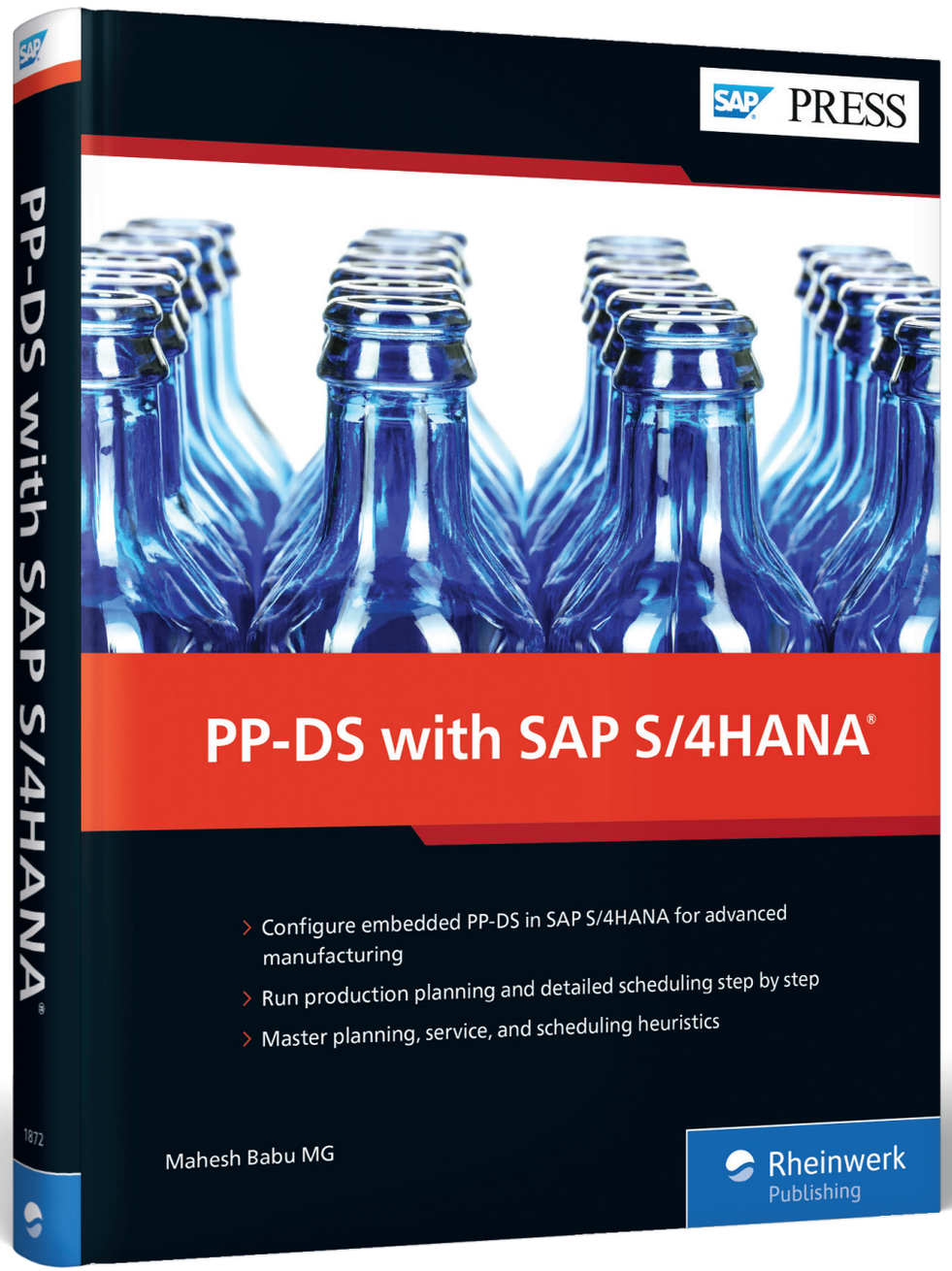

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In this chapter, you'll learn about the production planning functionality available in embedded PP-DS. You'll understand when to leverage advanced production planning, before walking through the steps to perform key functions and utilize planning and service heuristics.

"Production Planning"

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Chapter 5
Production Planning

In this chapter, we'll dive into the production planning process with PP-DS, from evaluating your requirements, to using heuristics, to evaluating the results of the planning run. You'll see how the process is impacted by integration with other planning solutions as well.

The SAP S/4HANA system has multiple options when it comes to planning materials for in-house or external procurement. SAP S/4HANA has sales and operations planning (S&OP), basic forecasting, demand management, long-term planning (LTP), and materials requirement planning (MRP). Some of these components, such as S&OP and forecasting, are no longer in further development, and SAP's next-generation supply chain planning tool, SAP Integrated Business Planning for Supply Chain (SAP IBP), takes over these components. In the SAP S/4HANA system, the traditional SAP ERP-based LTP and MRP went through a lot of improvements to simplify the way these processes are executed in SAP S/4HANA.

Apart from the improved enterprise resource planning (ERP) tools, the SAP S/4HANA system also has the PP-DS component in its core, which provides another option when complex planning problems arise that can't be solved by the SAP S/4HANA planning tools. The PP-DS planning is closely integrated to the SAP S/4HANA planning process via the new MRP Live function in the SAP S/4HANA system.

In this chapter, we'll start with the differentiators of PP-DS production planning compared to the SAP S/4HANA planning tools such as LTP and MRP, and then we'll cover the basic concepts in the PP-DS production planning process and the planning process itself, including the various heuristics for performing planning and the transactions and tools available in the PP-DS system for material planning. In addition, we'll discuss how PP-DS, MRP Live, and SAP IBP work in the SAP S/4HANA system, along with the tools available in the PP-DS system to evaluate the planning results and monitor the planning runs.

Any specific Customizing settings covered in previous chapters will be referred to here when they influence the PP-DS planning. Any new Customizing settings and the

functionality behind them, such as the specific planning heuristics settings and planning tool settings, also will be covered as required.

5.1 Determining When PP-DS Should Be Used for Planning

In classic MRP, the basic concept is to fulfill the requirements with receipt elements by performing a net requirements calculation and calculation of the dates and quantities for the receipt elements per the set master data and Customizing settings. In addition, this process selects the source of supply for the receipt elements per the master data setup, such as quota arrangements and rules, validity dates, and lot sizes defined. The MRP functionality in SAP S/4HANA works with a set algorithm and provides flexibility in defining the MRP types that determine how the requirements and receipts are processed during the planning run, the lot sizing procedures that determine the quantity of the receipt elements, and various Customizing settings that can be used by the MRP algorithm during the planning run to handle planning situations. The MRP process guarantees material availability by balancing the inventory and receipts against the requirements.

If your manufacturing and procurement processes require more sophisticated features to optimize the plan, then the PP-DS planning brings in a lot of features covering requirements across industries and processes. The basic decision to use PP-DS planning depends on whether the material is critical to the supply chain and/or if the material is manufactured in a bottleneck resource. Let's walk through some of the specific functions required in the planning process that PP-DS can support and that aren't available in the SAP S/4HANA planning process, such as MRP:

- **Capacity-constrained production plan**
  MRP doesn't consider the capacity of the resources on which the receipt orders are going to be manufactured or handled. If a resource-constrained production plan is required, PP-DS can support this via the scheduling strategy assigned in the planning process. The production plan isn't generally required to be constrained with the resource availability, but PP-DS can support this process.
- **Shelf-life planning**
  PP-DS can be used if your materials are handled in batch management with shelf life defined, and you want the planning process to consider the shelf life. In PP-DS, the planning algorithm can consider the maturity time of the products received, the shelf life of the product, and the requirements of the maximum and minimum shelf life required to fulfill the requirements. The shelf life also can be propagated

throughout the order levels when there are multilevel orders present that handle materials with shelf life.

- **Variable lot sizes**
  In MRP, the lot sizing throughout the planning horizon is defined in the material master lot sizing procedure if you want to plan using different lot sizes for short-, medium-, and long-term horizons so that the supply elements are planned to the granular lot size level, such as daily for the short term and a more aggregated weekly or monthly for the medium term or long term. Materials that have such requirements are supported by PP-DS to achieve the desired results.
- **Characteristics-dependent planning (CDP)**
  In MRP, the planning run only considers the quantity during planning and can't ensure that components with the same characteristics values are netted against the demand elements that have characteristics values assigned to them. But with PP-DS CDP, it's possible to make sure the characteristics matching is executed during planning, and new receipt elements are created to fulfill the demand of the requirement elements with characteristics if there are no existing receipts with the same characteristics value available to fulfill the demand.
- **Realignment of supply and demand**
  In MRP in SAP S/4HANA, the planning is unidirectional and recursive only if the master data setup requires such planning. Therefore, after the MRP execution, it's possible that there are delays and earliness of receipts in covering the requirement elements. The MRP exceptions or the MRP Live cockpit needs to be reviewed manually to actively address these situations. With PP-DS, functionalities such as top-down and bottom-up rescheduling can be used to realign the demand and receipt elements. PP-DS can be used for critical materials for which the alignment of the demand and supply needs to be ensured through the order network.
- **Optimization**
  Critical materials, which require optimization from a production plan, and the scheduling perspective, which needs to be planned by PP-DS, the PP-DS optimizer can be used to optimize the plan to reduce setup costs and times, reduce delays, and optimize the production plan and schedule for the defined objective functions in the PP-DS optimizer.
- **Multistep planning**
  The PP-DS planning run need not be just a one-step planning execution like MRP. In one planning run, multiple steps can be defined to execute multiple planning algorithms in sequence. For example, MRP PP-DS heuristics can be followed by a

top-down or bottom-up rescheduling heuristics to realign the newly created and changed receipts from the MRP heuristic. Scheduling heuristics or even an PP-DS optimizer run can be scheduled in one planning run. Materials requiring such special planning and scheduling apart from MRP planning in SAP ERP should be activated for advanced planning.

- **Push production**
  In push production in PP-DS, if materials with shorter shelf life are received or produced in excess, they should be used up in producing materials with longer shelf life. This is applicable in food, dairy, chemical, and pharma industries. Such materials can be activated for PP-DS planning, so that they can be processed with PP-DS push production to avoid wastage of raw materials. PP-DS push production can identify the materials that can be produced using the expiring materials based in the production data structure (PDS) master data setup, and the planners can interactively plan the quantity of such material to be produced.
- **Product interchangeability**
  PP-DS supports simple discontinuation, so that if there are materials that are discontinued and being replaced by new materials, certain PP-DS planning heuristics can support this by using up the old material before the requirements are passed on to the new material. Updating the master data, such as bills of material (BOMs) and PDSs, is the right way to handle material changes in production; however, during the interim, when there is existing stock available for the old material, PP-DS interchangeability can be used for such materials to support the transition from the old to new material without causing wastage of the old product inventory.
- **Industry-specific functions**
  PP-DS supports certain industry-specific functions such as order combinations where multiple orders going through the same operation can be combined, and a new order is created to simplify and optimize the planning and execution processes. As many of the industry solutions, such as discrete industry and mill products (DIMP), are part of the SAP S/4HANA core, PP-DS can be used to leverage the industry functions in SAP S/4HANA, which can be further optimized using PP-DS planning and scheduling functions.
- **Alerts-based monitoring**
  The MRP process in SAP ERP works based on exceptions in the planning situation that are preconfigured in the system. Limited options are available to enhance the exception management of MRP in SAP ERP. With MRP Live in SAP S/4HANA, the

MRP cockpit is a set of SAP Fiori apps that provide more insights into the planning situation based on key performance indicator (KPI) applications, which are based on material coverage and capacity consumption. PP-DS brings in a much more sophisticated alert framework that is customizable to add the tolerances for the alerts and can be embedded into almost all the planning and scheduling tools. The alerts can be configured for receipts, requirements, pegging, shelf life, capacity consumption, and so on, and the materials activated for advanced planning in SAP S/4HANA can leverage the alert monitor in PP-DS to manage the exceptions in planning and scheduling.

5.2 Basic Functions in PP-DS Planning

In this section, we'll cover the basic concepts in production planning within PP-DS. These concepts are used widely by most of the planning heuristics and planning processes in PP-DS. The basic task of any planning tool is to consider the receipt elements and the requirement elements, and then perform a net requirements calculation. Then, based on the delta quantity and the dates on which the net quantity falls below zero, the planning tools should create a receipt element based on the quantity restrictions (lot sizes) maintained in the master data.

In addition, this section will cover the terminology used in the PP-DS planning process. We've covered the planning procedures and day's supply calculation in Chapter 3, where we discussed the configuration. In this section, we'll cover the details about pegging, net requirements calculation, and source of supply selection concepts.

5.2.1 Pegging

Pegging in PP-DS is used to signify the relationship or the link between a receipt (supply) and a requirement (demand) element. By doing so for all the material BOM levels, the overall lead time for the finished material can be calculated. If there are any delays in fulfilling the requirements generated in any level of the BOM by the demand for the finished material, these delays can be identified, and an alert can be generated accordingly.

The pegging process is executed by the system after every planning run and after any planning-relevant change in data, so that the receipt and requirements elements are linked at all times. The alerts also can be determined when any planning tool is being loaded with the planning data for any product location.

PP-DS supports two kinds of pegging relationships:

- **Dynamic pegging**
  In dynamic pegging, the system creates the pegging relationship between the supply and demand element based on the current planning situation. If there is a change, or a new receipt or requirement is created manually or by the system in the planning process, the pegging relationship will be recalculated and re-created.
- **Fixed pegging**
  In fixed pegging, the dynamic pegging relationship created can be fixed so that any future planning situation change won't alter the fixed pegging relationship. Manually created fixed pegging can't be changed or deleted by the system automatically during production planning, but the fixed pegging relationship created by the system during a planning run can be later changed in a subsequent planning run. However, a mere change in the planning situation won't change the fixed pegging relationship created by the system.

