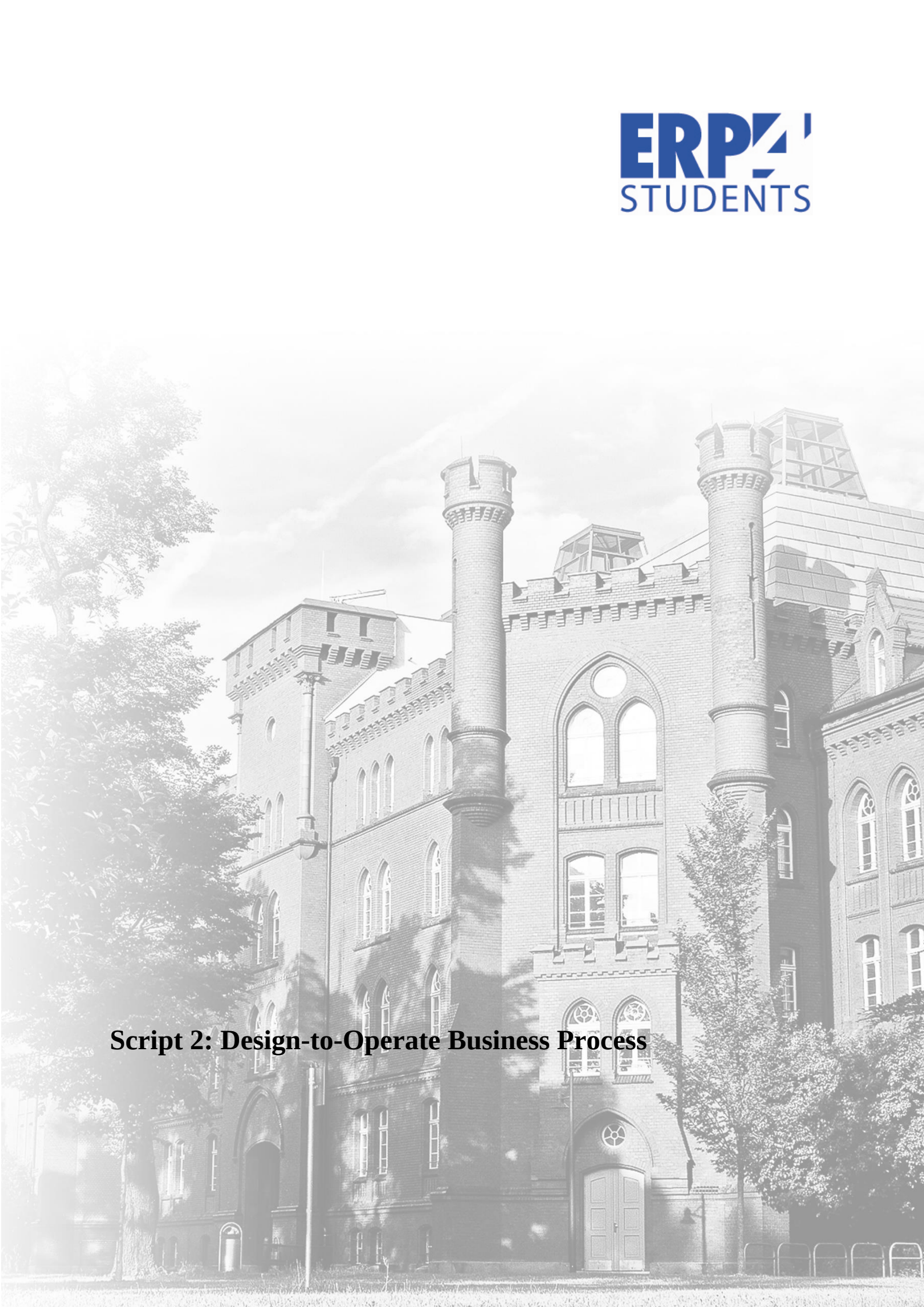
ERP4 STUDENTS



Script 2: Design-to-Operate Business Process

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1 Design-to-Operate Business Process

