years of experience in SAP consulting, solution architecture, and project management. He has led multiple full-cycle SAP implementations and rollouts across diverse industries. He currently leads the SAP practice at Infosys Poland.

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