Tip

The business add-in (BAdI) `/SAPAPO/RRP_HEUR_DO` can be used to create fixed pegging relationships during a PP-DS MRP run. However, the standard method for creating a fixed pegging relationship in planning is to execute the heuristics for creating fixed pegging as a subsequent step after the planning heuristics in the PP-DS planning run.

For the pegging to be executed between a receipt and requirement element, the following conditions must be met:

- **Same pegging area**
  The pegging area is the combination of a product and a location in a planning version with the account assignment if relevant. For example, for a make-to-stock (MTS) material in a plant, the pegging area in the active planning version 000 is the combination of the material and the location. For a make-to-order (MTO) material, every sales order from the customers forms a customer segment, and apart from the material and location, the sales order (as an account assignment object) also becomes a part of the pegging area. The receipt and requirement elements should be part of the same pegging area for them to get pegged to each other.

- **Pegging interval**
  The receipt elements, including the stock elements, will be pegged to the requirement element if they are within the pegging interval. The pegging interval is set by default as 277,000 hours, which is approximately 31.6 years. This is the maximum value technically allowed for this field. So in embedded PP-DS, the pegging interval is a rolling defaulted 31.6 years (calculated from the requirement element date) and can't be changed in the material master, as shown in Figure 5.1.

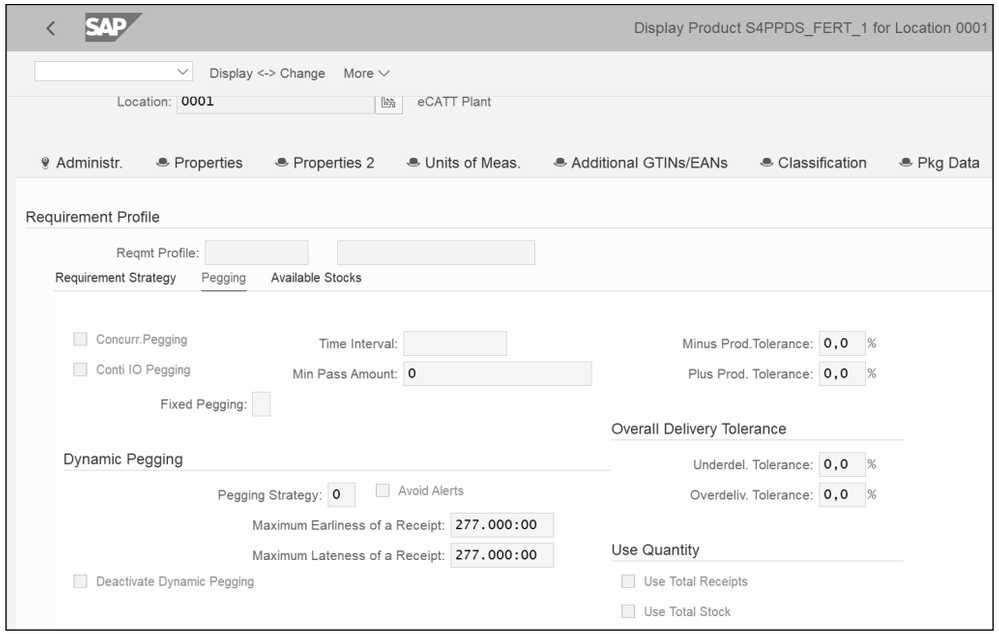

Figure 5.1 Default Values of Pegging Interval in the PP-DS Product Master

In CDP scenarios, the characteristics values of the receipt and requirement elements are checked for compatibility for pegging them.

For products that have a defined shelf life, minimum required shelf life, and maturation time after production, the dynamic pegging considers these values to make sure that when they are pegged to the requirement element, it's out of the maturity period of the product and complies with the minimum required shelf life.

5.2.2 Planning Horizon and Planning Time Fence

In PP-DS, either the demand can be transferred from a SAP planning system, such as SAP IBP, or a non-SAP system can send in the forecast in the form of planned independent requirements (PIRs) to SAP S/4HANA, which will be transferred to embedded PP-DS if the material is activated for advanced planning. A planning tool such as SAP IBP is responsible for forecasting and planning the mid- to long-term forecasting and supply planning. However, embedded PP-DS is a short- to mid-term planning tool, and PP-DS is used for short-term detailed scheduling.

To define the responsibility of PP-DS for planning only in the short term, a PP-DS planning horizon is defined. Any demand that falls under the PP-DS planning horizon is planned by PP-DS planning tools. The planning horizon is defined in the model version master data (Transaction /SAPAPO/MVM) (see Chapter 3, Section 3.2.1). The horizon defined here is considered by all the material locations. In a production planning run, the PP-DS planning heuristics only consider the demand and supply within this horizon for the calculation of the unfilled demand.

Note

In PP-DS for SAP S/4HANA (embedded PP-DS), the planning horizon can only be maintained at the model version level, and there is no possibility to maintain a material location-specific PP-DS planning horizon.

The PP-DS planning time fence is the shorter horizon in the planning horizon within which the system isn't allowed to make changes to the planning data during an interactive or background production planning run. Manual changes are allowed within the planning time fence. When the planners adjust the plan and finalize the schedule for the near-term shorter time horizon, the plan must not be altered by the system, and the planning time fence can be defined to such a duration. The PP-DS time fence is defined in the material master by using Transaction MM02 and navigating to the **MRP 1** tab, as shown in Figure 5.2. On the upper screen, you can see the **Planning time fence** value of "21" set, in our example. This value defined in the material master is also used by the PP-DS planning time fence if the material is activated for advanced planning, as shown in the lower screen in Figure 5.2.

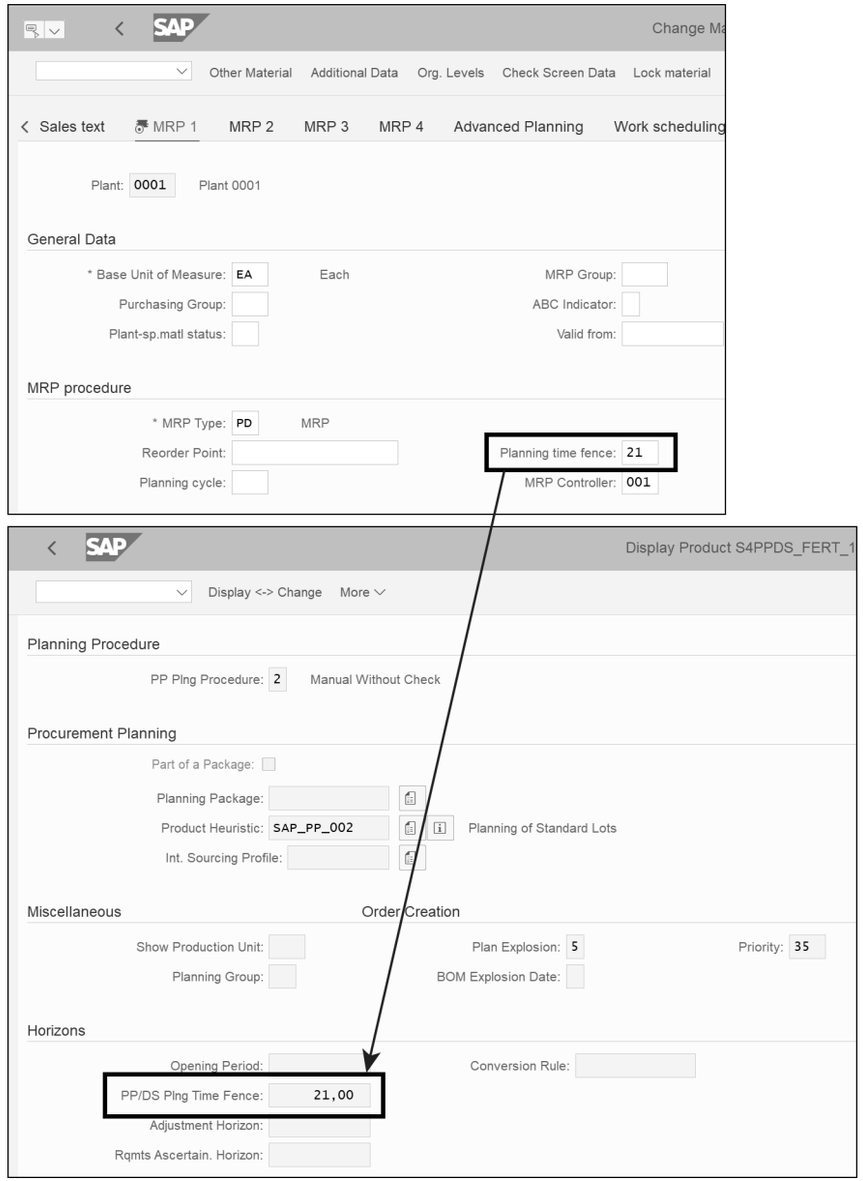

Figure 5.2 Planning Time Fence in the Material Master and in PP-DS Product Master Data

5.2.3 Net Requirements Calculation

Net requirements calculation is the process of balancing the demand and supply quantities and arriving at the missing quantities so that new receipt elements can be created to cover them.

In embedded PP-DS, it's possible to customize the way the receipts and requirement elements are treated by the net requirements calculation process. These customizations are made in the heuristics settings, so that when a planning heuristic is called in the planning run or interactive planning, the system uses the net requirements calculation procedure set in the heuristics to apply it on the planning.

The concept of pegging isn't to be confused with the concept of net requirements calculation. The pegging only links the available receipt and requirement element. But the role of net requirements calculation is to find out when the net quantity (sum of receipts and requirements) falls below zero and trigger a receipt creation at that point in time to fill the open demand.

During net requirements calculation, the system starts with the stock and the receipt elements and nets them against the open demand elements. The settings are made in the heuristics Customizing (Transaction /SAPAPO/CDPSC11), as shown in Figure 5.3. The following options are available to influence the netting:

- **FIFO**
  With the first in, first out (FIFO) netting procedure, the earliest available requirement element is assigned to the stock element or the earliest available receipt element, and the same chronological order is followed for netting throughout the PP-DS planning horizon.
- **Avoid Surpluses**
  This procedure will try to avoid new receipt elements creation by assigning the available receipt and stock elements to the requirement elements, irrespective of whether this assignment will cause a delay for the requirement element being fulfilled on time. This procedure divides the planning horizon into two sections, one for the elements within the PP-DS time fence and another section for the elements outside the planning time fence.
- **Avoid Delays**
  This netting procedure will try to avoid delays in fulfilling the requirement elements by assigning the stocks and fixed receipt elements to the requirements. If there is a delay, this procedure will propose creating a new receipt element. Thus, this procedure may lead to excess supply.

The other options available to influence the net requirements calculation are as follows:

- **Use Total Receipts**
  With this setting active, when one receipt element is pegged to a requirement element irrespective of the quantity being pegged to the requirement element, the complete receipt element is consumed. If there are partial available quantities from the receipt element, those are left open and are not assigned to any other requirement element.
- **Use Total Stocks**
  With this option, when the stock element is assigned to a requirement element during the net requirements calculation, then the stock element is completely consumed for the purpose of the net requirements calculation, and no other requirement element can be pegged to the stock element.

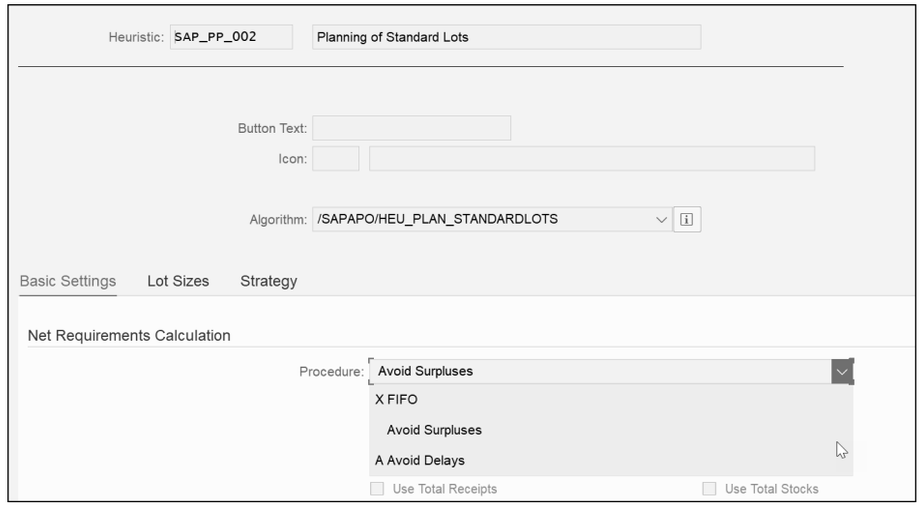

Figure 5.3 Net Requirements Calculation Procedures in PP-DS Planning Heuristics

5.2.4 Procurement Quantity Calculation

When the net requirements calculation determines when to create a receipt element, the procurement quantity calculation will determine for what quantity the receipt quantity should be created. This is determined by the lot size definition. The lot size

can be defined in the heuristics-specific settings and in the material master's **Advanced Planning** tab.

The heuristics-specific settings for lot size provide options that are only relevant for that heuristic. The lot size data maintained in the **MRP 1** view and the **Advanced Planning** view of the material master are considered by the PP-DS planning heuristics, which needs to determine a quantity for order creation. The lot sizing information from the **MRP 1** view, such as lot sizing procedure, minimum and maximum lot sizes, and rounding factors, is considered by PP-DS in addition to the lot sizing unit of measure and other lot sizing-specific fields from the **Advanced Planning** view of the material master.