This teaching unit explains the Design-to-Operate business process in the Production Planning Application (SAP PP). We will show how SAP has implemented the central functionalities that are required to accomplish production planning and scheduling processes. Thereby, we will focus on the Design-to-Operate business process that integrates different application areas of SAP PP. First, the organizational units and master data that are relevant to SAP PP are explained. Then we will focus on the Design-to-Operate business process and explain how manufacturing is implemented in SAP PP. Furthermore, integration points to other SAP applications are illustrated.

Educational Objectives in this Unit:

After this teaching unit, you will be able to:

- explain the organizational levels of the Design-to-Operate business process
- explain the master data that is used by the Design-to-Operate business process including the following elements:
  - material master data
  - bill of materials
  - routings
  - work centers
  - product groups
- explain the integration aspect of the Design-to-Operate business process with Product Cost Controlling of the Controlling Application (SAP CO)
- run the Design-to-Operate business process including the following elements
  - sales and operations planning
  - material requirements planning
  - production order creation
  - goods movements
  - production order confirmation
  - period-end closing operations
- describe important interfaces with other SAP processes and applications
- list tools for analyses and reporting in the Design-to-Operate business process

Scenario for the Case Study

In the following two figures, you can see the entire end-to-end business process, which you will independently accomplish in the practice chapters of this teaching unit. The color-coded process steps show that the main part of the Design-to-Operate business process takes place in the Production Planning (PP) application.

In the first practical section of this unit, you will create a new product (Speedstarlett) and define bill of materials as well as routings for your Speedstar and Speedstarletts (and their assemblies). This master data will build the basis for the product cost calculation in the Controlling application (SAP CO).

Furthermore, you will combine the Speedstarlett with the Speedstar in a product group. Building on that, you will perform the sales and operations planning as well as material requirements planning for the product group and its components (members). You will receive a sales order for the production of the Speedstarletts and Speedstars from a customer of the company and adjust your planning correspondingly.