The standard planning heuristics, such as the planning of standard lots heuristics, support several lot sizing procedures in the standard embedded PP-DS system. You can access the following procedures in the **Lot Sizes** tab, as shown in Figure 5.4:

- **Lot-for-Lot**
  This procedure will propose a receipt quantity exactly the same as the requirement quantity per the net requirements calculation. However, this procedure will consider the minimum and maximum lot size settings and the rounding parameters maintained in the material master.
- **Fixed Lot Size**
  This procedure will propose receipt quantities per the fixed lot size defined in the material master, irrespective of the net requirements quantity. If one receipt can't cover the entire net requirements quantity, multiple receipts are proposed with the fixed lot size until the requirement can be covered with the new receipts.
- **By Period**
  In periodic lot sizing procedures, the net requirements are grouped together per period (day, week, etc.), and one receipt element is proposed per period. This procedure also respects the minimum and maximum lot size settings and the rounding settings.
- **Reorder Point**
  Embedded PP-DS only supports the **Reorder Point Method 2**, which is reorder supply from the material location master.

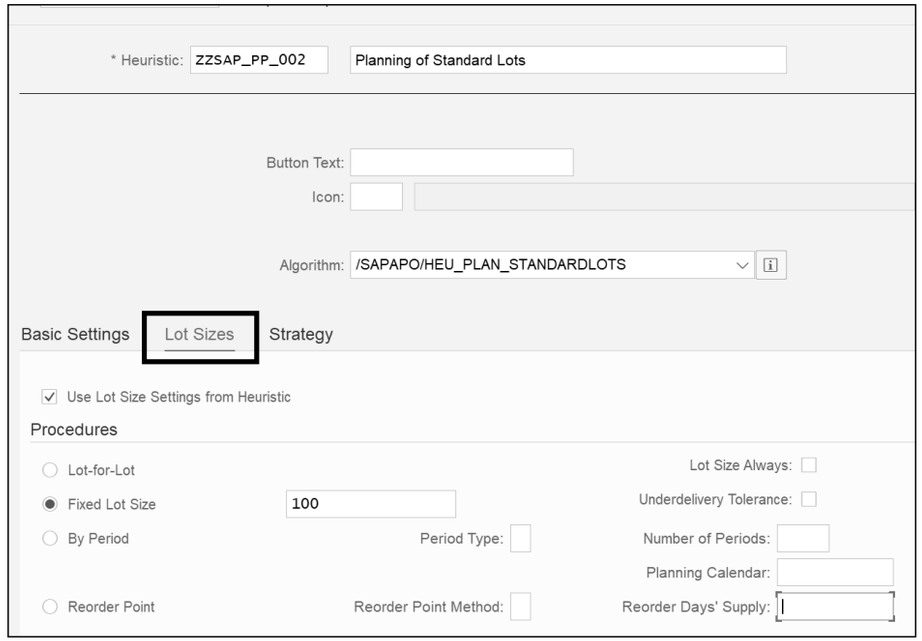

Figure 5.4 Lot Sizing Maintenance in PP-DS for Advanced Planned Materials

Tip

Irrespective of the lot sizing method maintained in the **MRP 1** view of the material master, if the reorder day's supply is maintained in the **Advanced Planning** view of the material master, then PP-DS planning heuristics will consider this material with a lot sizing procedure with the reorder order point method.

The minimum and maximum lot sizes are maintained in the material master (Transaction MM02) **MRP 1** tab in the **Minimum Lot Size** and **Maximum Lot Size** fields. In addition, the PP-DS specific lot sizing settings, such as the **Reorder Day's Supply**, is defined in the **Advanced Planning** tab under the **Lot Size** section, as shown in Figure 5.5.

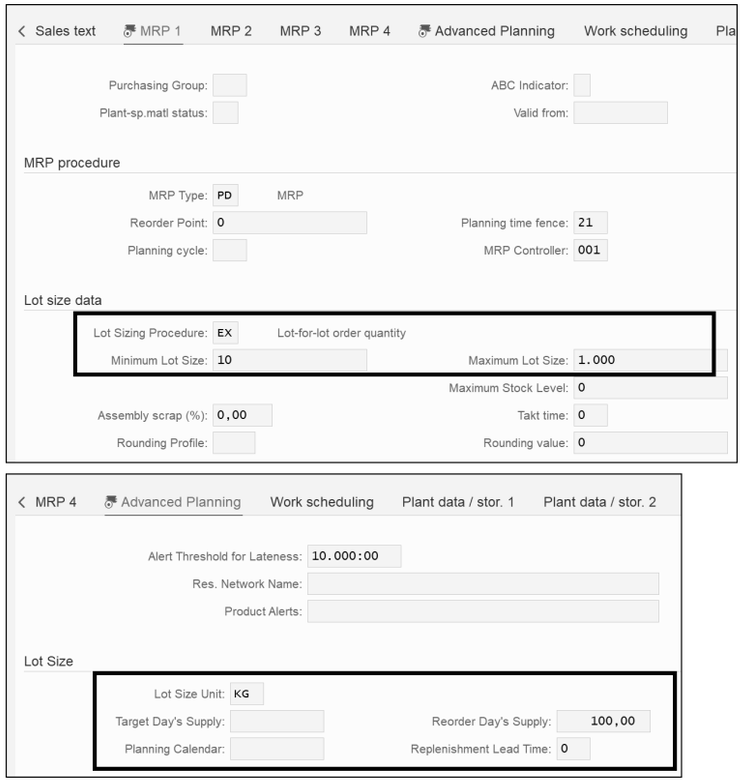

Figure 5.5 Lot Sizing Procedure Definition in MRP 1 and Advanced Planning Views

5.2.5 Source Determination

When the time and the quantity are determined by the netting and procurement quantity calculation processes, the next step is to determine the source of supply for the receipt element. Depending on the type of procurement, whether it's in-house produced material or externally procured material, the source determination process will determine either a valid PDS to produce the material or a valid external procurement relationship to procure the material.

For in-house produced materials, the system considers the available PDSs, and the PDS that can produce the material with the minimum delay is selected by the system to create the receipt element. In interactive planning, if the heuristics setting allows this, the user can select the source of supply manually from a ranked list of all the available sources.

For externally procured materials, the rankings of the source of supplies are calculated per the procurement priority, procurement costs assigned to the procurement relationships, and the quota. The system will look for the least costly and highest priority source that can fulfill the demand without any delay.

For PP-DS source determination in general, on-time delivery is the driving principle in selecting the source of supply.

5.3 Leveraging Planning Heuristics

In embedded PP-DS, the planning of a material can be executed in multiple ways, including MRP Live planning, PP-DS background planning runs, and interactive planning from the PP-DS planning tools. All these methods of executing the planning, end up calling a planning heuristic, and the heuristics settings, along with the various profiles used by different planning tools, determine the planning results. In this section, we'll discuss the features offered by the commonly used production planning heuristics.

The planning heuristics have an algorithm that can determine a shortage quantity and create a receipt to cover the shortage quantity. The algorithm is an ABAP function module that is designed to execute the specific planning task. The screens and the available settings in the heuristics Customizing are also part of the algorithm definition. Any of the production planning heuristics can be called in the MRP heuristic, which offer a mechanism to determine the BOM structure and execute the heuristics assigned to the MRP heuristic or the product heuristics following the low-level code of the material.

> **Note**
>
> Irrespective of the heuristics type (planning, scheduling, or service heuristics), it's always recommended to create a copy of the heuristics, and make the required changes to enable options and functionalities offered by the specific heuristics.

5.3.1 Planning of Standard Lots

Planning of standard lots is the most commonly used planning heuristic to fulfill uncovered demands. The standard heuristics are delivered with the name SAP_PP_

002 and the standard algorithm /SAPAPO/HEU_PLAN_STANDARDLOTS assigned to the heuristic.

The planning of standard lots heuristic executes the standard net requirements calculation and calculates the procurement quantity per the lot sizing definition from the material master or from the heuristic itself. Then, it executes source of supply determination per the standard logic. After the dates, quantities, and sources are determined, the receipt elements are created by this heuristic. When creating the planned orders for in-house produced materials, these planned orders need to be scheduled on the resources belonging to the PDS selected. Therefore, this heuristic provides options to control the scheduling parameters via the scheduling strategy assignment in the heuristic setting.

This heuristic can respect the characteristics values during net requirements calculation to evaluate the characteristics values of the requirement and receipt elements during the netting process. The shelf-life data, such as maturation time and minimum remaining shelf life, is also considered by this heuristic if the heuristics setting is made accordingly (see Chapter 8, Section 8.1).

To access this heuristic, execute Transaction /SAPAPO/CDPSC11 and double-click on the **SAP_PP_002** heuristic in the list displayed. You'll arrive at the screen shown in Figure 5.6. The basic settings of the **Planning of Standard Lots** heuristic has several areas, which we'll explore in the following sections.

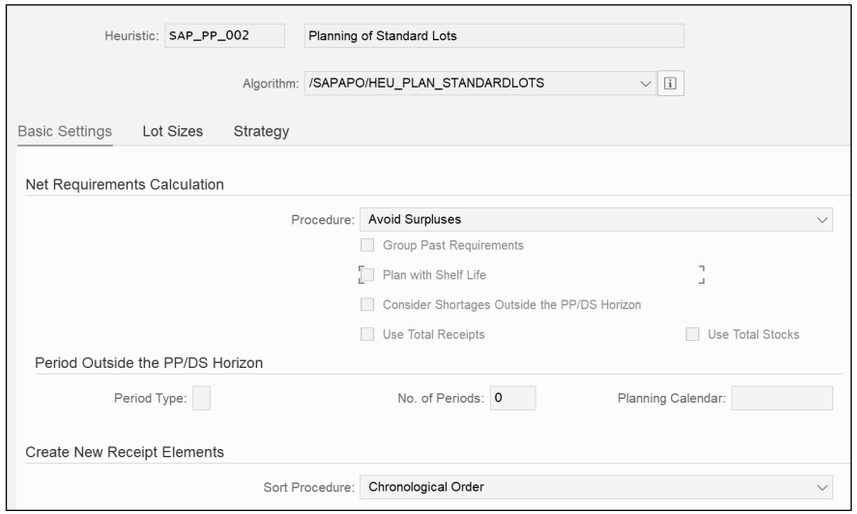

Figure 5.6 Net Requirements Calculation Settings for the Planning of Standard Lots Heuristic

Net Requirements Calculation

As shown in Figure 5.6, in the **Net Requirements Calculation** section of the heuristics Customizing, the **Procedure** for the net requirements calculation is set. The **Group Past Requirements** checkbox can be used to cumulate all the requirement elements in the past (older than current date) and the requirements within the PP-DS time fence together and consider this as one demand element so that the procurement quantity calculation, including the lot sizing, is applied on this cumulated quantity. It makes sense to use this checkbox in planning situations where past demands are always present that weren't fulfilled on time and need to be fulfilled immediately. Grouping them together will reduce any excess quantities procured due to lot sizing restrictions.

For the consideration of the shelf-life restrictions, such as maturity time and the minimum required shelf life, the **Plan with Shelf Life** checkbox needs to be selected. In addition, the corresponding products must have the **Plan with Shelf Life** checkbox activated in the **Advanced Planning** tab of the material master.

In planning scenarios where the shortages outside the PP-DS horizon need to be planned within the PP-DS horizon, the **Consider Shortages Outside the PP/DS Horizon** option can be used. With this option, the system temporarily brings in the requirements outside of the PP-DS horizon for the duration defined under the **Period Outside the PP/DS Horizon** section. If there are shortages, then receipt elements will be created inside the PP-DS horizon.

Create New Receipt Elements

As shown in Figure 5.7, the order of the new receipt creation and the reuse mode is defined for the heuristics. The **Sort Procedure** has two options:

- **Chronological Order**
  When the heuristic needs to create several orders due to the dates, netted quantities, and lot sizing procedures, they are created in the order of the earliest order first.
- **Order Priority, Chronological**
  With this option, the orders with higher priorities are created first and then the earliest order within the priority is created first. Along with the scheduling profiles assigned to the planning of standard lots heuristic, this setting can help ensure that the higher-priority orders are created and scheduled first before other orders are created.

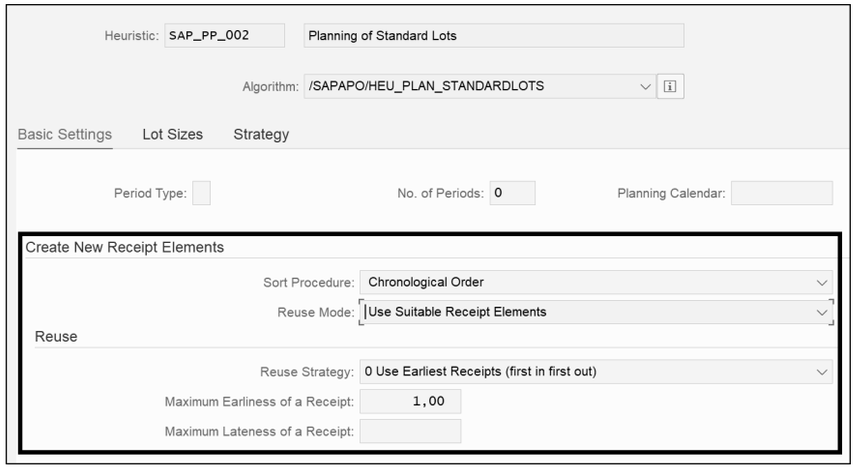

Figure 5.7 Settings for New Receipt Creation in Planning of Standard Lots Heuristic

The **Reuse Mode** within the heuristics setting controls how the existing fixed and unfixed receipt elements are treated during the execution of this heuristic. We covered the details of the reuse modes in Chapter 3, Section 3.4.1, where we discussed the PP-DS planning procedure customization.