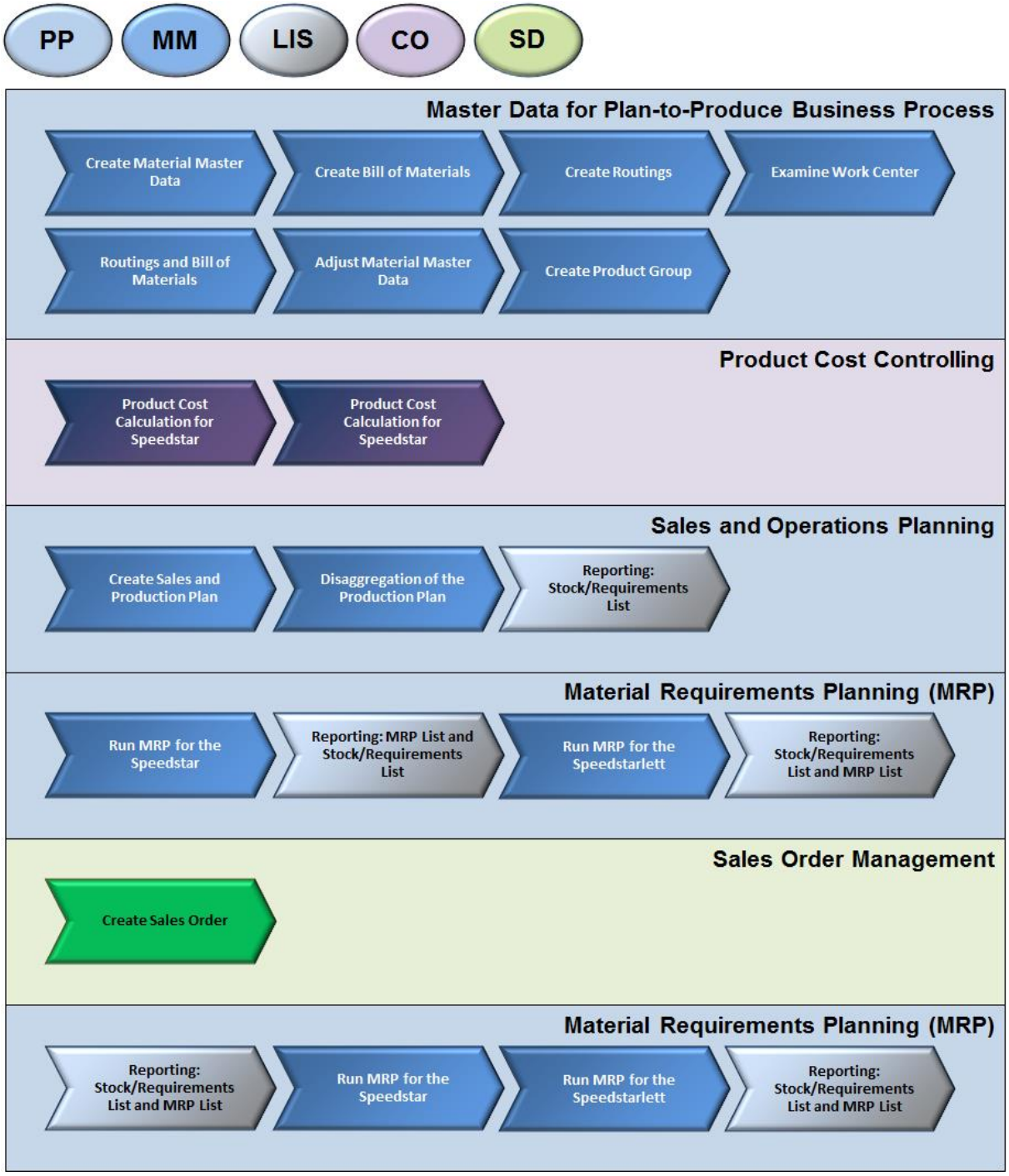


Figure 1: Process Overview: Design-to-Operate Business Process (1)

In the second practical section of this unit, you will deal with production scheduling and shop floor control. In this part, you will manufacture the Speedstar, procure missing components, and perform period-end closing operations in the Controlling application. Finally, you will create a report in the order information system.