When the **Reuse Mode** is set to **Use Suitable Receipt Elements**, the system also leverages the settings under the **Reuse** section. The **Reuse Strategy** defines how the existing receipt elements are used by this heuristic to cover open requirements. Following are the available options:

- **0 Use Earliest Receipts (first in first out)**
  Irrespective of the requirement date, use an existing receipt in chronological order (first in first out) when there is a shortage. This may lead to requirement elements covered too early or too late, as well as earliness and lateness alerts for pegging.
- **Use Timely Receipts**
  With this option, the system searches for a timely receipt within the reuse interval defined per the **Maximum Earliness of a Receipt** and **Maximum Lateness of a Receipt** fields. If there are no suitable receipt elements available within the reuse interval, this heuristic will propose a new receipt to be created.

Settings for New Explosion

As shown in Figure 5.8, the **Settings for New Explosion** section is relevant for the standard lot heuristics when the **Reuse Mode** is set to **Reexplode Plan**. With this reuse mode, the source of supply is re-exploded. When this happens for an in-house manufacturing planned order, this may lead to changes in the modes/dates and thus the resources used by the order. To ensure that the heuristics retain the same mode (and the resource) during a re-explosion of the PDS triggered by the planning of standard lots heuristic, the **Retain Mode** checkbox can be selected.

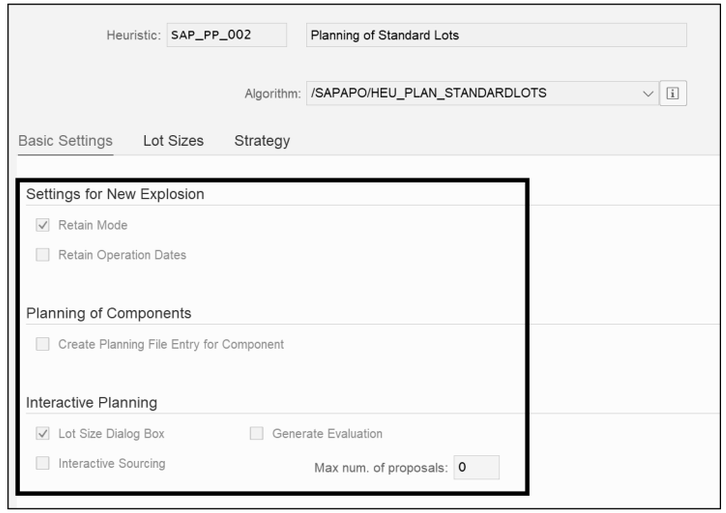

Figure 5.8 Settings for Re-Explosion, Components, and Interactive Planning in the Planning of Standard Lots Heuristic

> **Note**
>
> If the mode is no longer available due to a change in the PDS or the validity date of the mode is no longer under the validity of the order, a mode change can happen irrespective of the **Retain Mode** checkbox value.

A re-explosion of an in-house manufacturing planned order may lead to a rescheduling of the order, and, thus, the operation dates may get changed in this process. To retain the operation date as it appeared before the re-explosion, you can use the

Retain Operation Dates checkbox. When this is selected and the scheduling direction is set as backward scheduling, the operation end date is derived from the operation of the order before it's re-exploded. When the scheduling direction is set as forward scheduling, the operation start date is derived from the operation of the order before the re-explosion is triggered. (The details of the scheduling direction are covered in Chapter 6, Section 6.2.2.) However, because a finite scheduling strategy will lead to a change in the operation dates, it's generally recommended to perform the production planning run in PP-DS without finite scheduling.

Planning of Components

Creating new receipts by the planning of standard lots heuristic will create dependent demand for the components of the material being planned. According to the planning procedure set for the component materials, when the dependent demand is created or changed, the system reacts accordingly (no action, planning run immediately, create planning file entry, etc.). But if you want to override the planning procedure action and always create a planning file entry for the materials for which the dependent demand is created, you can select the **Create Planning File Entry for Components** checkbox in the heuristics settings. If the component material has a planning procedure with **Do Not Carry Out Any Action** defined as the **Action**, then no planning file entry will be created (see Chapter 3, Section 3.4.1).

Interactive Planning

The **Interactive Planning** section (refer to Figure 5.8) determines how the system behaves when the planning of standard lots heuristic is called from an interactive planning tool, such as the product view or order view. During interactive planning, you can change the lot size definition for just that heuristic execution in the planning tool; to allow this, select the **Lot Size Dialog Box** checkbox in the heuristics settings. With this setting, a dialog box with the current lot sizing procedure per the values from the material master or the values from the heuristics is defaulted on the screen, and the user has an option to change them manually.

To understand the planning elements the system has considered during the interactive execution of the planning of standard lots heuristic, you can select the **Generate Evaluation** checkbox in the heuristics settings. The evaluation contains the information of all the requirement elements, the fixed receipts, the receipts the heuristics has deleted, and the planning file entries created during the execution of the planning of standard lots heuristic in interactive mode.

In addition, you can select the **Interactive Sourcing** checkbox to manually select the source of supply for the external procurement receipts being generated by this heuristic. When there are more orders than the value defined in the **Max. num. of proposals**, the interactive sourcing isn't enabled.

Lot Sizes

The **Lot Sizes** tab of the heuristics settings has the same lot sizing settings that can be set from the material master **MRP 1** and **Advanced Planning** views (as you saw in Section 5.2.4). But if you want to override the lot size data maintained in the material master and use the one defined in the heuristics settings, select the **Use Lot Size Settings from Heuristic** checkbox, as shown in Figure 5.9.

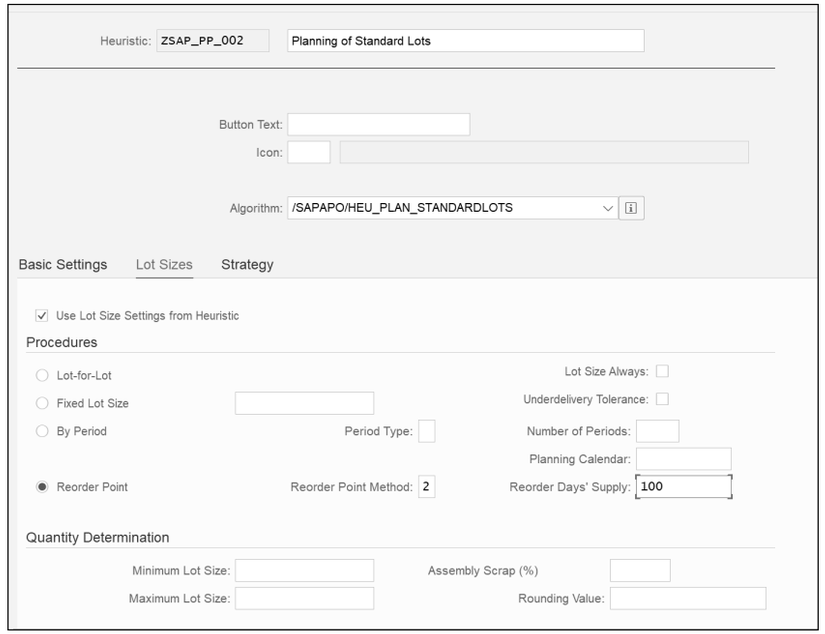

Figure 5.9 Heuristic-Specific Lot Sizing Overriding Material Master Lot Size Data

Strategy

As shown in Figure 5.10, the **Strategy** tab of the heuristics settings determines the scheduling parameters to be used for scheduling the receipt elements created by the planning of standard lots heuristic. The scheduling strategy options within the planning of standard lots heuristic are controlled, so that the heuristic can execute and

created orders. For example, only the infinite scheduling strategy is available within the heuristics setting for the scheduling mode. However, the scheduling strategy also can be defined in the individual planning tools, which will take precedence over the strategy profile defined at this heuristic level. The following scheduling strategies are available in the **Sched. Mode** dropdown:

- **4 Infinite Scheduling**
- **7 Search for Bucket with Free Capacity**

When the scheduling strategy defined at the planning tool level isn't able to create the order due to scheduling constraints imposed by the strategy, the strategies defined at the planning of standard lots heuristic will act as a backup strategy and can create orders if allowed.

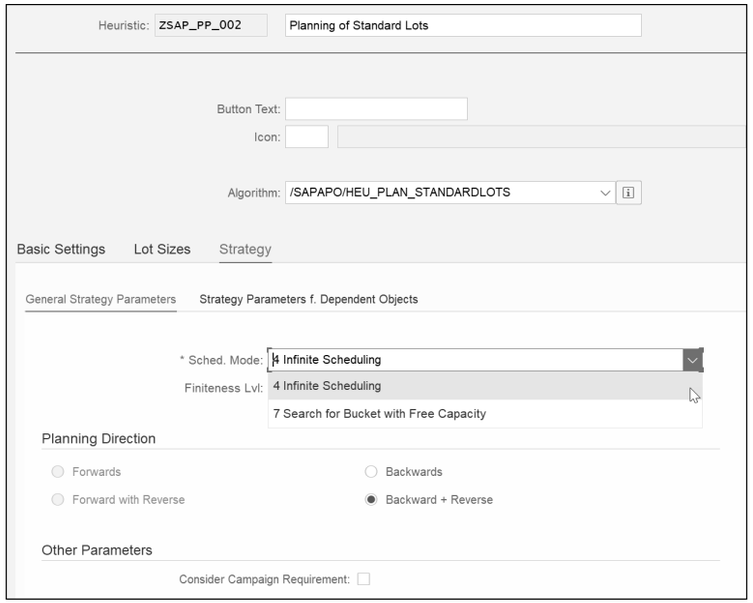

Figure 5.10 Scheduling Strategy for Planning of Standard Lots Heuristic

5.3.2 Reorder Point Planning

The reorder point planning heuristic is delivered in the standard embedded PP-DS system with the name SAP_PP_007 – Reorder Point Planning and with the algorithm /SAPAPO/HEU_REORDER_POINT_PLAN.

The reorder point maintained in the material master **MRP 1** tab is considered by this heuristic for refilling the stock up to the reorder point if the current stock level is below the reorder level maintained in the material master.

The net requirements calculation for this heuristic only considers the current stock level, the receipt elements, and the reorder point defined in the material master. No other requirement elements are considered for the net requirements calculation, which may lead to excess supply or supply shortage; therefore, this heuristic should be used for materials that are truly procured based on reorder point planning. In general, for such materials, advanced planning isn't necessary, and they can be planned in MRP Live in SAP S/4HANA. If such materials are produced in-house on a bottleneck resource, then those materials can be activated for advanced planning, and the reorder point planning heuristic can be assigned as the product heuristic for those products.

The heuristics settings for the reorder point planning heuristic are shown in Figure 5.11. In the **Basic Settings** tab, the **Delete Non-Fixed Receipt Elements** option will delete all the nonfixed receipt elements and re-create them if the net requirements calculation determines a shortage. If the **Delete Non-Fixed Receipt Elements** checkbox isn't selected, the excess nonfixed receipt elements won't be deleted by this heuristic.

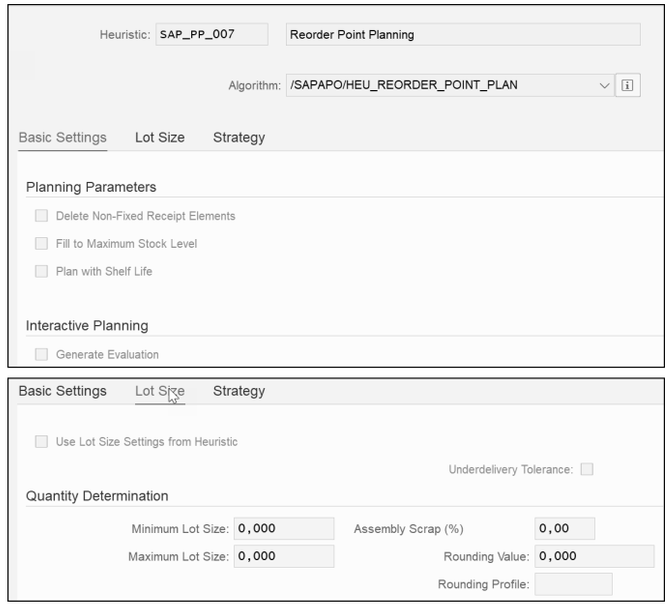

Figure 5.11 Reorder Point Planning Heuristic Basic and Lot Size Settings

The example for the treatment of the nonfixed receipt elements is depicted in Table 5.1 and Table 5.2. Table 5.1 shows the current planning situation with a reorder point of 70 maintained in the material master.

Date	Time	Element	Number	Receipt/Requirement Quantity
05.07.2019	0:00:00	Stock	Stock	10
24.07.2019	12:00:00	Forecast requirement		–50
02.08.2019	17:00:00	Purchase requisition	10140086/00	100

Table 5.1 Example of Current Planning Situation

This situation would look the same without the **Delete Non-Fixed Receipt Elements** option selected. Because the nonfixed receipt element (purchase requisition) isn't deleted, the total available receipts (stocks + purchase requisition) quantity (10 + 100) is more than the reorder point defined in the material master (70).

However, with the option selected, the situation would look like Table 5.2 after the reorder point planning heuristic. As you can see, the nonfixed purchase requisition with quantity 100 is deleted, and a new purchase requisition is created with quantity 60 to balance the reorder point quantity of 70: stock quantity 10 + new purchase requisition quantity 60 = 70 (reorder point).

Date	Time	Element	Number	Receipt/Requirement Quantity
05.07.2019	0:00:00	Stock	Stock	10
24.07.2019	12:00:00	Forecast requirement		–50
02.08.2019	17:00:00	New purchase requisition	10140086/00	60

Table 5.2 Planning Situation after Reorder Point Planning (with Delete Nonfixed Receipts Option)

Referring back to the settings shown in Figure 5.11, the **Fill to Maximum Stock Level** checkbox will create a receipt element to fill up to the maximum stock level maintained in the **MRP 1** view of the material master when the net requirements calculation warrants the creation of a receipt element by the system.