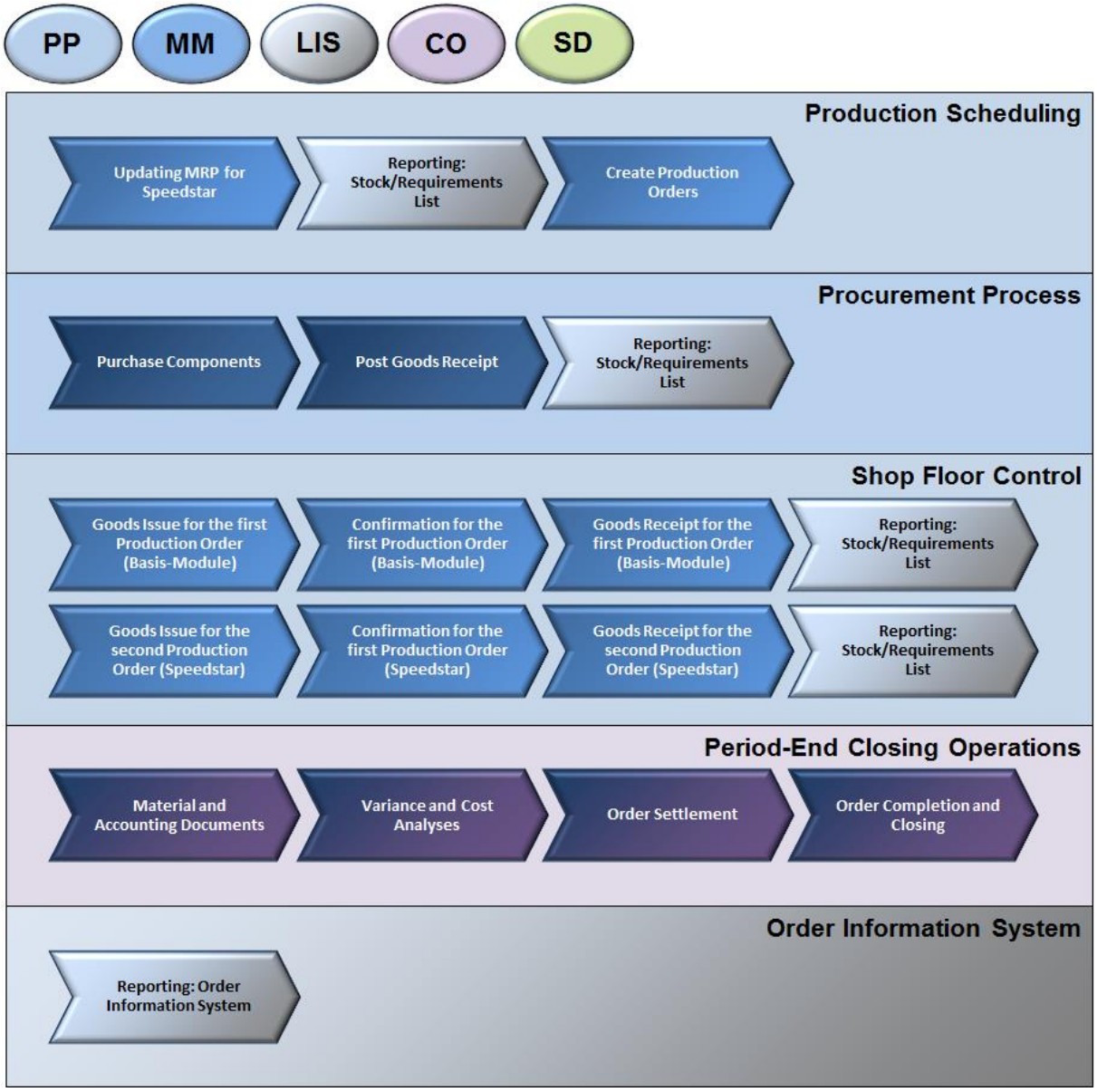


Figure 2: Process Overview: Design-to-Operate Business Process (2)

2 Basic Data of Design-to-Operate Business Process

In this section, you will learn about the organizational levels and master data that are relevant for the Design-to-Operate Business Process. The Design-to-Operate Business Process spans from forecasting the future demand for a product in Sales and Production Planning up to manufacturing the product in Shop Floor Control. Thus, the main parts of this business process are accomplished in the Production Planning (PP) application. However, there are important integration points to SAP MM (Materials Management), SAP CO (Controlling), SAP SD (Sales and Distribution) as well as SAP FI (Financial Accounting) that we will discuss later in this teaching unit.

2.1 Theory: Organizational Levels of Design-to-Operate Business Process

In the introductory teaching unit of this course, you have already become acquainted with the main organizational units of the SAP system. For instance, these were the client, company codes, plants, sales organizations, etc. In the following, organizational units that are relevant for the Design-to-Operate business process are introduced. Note that there are organizational units like the client or company code, which are relevant to more than one functional area.

You are already familiar with the organizational levels that relevant to the Design-to-Operate business process, since they are the same as for the material planning application (Source-to-Pay business process), except of the purchasing organization and the purchasing group. Thus, you will only find a summary in this section.

2.1.1 Design-to-Operate: Organizational Levels for Production

Organizational units are structures for modeling the legal or organizational views of a company. They help building the company structure based on the company's business processes. In production planning and manufacturing, the following organizational units are used:

Client

A **client** is the highest-level organizational unit in an SAP system and constitutes an independent environment with its own set of tables and data, which are separate from other clients. Each SAP system can host multiple clients.

Each client represents the enterprise, company or business, depending on the size. Thus, a client is an organizationally, data model-wise, and legally closed unit. In SAP, clients are identified through their three-digit client number. The GBI Company is mapped in one client of an SAP system.

Company Code

Company structure determines whether a self-contained set of accounts is required for external reporting purposes or not. Therefore, the SAP system features the **company code** as an organizational level. It is the smallest organizational unit for which a self-contained set of books can be defined according to commercial law; a complete profit and loss statement can be issued.

If a business organization consists of more than one company (i.e., a group), company codes represent the particular companies of the group from an accounting point of view.
The company code is the central organizational element of **Financial Accounting**. However, it is relevant to almost any process in the SAP system, since most processes influence the accounting of the company. Thus, the company code is also relevant for SAP PP. For instance, when you process a production order, costs for activities performed or materials used incur. These costs are posted to particular accounts in financial accounting, which belong to the responsible company code.
The GBI has two company codes – one for the US headquarter (US00) and one for the German subsidiary (DE00). It is necessary to separate the two company parts from the point of view of financial accounting, since each country has its own laws regarding financial statements and taxes.

Plant
From a logical point of view, **plants** structure a company in organizational terms, i.e., they distinguish between different operating areas. A plant can be used as a manufacturing facility for procurement, maintenance and/or planning location, as well as a distribution center. From a commercial point of view, a plant is a branch.
The plant is the central organizational unit in logistics. In SAP PP plants are used for the following purposes:

- As a material planning area: Sales plans, production plans, and material requirements planning take place on the level of a Plant. Thereby, material requirements can be planned for one Plant or an MRP area (one to multiple Plants that belong to one Company Code)
- As a manufacturing facility: Within a plant, goods are produced, and services created. The Plant is in charge of processing production orders.
- As a distribution center: As a warehouse distribution center a plant is in charge of preparing goods for sales and distribution.

A Plant must be assigned to a company code for financial accounting relevant processes (e.g., material valuation, production activity costing, etc.). Thereby, a plant assigned to exactly one Company Code can contain multiple Plants (1:N).

The GBI has three plants in the USA (and two plants in Germany). Thereby, each plant has multiple Storage Locations assigned for different purposes. Also note that the plant DL00 (Dallas) is a manufacturing facility, whereas all other plants are Distribution Centers and, thus, only relevant for preparing goods for sales and distribution.
Since the manufacturing plant DL00 must perform production tasks, it has ***Work Centers*** (also called Work Center Locations) assigned. Work Centers (e.g., ASSY1000 – DL Assembly) are "organizational units" that define where and when an operation is performed. They are relevant for capacity planning, scheduling, and activity costing within plants. In the following figure, a work center is illustrated in a different color than the organizational units, since work centers are not considered as organizational units in the SAP system but rather as master data.

Storage Location

A **storage location** is an organizational unit enabling differentiation between the various material stocks within a Plant. Thereby, storage locations can differentiate the stocks according to location within a plant (storage locations FG00, TG00, etc.) and stock type (quality inspection stock, unrestricted-use stock, blocked stock, etc.). Quantitative inventory management and inventory are conducted on storage location level. A storage location is part of a Plant; a Plant can contain multiple storage locations (1:N).
Each GBI plant contains several storage locations. Each of those storage locations is used for a certain purpose within its plant. For instance, in plant DL00 (Dallas), storage location FG00 is used to store materials of type Finished Goods.

The following figure displays the above-described organizational units that are relevant for the Design-to-Operate business process. The example refers to the organizational model of the US headquarter of GBI. In addition, the controlling area is illustrated as well as different master data and its connection to the organizational model.