Note

When maintaining the maximum stock level and reorder point in the **MRP 1** tab of the material master, the system will raise a warning or an information message saying the MRP procedure doesn't make use of these fields. But with advanced planning, PP-DS uses these fields when the reorder point planning heuristic is executed.

The **Lot Size** settings in the reorder point planning heuristic (shown on the lower area of Figure 5.11) only provide the option to define the maximum and minimum lot sizes because other settings, such as lot sizing procedure, aren't relevant for the reorder point planning scenario and are ignored by this heuristic.

The **Strategy** tab is like the planning of standard lots heuristic where the heuristic only has infinite scheduling modes available in the heuristics settings.

5.3.3 Planning of Standard Lots in Three Horizons

The planning of standard lots in three horizons heuristic is delivered in the SAP standard system with the name SAP_PP_004 and the standard algorithm /SAPAPO/HEU_PEGID_PERIODIC_LOT.

The planning of standard lots in three horizons is the same as the planning of standard lots heuristic, except for the lot sizing procedure defined in the heuristics settings. The basic settings and the strategy settings are the same as the planning of standard lots heuristic.

This heuristic offers up to three different lot sizing procedures that can be used in certain periods. For example, week 1 is planned in lot-for-lot lot sizing procedure, week 2 to week 5 are planned using a daily (periodic) lot sizing procedure, and week 6 to the end of the PP-DS horizon are planned with a weekly (periodic) lot sizing.

As shown in Figure 5.12, the **Lot Size** tab of this heuristic offers the flexibility to enter three different lot sizes for different time horizons. The **Short-Term Horizon** starts from the date of the heuristics execution until the duration defined as the short-term horizon, and the **Medium-Term Horizon** starts at the end of the short-term horizon and runs for the duration defined in the heuristics setting. The **Long-Term Horizon** starts from the end of the medium-term horizon and runs through until the end of the PP-DS horizon. Following are the commonly used **Period Types**:

- **D** (day)
- **W** (week)
- **M** (month)
- **Q** (quarter)

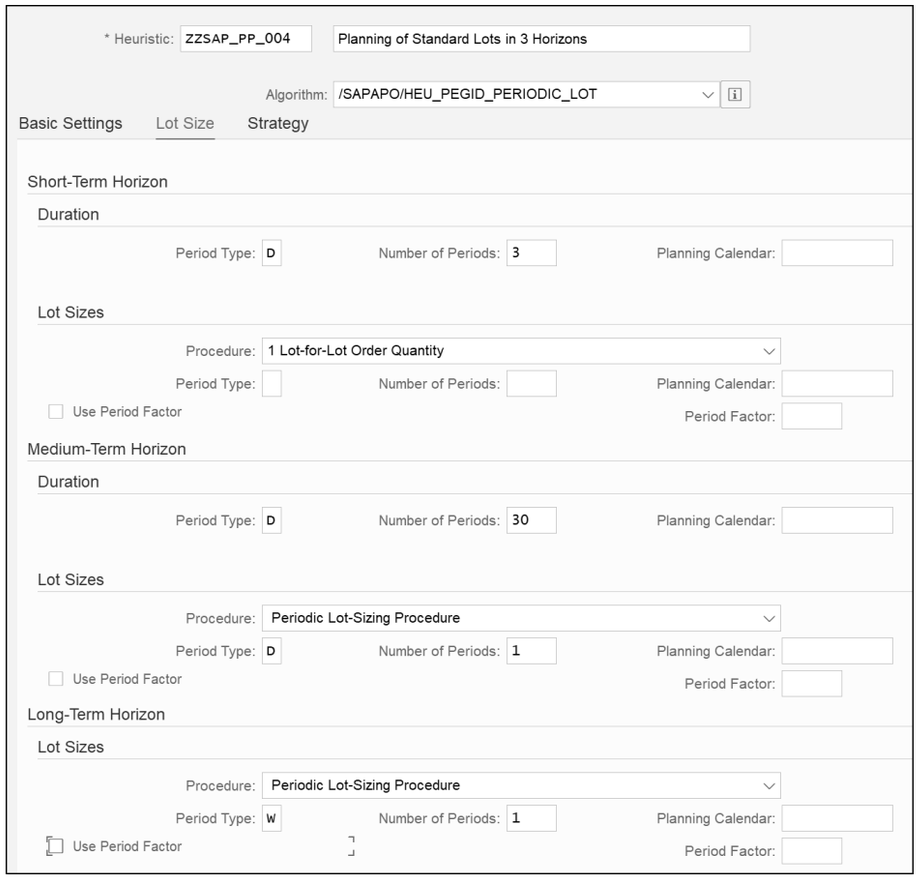

Figure 5.12 Lot Sizing Settings for the Planning of Standard Lots in Three Horizons Heuristic

An example of the lot size calculation from the planning of standard lots in three horizons heuristic is illustrated in Table 5.3, Table 5.4, Table 5.5, and Table 5.6. Table 5.3 shows the current planning situation before the heuristic is executed.

Date	Element	Quantity
24/07/2019 (current date)	Forecast requirement	–10
24/07/2019	Dependent demand	–10
27/07/2019	Forecast requirement	–12
27/07/2019	Forecast requirement	–25
10/9/2019	Forecast requirement	–30
11/9/2019	Forecast requirement	–25
12/9/2019	Forecast requirement	–10

Table 5.3 Current Planning Situation

Because the short-term horizon is defined as three days in this example, and the lot-for-lot lot sizing procedure is used, the planned orders are created with the exact lot of the forecast requirements, as shown in Table 5.4.

Date	Element	Quantity
24/07/2019	Forecast requirement	–10
24/07/2019	Planned order	10
24/07/2019	Dependent demand	–10
24/07/2019	Planned order	10

Table 5.4 After the Planning of Standard Lots in Three Horizons Heuristic Execution: Short-Term Horizon 3 Days, Lot Sizing Lot-for Lot

Because the mid-term horizon is defined as 30 days in Table 5.5, and the daily lot sizing procedure is used, the planned order is created by combining the requirement quantities (12 and 25) of the same day in one planned order with quantity 37.

Date	Element	Quantity
27/07/2019	Forecast requirement	–12
27/07/2019	Forecast requirement	–25
27/07/2019	Planned order	37

Table 5.5 After the Planning of Standard Lots in Three Horizons Heuristic Execution: Mid-Term Horizon 30 Days, Lot Sizing: Daily (Periodic)

The long-term horizon has the weekly lot sizing procedure in this example shown in Table 5.6. Executing the planning of standard lots in three horizons heuristic combines all the requirement quantities from the week (-30, -25, and -10) and creates one planned order for the total quantity 65.

Date	Element	Quantity
10/9/2019	Forecast requirement	–30
11/9/2019	Forecast requirement	–25
12/9/2019	Forecast requirement	–10
10/9/2019	Planned order	65

Table 5.6 After the Planning of Standard Lots in Three Horizons Heuristic Execution: Long-Term Horizon, Lot Sizing: Weekly (Periodic)

5.3.4 MRP Heuristic

The MRP heuristic in PP-DS is an enabling heuristic that can execute a production planning heuristic assigned to the heuristics or the product heuristics assigned to the material in the **Advanced Planning** view of the material master. It's delivered in the standard PP-DS system with the name SAP_MRP_001 and with the standard algorithm /SAPAPO/HEU_MRP_PLANNING.

The MRP heuristic is classified as an enabling heuristic because it can't perform planning (net requirements calculation, procurement quantity determination, and source determination) on its own. However, because it can be used for executing planning heuristics, we're covering the details of the MRP heuristic in this section.

The MRP heuristic settings are very limited, as shown in Figure 5.13, to the extent of a few heuristics parameters and the technical settings for parallel processing to improve the performance of the PP-DS planning run.

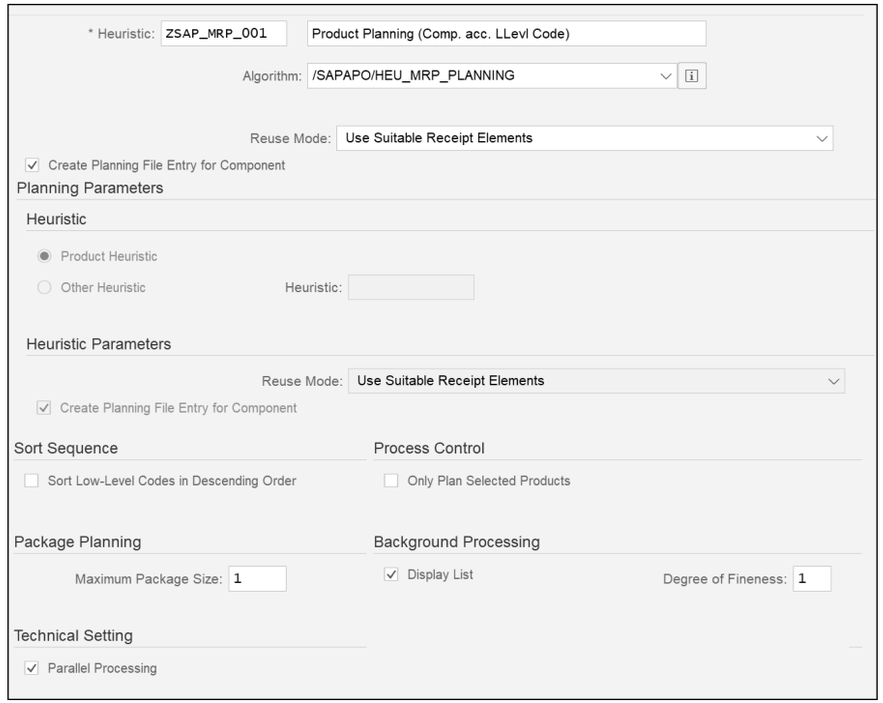

Figure 5.13 Settings for the MRP Heuristic

The **Heuristic** section of the settings determines if the MRP heuristic will execute the product heuristic or another heuristic assigned in the heuristics settings.

The heuristics parameters are the same as the planning of standard lots heuristic for the **Reuse Mode** and **Create Planning File Entry for Component**. The **Sort Low-Level Codes in Descending Order** setting will change the direction of the planning from the lowest level component to the top-level finished product. This can be useful when executing other service heuristics via the MRP heuristic to realign the higher-level requirement with the lower-level supplies. However, in a production planning run (using a planning heuristic), this checkbox must be deselected to avoid adverse impacts in the planning results.

The **Maximum Package Size** is relevant when **Parallel Processing** is selected for the MRP heuristic. The production planning runs handles a large data volume, and even with the power of SAP liveCache in the PP-DS, the performance can still be a concern. To reduce the runtime of the MRP heuristic, parallel processing can be activated in the heuristics settings. The technical setup of parallel processing for the MRP heuristic is covered in Chapter 3, Section 3.4.2.

The package size determines the number of material locations included in one package, which is dispatched to a parallel process to execute the heuristics.

Note

When the MRP heuristic is executed, if one of the materials in a planning package ends up with a termination, the planning of all the materials in the package are rolled back. Therefore, it's important to have a small number as the package size to reduce the impact and avoid one material in the package making the whole package fail.

5.3.5 Demand Propagation Heuristic

This heuristic is delivered in standard embedded PP-DS with the name SAP_PP_022 and the algorithm /SAPAPO/HEU_DEMAND_PROPAGATION. It can be used in external procurement scenarios where stocks are transferred between locations. This heuristic identifies all the locations that supply material to the material location for which the heuristic is being executed, and it propagates the demand to the supplying locations by creating procurement elements such as stock transport requisitions.

This heuristic can execute multilevel demand propagation according to the heuristics settings. As shown in Figure 5.14, when the **Multilevel** checkbox is set, it executes the heuristic across all locations of the material. The **Reuse Mode** and the **Create Planning File Entry for Component** function similar to the settings available in the planning of standard lots heuristic (refer to Section 5.3.1).

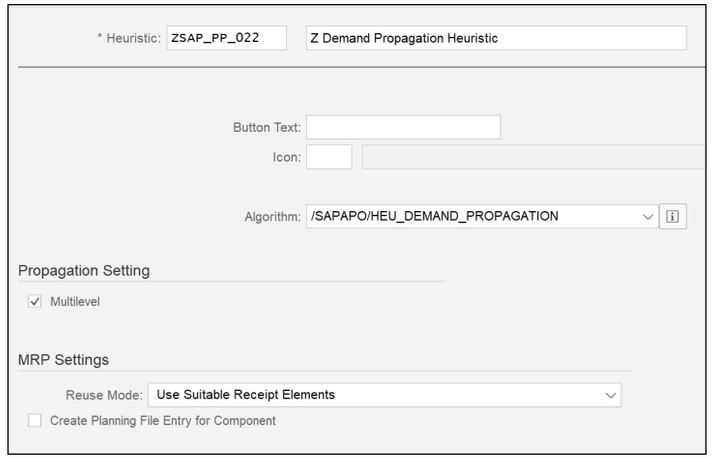

Figure 5.14 Demand Propagation Heuristic: Available Settings

5.4 Leveraging Service Heuristics

In embedded PP-DS, the service heuristics are the algorithms that can't directly be involved in planning or in scheduling but help in altering the planning data, which is later leveraged by the planning and scheduling heuristics. These heuristics can't create or change the quantity of the receipt or requirement elements.

Service heuristics, such as the fixed pegging creation or deletion, changing the order priorities, or new explosion, trigger a nonplanning or a nonscheduling action but can change the receipt elements with the task they are assigned to perform. We'll cover the details of the commonly used service heuristics in this section.

5.4.1 Bottom-Up Rescheduling

The bottom-up rescheduling heuristic is delivered in standard embedded PP-DS with the name SAP_PP_009 and the algorithm /SAPAPO/HEU_MIN_PEG_GIV_SUPPLY. The primary purpose of this heuristic is to ensure that the existing supplies that were planned as part of a production planning heuristic for the dependent demands can fulfill the demands with as little delay as possible. This heuristic evaluates the existing supplies and then shifts the requirement elements (dependent demands) closer to the availability date of the existing receipts, so that there is no or very little delay. As the components from the orders are assigned to an activity of the order under an

operation, this heuristic needs to reschedule the activity to a newer date where the component requirements can be fulfilled with the existing receipts.

To keep the delays minimal, this heuristic takes the component availability date (the date of the existing receipt elements) and then reschedules the activity using forward scheduling. If there are related orders due to their BOM structure, depending on the settings made in the detailed scheduling (DS) strategy profile of this heuristic, it can update the availability dates of the related orders.

This heuristic can only shift the dependent demand date by rescheduling the corresponding activity of the order. However, it won't shift the customer requirement (sales order or customer-dependent requirement) dates or PIR dates. So, after the execution of this heuristic, even though the receipts and requirements at the lower-level BOM levels are aligned with no or little delay, at the top level (finished product level), there could be a delay in fulfilling the requirement.

The available settings for this heuristic are shown in Figure 5.15. We'll walk through them in the following sections.

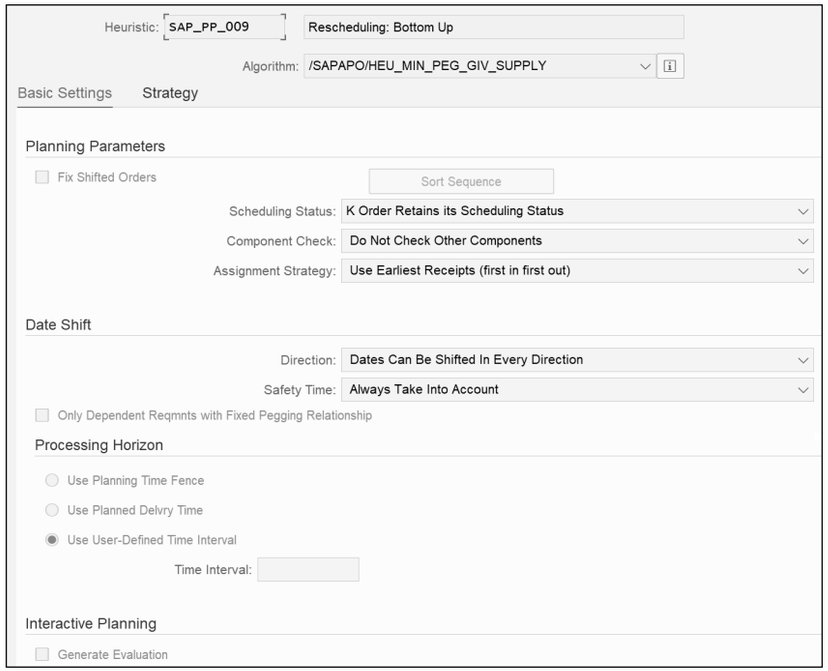

Figure 5.15 Settings for the Bottom-Up Rescheduling Heuristic

Planning Parameters

The **Planning Parameters** have the following functionality:

- **Fix Shifted Orders**
  If this checkbox is selected, then the orders whose activities are rescheduled by this heuristic will get the output firmed indicator so that no other planning run changes such orders automatically.
- **Sort Sequence**
  The sort sequence is the sequence in which the requirement elements are sorted for matching with an existing receipt element. The default delivered setting is to sort the requirement elements chronologically. Clicking the **Sort Sequence** button brings up a popup where the following list of available fields for sorting can be selected:
  - **Requirements Time**
  - **Deallocated**
  - **Order Priority**
  - **Output Firmed**
- **Scheduling Status**
  When the activities and the corresponding orders are rescheduled to the new dates by this heuristic, the orders can retain the scheduling status (scheduled on a resource or deallocated), or it can be set to either deallocate or set to reschedule on the same resource using the **Scheduling Status** heuristics settings.
- **Component Check**
  When the activities are rescheduled by this heuristic, that action may lead to other dependent activities of the order being rescheduled to maintain the order-internal relationship between the activities, which will then lead to a change in the requirement dates for the components assigned to those activities. To determine the behavior of the heuristics in the handling of other components of the same order, the following options are available in the **Component Check** setting:
  - **Do Not Check Other Components**
    With this setting, the heuristic doesn't check for the availability of the other components of the order and only works with the selected component's dependent demand dates.
  - **Check Component to Be Planned Immediately**
    For components that are critical in determining the order availability date, planning procedure 3 (immediate planning) is used so that the component is

planned immediately instead of waiting for the PP-DS planning run. This helps in creating the required alerts as early as possible in the process and avoids any delays for the order. This mode for the component check in the heuristics setting considers all the components with planning procedure 3, checks for their availability, and realigns their requirement dates as well when the bottom-up heuristic is executed for any one of the components of the order.

  - **Check Other Components**
    This option checks for the availability of all the components of the order, which may result in multiple activities being rescheduled. Depending on the number of components and activities of the order, this option can be very performance intensive, so it isn't recommended to have this setting for scenarios where many order activities and components are involved in the planning process.

- **Assignment Strategy**
  The **Assignment Strategy** is used to determine the receipt element that can be assigned to the requirement elements. This setting is similar to the settings available in the planning of standard lots heuristic (refer to Section 5.3.1).

Date Shift

The **Date Shift** settings determine the direction in which the activities of the requirement elements can be rescheduled. These activities can be rescheduled into a future date from the current requirement date or toward the current date from the requirement date. With the **Date Can Be Shifted in Every Direction** option, when the delay can be minimized for a requirement element, the activity can be rescheduled into the future or toward the current date of the heuristics execution.

Safety time in PP-DS is the time duration with which the requirement dates for a material are brought forward virtually during a planning run. This is defined in the material master. For the bottom-up heuristics, the safety time consideration during the determination of the requirement elements can be controlled by the **Safety Time** heuristics setting, which can be set on or off. In addition, a third option is available where the safety time will participate in the requirement date termination if there is no delay caused by considering the safety time in the calculation.

During the execution of the heuristics, the fixed pegging relationship between the receipt and requirement elements is always respected, and the heuristics bring the requirement date closer to the receipt date to reduce any delays. With the other receipt and requirement elements, it uses the **Sort Sequence** for the requirement elements and the **Assignment Strategy** for determining the receipt elements. By setting

the **Only Dependent Reqmnts with Fixed Pegging Relationship** checkbox in the **Date Shift** settings, the receipt and requirement elements that aren't in a fixed pegging relationship aren't selected and processed by the heuristics.

Processing Horizon

For the bottom-up heuristics to select the receipt and requirement elements for aligning them, a specific period is required within which this matching and realignment needs to happen. It doesn't make much sense to execute this heuristic for the whole PP-DS planning horizon as the planning situation changes often for the mid- to long-term horizon. This heuristic provides the following options for the definition of time duration (**Processing Horizon**, as shown previously in Figure 5.15). If the start date of the activities of an order is within the processing horizon, these activities and the relevant components are selected by the heuristics for processing.

- **Use Planning Time Fence**
  The planning time fence defined in the material master is considered the horizon for processing the receipts and requirements.
- **Use Planned Delvry Time**
  The planned delivery time defined in the material master is set as the processing horizon.
- **Use User-Defined Time Interval**
  The previous two options are specific to the material location, and the other option available is **Use User Defined Time Interval**. The value is defined in the number of working days, and all the materials selected for the heuristics will use this value as the processing horizon.

Multilevel Planning

For enabling the bottom-up heuristics to work in the multilevel execution of a production planning run (consider the lowest level component of the BOM and work all the way up to the finished product), the bottom-up heuristics needs to be called within the MRP heuristic.

The **Heuristic** settings can be navigated by double-clicking the heuristics in the heuristics list available in Transaction /SAPAPO/CDPSC11. As shown in Figure 5.16, the bottom-up rescheduling heuristics can be assigned to the MRP heuristic by selecting the **Other Heuristic** option. As this heuristic needs to work from the lowest level first to the top level last, the **Sort Low-Level Codes in Descending Order** checkbox needs to be set in the MRP heuristic setting under the **Sort Sequence** section of the heuristics

setting screen, which is created for executing the bottom-up rescheduling in a multi-level scenario.

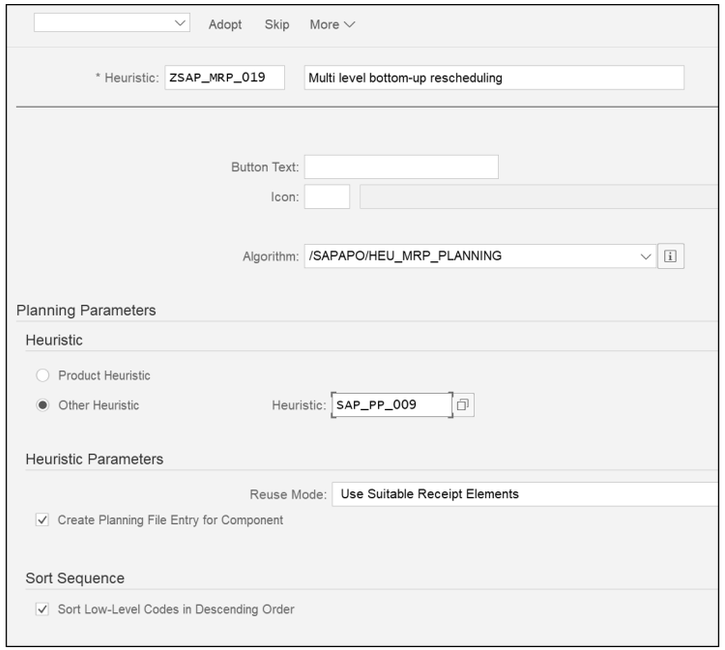

Figure 5.16 MRP Heuristic Enabled to Execute Bottom-Up Rescheduling Heuristics in Multilevel Scenarios

The DS strategy assigned to the bottom-up rescheduling heuristics offers infinite scheduling strategies so that the order activities with the requirements assigned can be scheduled with minimal delays and without capacity constraints during the planning to create a feasible plan.

The requirements from the orders that have the status **Date Fixed**, **Started**, **Confirmed** (**Partial** or **Final**), and **Delivered** (**Partial** or **Final**) aren't changed by this heuristic.

Interactive Planning

The bottom-up rescheduling heuristic also can be executed interactively from tools such as the detailed scheduling (DS) planning board. For performing such execution, the SAP_MLO_BU heuristic is delivered, and the bottom-up heuristic (SAP_PP_009) is assigned to this heuristic. The SAP_MLO_BU heuristic is like the MRP heuristic, but it works based only on the orders as an object selected for executing this heuristic.

> **Note**
>
> When copied to another custom heuristic, the SAP_MLO_BU heuristic can be used for executing any heuristics that works based on order selection. However, in the standard system, it's only used for bottom-up and top-down rescheduling.

In interactive planning, using tools such as the DS planning board, the SAP_MLO_BU heuristics starts with the order selected in the planning tool and works all the way up to the finished product level based on the low-level codes. As shown in Figure 5.17, this heuristic is also set with **Sort low-level codes in descending order** checked, so that after the relevant materials and locations are identified by the order relationships, the heuristic starts with the lowest BOM level to apply the bottom-up rescheduling algorithm.

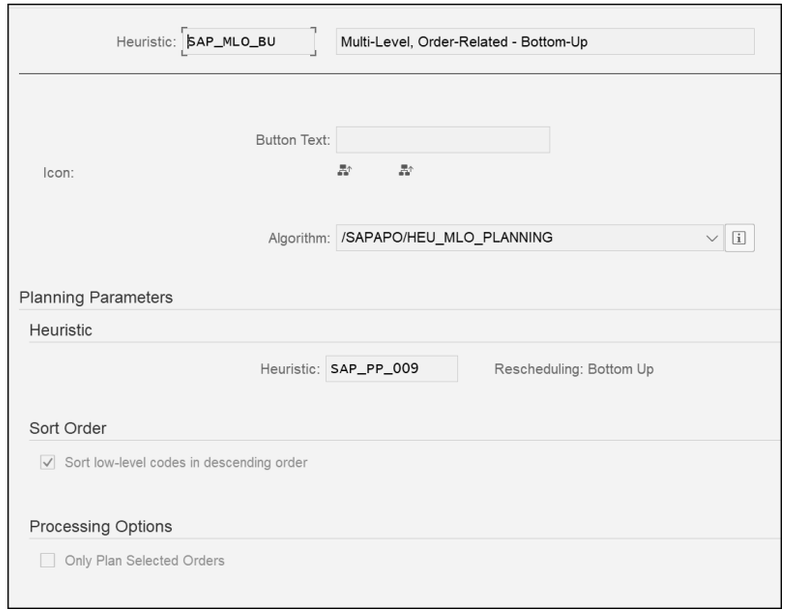

Figure 5.17 Multilevel Order Related Bottom-Up Heuristics Settings

5.4.2 Top-Down Rescheduling

The top-down rescheduling heuristic is delivered with the name SAP_PP_010 and with the standard algorithm /SAPAPO/HEU_MIN_PEG_GIV_DEMAND assigned to it.

The top-down heuristics can be used in planning situations where the planning run results in the receipt elements scheduled too far from the requirement elements. This heuristic tries to reduce the delay to the requirement element by shifting the receipt elements closer to the requirement date. This heuristic uses backward scheduling from the requirement date to schedule the shifted orders.

Other heuristics settings, such as the **Basic Settings** and the **Strategy** settings, are the same as the bottom-up rescheduling heuristic shown in Figure 5.18. The top-down heuristic derives the planning period from the time profile assigned in the production planning run (see Chapter 3, Section 3.6.2).