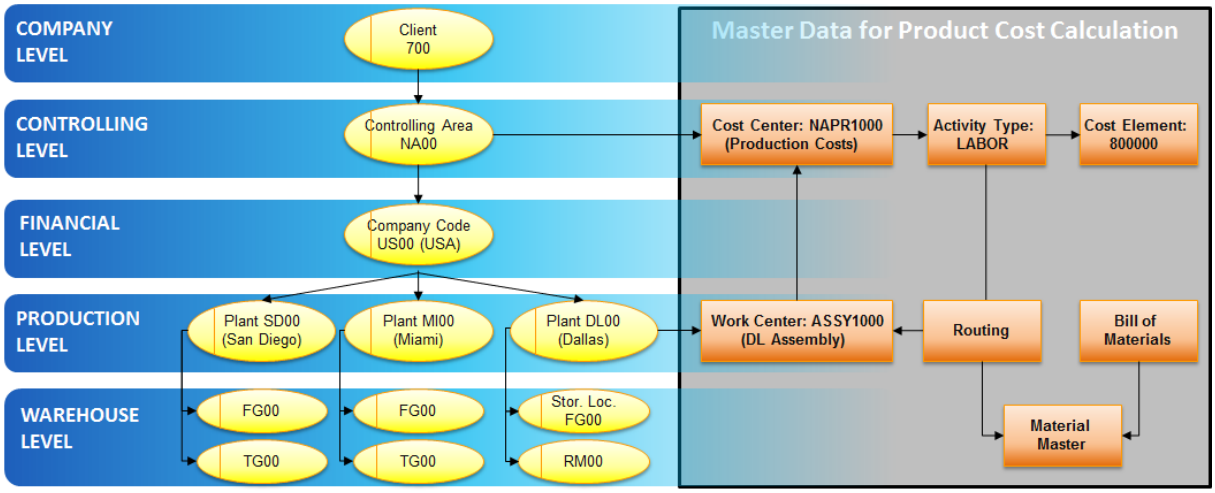


Figure 3: Relevant Organizational Levels in the Design-to-Operate Business Process

2.1.2 Design-to-Operate: Organizational Levels for Product Cost Calculation

The figure above mentions the controlling area and different master data that are used in the SAP system among others to calculate manufacturing costs for a product. Product Cost Calculation is a sub-component of the Controlling application (SAP CO) and depicts an integration point between SAP PP and SAP CO.

Controlling Area

The **controlling area** is the main organizational level of Controlling. A controlling area represents a closed entity for cost accounting. Costs can only be allocated within a controlling area. Objects in other controlling areas cannot be included in this allocation. Thus, a controlling area depicts a self-contained, organizational unit for which the management of revenues and expenses can be performed.

A controlling area can be responsible for several company codes allowing for cross-company-code cost accounting (e.g., allocation of costs) as well as management accounting analyses and reports.
The GBI uses two controlling areas. GBI Europe (EU00) is responsible for the cost accounting of company codes in Europe, which so far is only the company code DE00 in Germany. GBI North America (NA00) is responsible for the cost accounting of company codes in the USA, which so far is only the company code US00. Thus, no cross-company-code cost accounting is implemented in the GBI.

Cost Center

A ***cost center*** is an "organizational unit" within a Controlling Area that represents a clearly delimited location of cost occurrence. Like work centers they are rather considered as master data than as organizational units. Cost centers are not responsible for revenue generation. Within each cost center one or multiple value-added ***activities*** are performed. By using Cost Center Accounting (CO-OM-CCA) in the SAP system, it can be determined, **where** costs incur in a company.

In the figure above, several other master data types have been illustrated. We will discuss this master data and its usage in different processes in the next chapters.