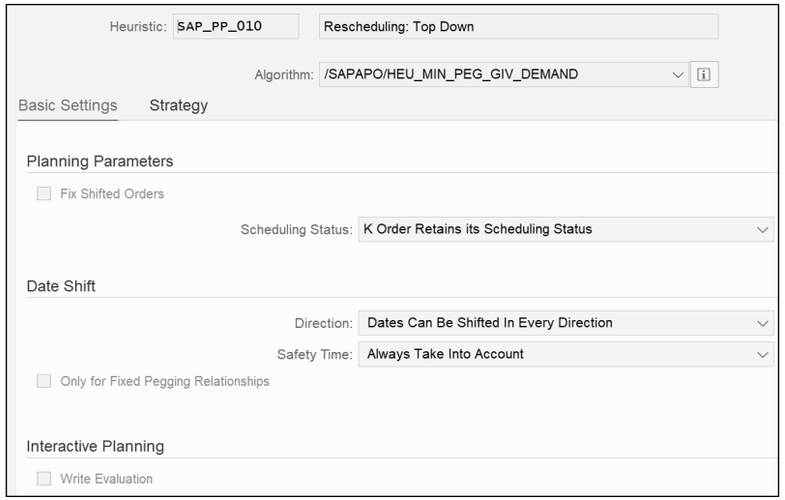

Figure 5.18 Top-Down Rescheduling Heuristics Settings

For executing the top-down rescheduling heuristic in a planning run, heuristic SAP_PP_010 can be called within the MRP heuristic. The **Sort low-level codes in descending order** checkbox must be deselected so that when the low-level codes are determined by the MRP heuristic, it starts with the topmost BOM level (finished materials) and works toward the lower-level components.

In interactive mode, this heuristic can be executed for an order at the top level of the BOM structure by calling the multilevel order heuristic SAP_MLO_TD. This heuristic

calls the top-down heuristics for the selected orders from the top level to the bottom-most component level.

5.4.3 Change Order Priorities

In embedded PP-DS, the order priorities are considered during the planning to prioritize the higher priority orders for scheduling and avoid delay for these high-priority orders. In addition, the PP-DS optimizer can respect the order priority to reduce penalty costs for the high-priority orders by reducing the delays.

The priority for the orders are determined based on the setting maintained in the model and version master data in Transaction /SAPAPO/MVM (refer to Chapter 3, Section 3.2.1, for details). Especially in MTO scenarios, one receipt element can be pegged to multiple requirement elements. During a planning run, when the receipt and requirement elements are changed, this will lead to changes in dynamic pegging. Therefore, the order priorities assigned to the receipt elements before the planning runs are no longer valid as the pegging situation has changed.

The change order priority heuristics can be used in such cases to change the priority of the receipt element to the same as the pegged requirement element. This heuristic is delivered with the name SAP_PP_012 and the algorithm /SAPAPO/HEU_PRIO_CHANGE.

The heuristic checks for the priority of all the requirement elements that are assigned to a receipt element, and it sets the highest priority of the pegged requirement to the receipt element.

5.4.4 Create Fixed Pegging

In embedded PP-DS, the pegging structure is generated by the system to maintain the relation of the receipt and requirement elements within a pegging area (material/location/account assignment object). The structure comprises the order relationship across the supply chain network, including the in-house production and external procurement orders. These relationships are possible due to the relationship between various BOM levels, which is represented by the dependent requirement (demand) elements.

The pegging relationship can be displayed from the product view (Transaction /SAPAPO/RRP3), and the inter-order relationship can be displayed in tools such as the DS planning board (see Chapter 6, Section 6.4.1).

The pegging relationships can change when the planning situation changes; therefore, if you want to maintain the pegging structure permanently for the lifecycle of an independent requirement element such as a sales order or a PIR, you can create a fixed pegging relationship between the receipt and requirement elements.

The creation of fixed pegging relationships is delivered with a heuristic name SAP_PP_019 and the algorithm /SAPAPO/HEU_FIX_PEG_CREATE.

The available heuristics settings for the fixed pegging relationship heuristic are shown in Figure 5.19.

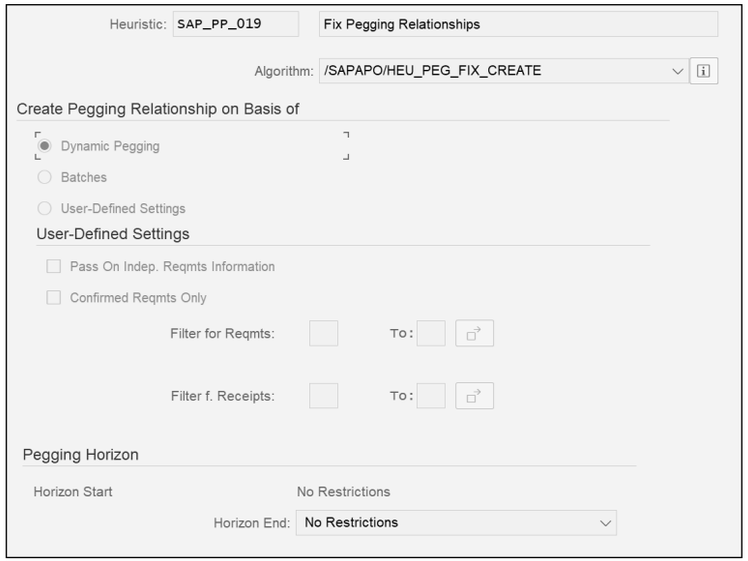

Figure 5.19 Heuristics Settings for the Fixed Pegging Heuristic

The **Create Pegging Relationship on Basis of** setting defines the basis for the pegging relationship, which will be converted to a fixed pegging relationship. The pegging structure is created with fixed pegging as well. The available options are as follows:

- **Dynamic Pegging**
  With this setting, the existing dynamic pegging relationship will be converted into a fixed pegging relationship.
- **Batches**
  For materials with batches when the requirement element and the receipt element has the same batch assigned, they will be fixed pegged to each other.

- **User-Defined Setting**
  With this setting, you'll have to define how the fixed pegging relationships are created between the receipt and requirement elements.

The **User-Defined Settings** contain the following options:

- **Pass on Indep. Reqmts Information**
  This checkbox is used to create fixed pegging in a multilevel fixed pegging creation scenario. The information, such as the available-to-promise (ATP) category of the independent requirement (sales orders, PIRs), is sent to the lower levels.

> **Note**
>
> The custom sort profiles in which the requirement elements can be sorted according to custom sort rules are only supported in the PP-DS component in SAP APO. This custom sort profile isn't supported in embedded PP-DS, as this functionality is based on global available-to-promise (GATP).
>
> You may use the BAdI `/SAPAPO/RRP_FIXPEG` to adjust the filter and sorting of the input and output elements during the heuristics execution.

- **Confirmed Reqmts Only**
  This checkbox will filter out the requirement elements based on their status. Confirmed requirement elements, such as the sales order, are only considered for filtering out the requirement elements, and other requirements aren't included in creation of the fixed pegging relationship.
- **Filter for Reqmts/Filter f. Receipts**
  You can use these fields to define specific requirement and receipt elements that need to be considered for the fixed pegging creation. The assignment strategy determines the order in which the selected receipt elements are assigned to the selected requirement elements for creating the fixed pegging relationship.

The **Pegging Horizon** settings are used to limit the duration in which the fixed pegging relationship is created by this heuristic. The start of the horizon is defaulted to **No Restrictions**, meaning all the receipt and requirement elements, even if they are older than the current date, will be selected by this heuristic. The **Horizon End** has the following options from where the number of days of the set parameter is added to the current date (date of the heuristics execution) to determine the end of the horizon:

- **No Restrictions**
  All the receipt and requirement elements irrespective of their dates are selected.
- **PP-DS Horizon**
  The PP-DS horizon set in the model version master data is considered as the end of horizon.
- **Planning Time Fence, Planned Delivery Time**
  These are dependent on the material location and are defined in the material master.
- **User Defined**
  A set value can be configured for the number of days that will be used by this heuristic to calculate the end of the horizon for fixed pegging.
- **ATP Check Horizon**
  The GATP features aren't supported in embedded PP-DS, and advanced available-to-promise (aATP) can also be used but it isn't yet integrated with embedded PP-DS. However, the value maintained for the **Tot. repl. lead time** (total replenishment lead time) field in the **MRP 3** view of the material master is considered the ATP check horizon value at the database table level for the material master. But because the ATP checking calendar can't be maintained in embedded PP-DS's material master, the value derived as the ATP check horizon is used as the number of calendar days and added to the current date to calculate the pegging horizon.

Note

When a specific setting is maintained for the determination of the pegging horizon and no value is maintained in the material master for the selected field, this heuristic won't be able to calculate a horizon end and won't create any fixed pegging relationship for such materials.

From the product view, you can create fixed pegging by executing the fixed pegging heuristics via the **Variable Heuristics** button. You then select the fixed pegging heuristics from the list of available heuristics in the **Variable Heuristics** screen and click the **Execute** button.

The fixed pegging created by the heuristics can be manually changed from the product view (Transaction /SAPAPO/RRP3), and the fixed pegging relationships can be manually created from the product view. As shown in Figure 5.20, to check the current fixed pegging relationships, navigate to the **Pegging Overview** tab. The quantity

that is fixed pegged to the requirement and the corresponding receipt elements are listed here. The **FixPegQty** ❶ shows the quantity that is fixed pegged to the receipt automatically by the system. The second **FixPegQty** column ❷ is editable and can be used to create or delete fixed pegging relationships between the receipt and requirement elements. If you want to change the pegging type from fixed pegging to dynamic pegging, remove the quantity from the **FixPegQty** column ❷ and press Enter. When the fixed pegged quantity is 0, the system creates a dynamic pegging link.

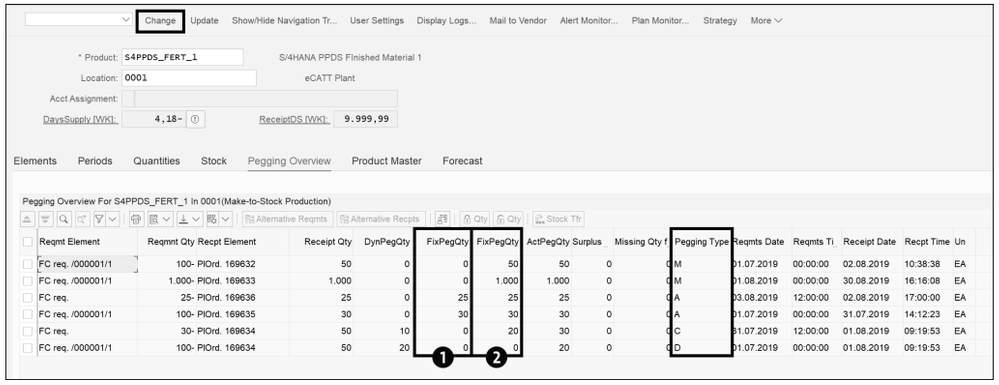

Figure 5.20 Working with Fixed Pegging Relationships from the Product View in Transaction /SAPAPO/RRP3

The **Pegging Type** column on this screen shows the type of pegging according to the way the pegging relationship was created. As shown in Figure 5.20, the available pegging types are as follows:

- **D**
  A dynamic pegging relationship is established.
- **M**
  The fixed pegging relationship that is manually created from the interactive planning tools sets the pegging type **M**.
- **A**
  The system automatically creates a fixed pegging relationship (e.g., the fixed pegging heuristics).

- **C**
  A combined pegging relationship is set when one requirement element is partially dynamically pegged and partially fixed pegged.
- **[Blank]**
  No pegging relationship has been established yet for the requirement element.

5.4.5 Delete Fixed Pegging

When the create fixed pegging heuristic is executed in the production planning run for creating a multilevel fixed pegging structure, it's recommended to delete any fixed pegging relationships created previously so that the current fixed pegging run will recalculate the pegging link and fix them.

To delete any previously created fixed pegging relationships, the heuristics for deleting fixed pegging named SAP_PP_011 is delivered with the algorithm /SAPAPO/HEU_PEG_FIX_DELETE_NEW. This heuristics can be interactively called for one material location or can be called within the MRP heuristic in a production planning run.

The settings available for the delete fixed pegging heuristic is almost like the create fixed pegging relationship heuristic. As shown in Figure 5.21, under the **Delete Pegging Relationship** section, the heuristic can be set to **Automatically Created Fixed Pegging Relationships**, **Manually Created Pegging Relationships**, or both.

The **Filter for Pegging Relationship** section has the same options as the same section for the create fixed pegging relationship heuristic. The **Pegging Horizon** for the delete fixed pegging heuristic is the horizon in which the heuristic can delete the fixed pegging relationships. If you want the heuristic to delete the fixed pegging relationship only after the PP-DS planning fence, you can set the value accordingly in the heuristic. The end of the horizon for the deletion of the fixed pegging relationship is set as **No Restrictions** by default, and this value isn't changeable in the heuristics settings.

The delete fixed pegging heuristic deletes the fixed pegging relationship according to the heuristics settings maintained. If those elements can be dynamically pegged, the dynamic pegging relationship is established between the requirement and receipt element.

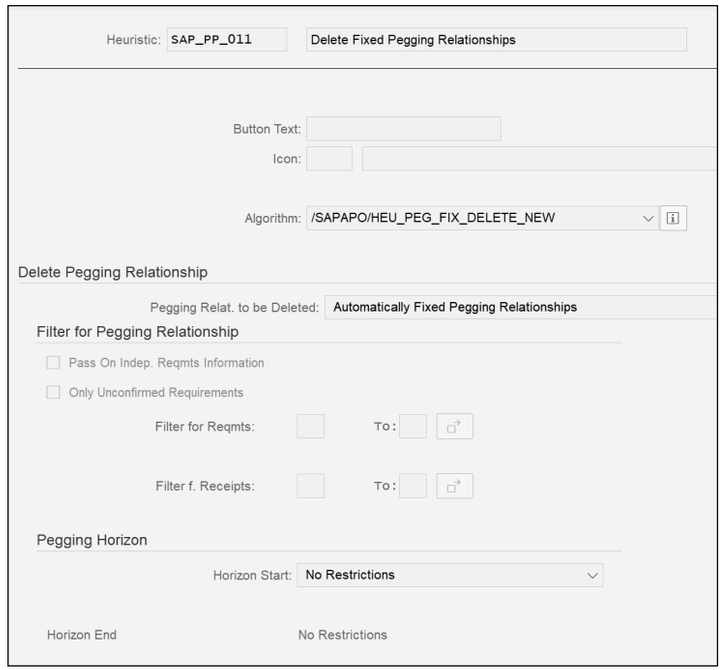

Figure 5.21 Settings for the Delete Fixed Pegging Heuristic

5.4.6 Stage Numbering

In PP-DS, the low-level codes determine the position of a material and location in the supply chain hierarchy. For example, for an in-house manufactured material, the low-level code is determined on its position in the multilevel BOM structure. For materials that are part of the BOM of multiple materials, the lowest position of the usage of the material among all the BOMs is determined as the low-level code for that material/plant.

Low-level code is very important for the PP-DS planning run, as it determines the sequence of the materials in the planning. If the sequence is incorrect, it may lead to a dependent demand created by a finished material as a semifinished material isn't fulfilled by creating a receipt element. The incorrect sequencing may plan the semifinished material first and then the finished material. As shown in Figure 5.22, the position of a material in the BOM determines its low-level code, and the low-level code determines the sequence in which the planning is executed during a planning run. In the example in Figure 5.22, the Finished 1 material is at the top of the BOM

level, so the low-level code (LLC in Figure 5.22) 0 is determined. For the material Raw 1, which is used in all the BOM explosion levels, the low-level code is determined as 3, as that is the lowest BOM explosion level for this material. Similarly, the low-level codes for other materials are also displayed in the example.

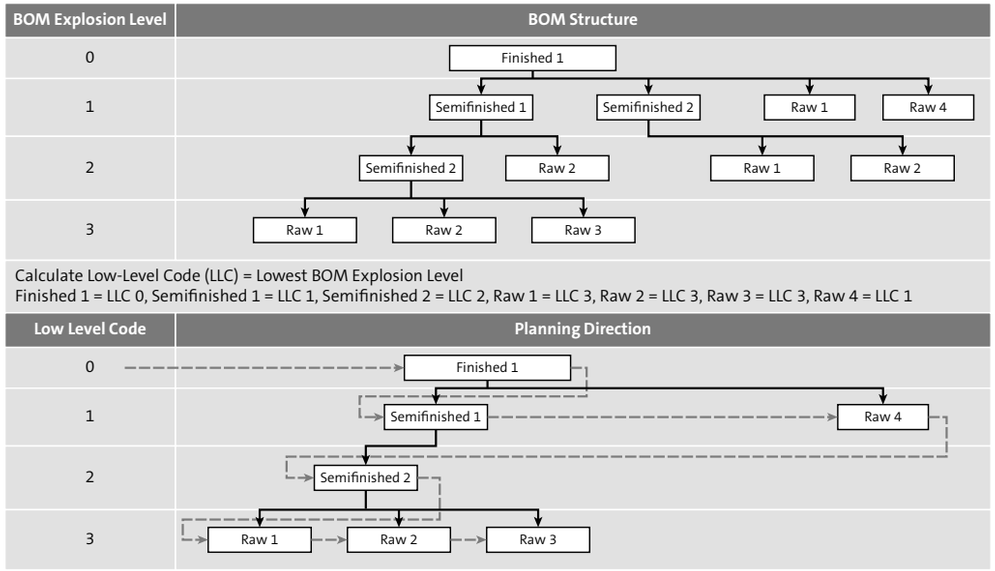

Figure 5.22 Example BOM Structure and Low-Level Code Calculation

When materials are activated for advanced planning in the SAP S/4HANA material master, they are made available for PP-DS planning. The low-level code determined in SAP S/4HANA is also transferred to PP-DS, which can be used by the PP-DS planning run. If the position of the material changes in the BOM structure or in the stock transfer scenarios, the change in the low-level code isn't updated back to embedded PP-DS from SAP S/4HANA. Therefore, it's important to recalculate the low-level code using the stage numbering heuristic in PP-DS if the PP-DS planning run is used as one of the planning tools.

Note

When MRP Live is used as the only tool for planning PP-DS materials in the SAP S/4HANA system, it uses the low-level code calculated in SAP S/4HANA. In these scenarios, the low-level code in embedded PP-DS doesn't need to be recalculated.

In embedded PP-DS, the stage numbering heuristic is delivered with the name SAP_PP_LLC and the standard algorithm /SAPAPO/HEU_LOLVLCODE. Its settings are shown in Figure 5.23.

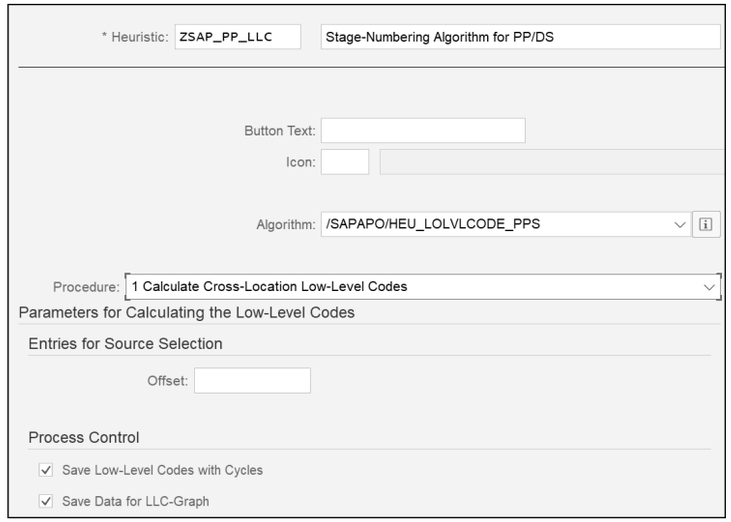

Figure 5.23 Settings for the Stage Numbering Heuristic

The calculation **Procedure** determines how the low-level code is calculated. Following are the available options:

- **0 Transfer Low-Level Code from R/3**
  With this option, the low-level code calculated in SAP S/4HANA is adopted in PP-DS.
- **1 Calculate Cross-Location Low-Level Codes**
  This procedure also considers the stock transfer relationship of components between locations and sets the low-level code accordingly.
- **2 Calculate Location Internal Low-Level Code**
  This option doesn't consider the stock transfer relationships. It can only be used if the planning is limited internally within a location. In addition, the planning run is executed per location, and the sequence of the location is done manually when scheduling the planning run in PP-DS.

This heuristic evaluates the sources of supply for determining the low-level codes. The sources of supply that are valid for the current date of the heuristic execution are

considered by the heuristic. If you want to shift the current date (to the past or future) for determining the validity of the sources of supply, you can set the required (positive or negative) number of days in the **Offset** field.

In the supply chain model, cycles can occur when two locations are bidirectional (both source and destination) for the same material. In such cases, the low-level code calculation can't be performed. The behavior of the heuristic can be controlled by using the **Save Low-Level Codes with Cycles** checkbox, however. When it's selected, the heuristic will save the current low-level code calculated so far before the cycle occurred. If the option isn't selected, the system will write a log message and won't update the low-level code for such materials. In in-house manufacturing scenarios, recursive BOMs (the header material of the BOM is also used as a component) lead to cycles in low-level code calculation.

The **Save Data for LLC-Graph** checkbox records the low-level code calculation results in the system to generate a graph to show the relationship of the materials and their low-level codes and the corresponding sources of supplies. The low-level code graph can be accessed after the low-level code calculation by executing the ABAP program /SAPAPO/SHOW_LLC_GRAPH from Transaction SE38 or Transaction SA38. This report is also available in SAP APO, so you'll see some selection options related to SAP APO in the selection screen. For embedded PP-DS, only the selections relevant to PP-DS are valid.

As shown in Figure 5.24, the upper-left screen shows the selection options of the low-level code graphical display report. You can navigate to the source of supply details by double-clicking the link lines ❶ between the boxes with the material numbers. You can double-click on the material numbers ❷ in the graphical object to navigate to the product view. The highlighted numbers ❸ below the material numbers display the low-level code of the material.

Note

If materials are assigned to a planning group, all the materials in the planning group will get the same low-level code and will be planned together in a planning run.

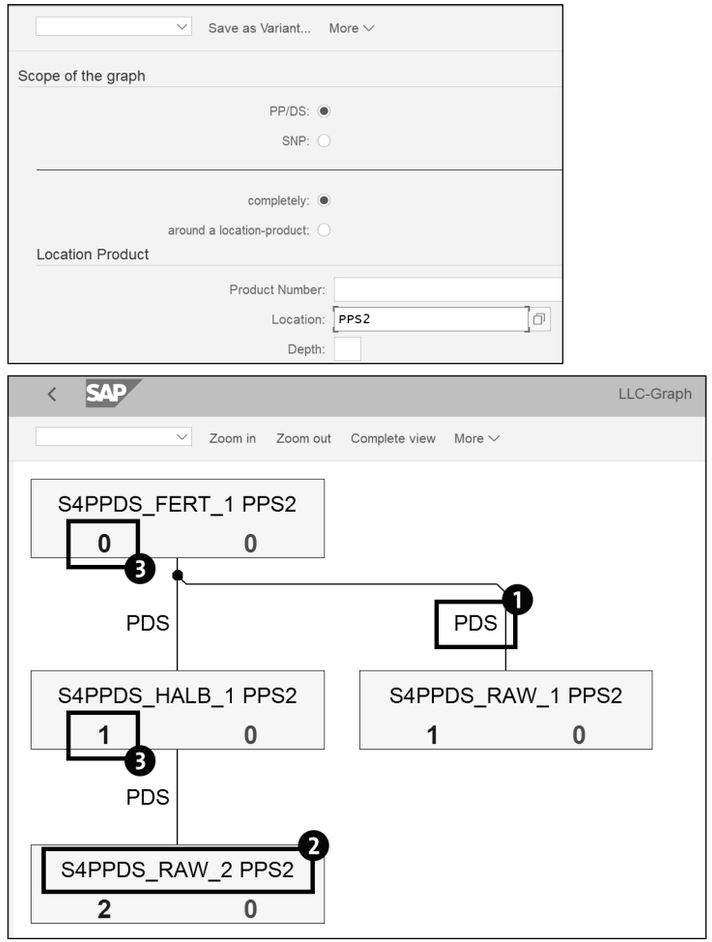

Figure 5.24 Low-Level Code Graph Generated from the Stage Numbering Algorithm Heuristic

5.5 Triggering a PP-DS Planning Run

In SAP S/4HANA and in embedded PP-DS, triggering a planning run means making a selection for the material that needs to go through the planning process. In PP-DS, the planning run is passing the materials through one or multiple heuristics (algorithms) according to the business processes involved.

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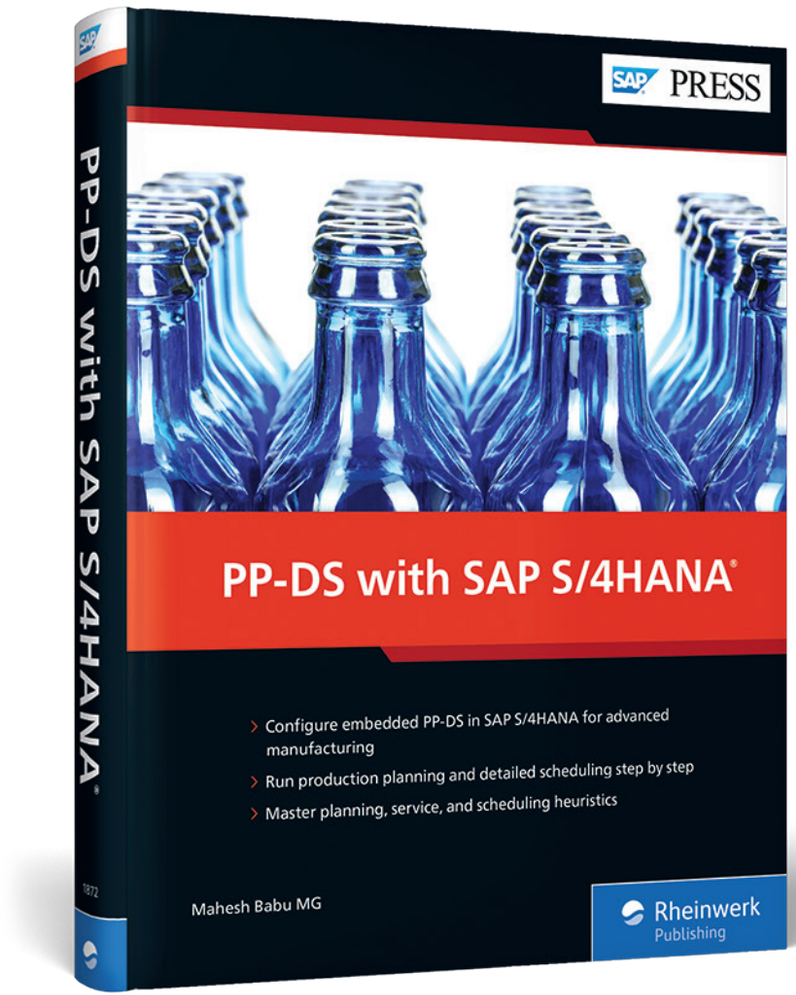

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