2.2 Theory: Master Data for Design-to-Operate Business Process

You have already learned that master data provide information about objects for multiple applications, and that they build the next-higher level in the SAP system structure after the organizational structures.
In this chapter we will discuss master data that is relevant for the SAP PP application, namely:

- Material
- Bill of Materials (BoM)
- Routing
- Work Center
- Product Group

2.2.1 Material Master

You are already familiar with the **material master** concept from the previous teaching unit (Source-to-Pay business process). The material master is a company's central source for depositing and accessing *material-related data* and contains all information that is required to manage materials in a company. In particular, all material relevant settings for procurement, production, storage or sales etc. are stored in the material master. The material master is used by most of the applications of the SAP system. Examples are:

- Sales and Distribution: material master is used in sales orders and delivery documents
- Materials Management: material master is used in material planning
- Production: material master is used in production orders
- Plant Maintenance: material master is used for spare parts
- Accounting: material master is used for value updates
- Controlling: material master is used for product cost calculations
- Quality Management: material master is used in quality control of, e.g., goods receipts

Not all settings in the material master are relevant for Material Management and Production Planning. Some of them are more applicable to other functional areas in the SAP system. In the following we will discuss the data and the views in the material master that are particularly relevant for the Design-to-Operate business process.

2.2.1.1 Relevant Views and Organizational Levels

You already learned from the previous two teaching units that the material master is divided into different ***views*** that contain the data for the different functional areas of a company (departments) and of the SAP system (applications). The data is stored on different organizational levels and can be maintained for multiple organizational units in parallel.

View Aspect

When defining a material in the SAP system, you first select the views that you want to create. The data stored in these views can generally be used by all departments, e.g. purchasing, inventory management, MRP, invoice verification, etc. However, functional areas (departments) of a company oversee maintenance of individual views within their responsibility.

Basic data (Basic data views 1 and **2)** in the material master can be applied to the entire company and is stored on the ***client level***. This means that a material with a specific name may only exist once in the client. The basic data views are always created when you define a material.

Views that are relevant for the Design-to-Operate business process but that are primarily associated with other functional areas of the SAP system and departments of a company are:

- ***Forecasting***: This view is relevant within the Design-to-Operate business process for Sales and Operations Planning performed to forecast future product sales figures.
- ***Purchasing***: This view is relevant within the Design-to-Operate business process for material planning of materials (components) that are procured externally.
- ***Accounting***: The accounting views are relevant within the Design-to-Operate business process for updating material standard and moving average prices after manufacturing took place. Furthermore, the valuation class controls the account assignment for any goods movements in the manufacturing process.
- ***Costing***: The costing views are relevant within the Design-to-Operate business process for calculation of production costs (Product Cost Controlling).

Views that are relevant for the Design-to-Operate business process and that are primarily associated with the functional area of Production Planning (SAP PP) and the manufacturing department of a company, are:

- ***Advanced Planning***: Production Planning and Detailed Scheduling (PP/DS) is a component of SAP APO, which is now integrated into S/4HANA (as of release 1610). Accordingly, the material master in S/4HANA was extended by this view to allow making advanced planning settings for the material such as plan explosion, PP planning procedure, product inventory costs, demand thresholds or lot size settings.
- ***MRP 1-4***: The MRP views are the central views for material planning. All parameters that control how a specific material is procured, planned, scheduled, etc. are entered in these views. Thus, these views are relevant for all materials that are procured externally or produced internally.
- ***Work Scheduling***: This view is used for parameters that are required by production orders. Thus, this view is only relevant for materials that are produced internally.

Organizational Aspect

As you already know, a material master contains ***global data*** that is valid across all locations and ***location-specific data*** that is valid only for specific organizational units:

- Global data is general material data that is valid no matter of the view or organizational level, thus, valid on ***client level***. For instance, this could be data that is the same for any plant such as the measurements and weight of a material.
- Location-specific data is data that is valid for a ***specific organizational level*** (e.g., MRP view on plant level) or a specific organizational unit (e.g., MRP view for plant DL00). For example, a material could be set as procured externally in plant SD00, while it is set up to be procured externally and internally in plant DL00. Thus, the MRP view would be created for plant DL00 and SD00 each with different parameter settings.

As you already know, global data is mainly stored on the **basic data views 1** and **2**, which are completely independent of organizational units (such as company codes, plants, etc.) and, thus, valid for the whole **client**. For example, product descriptions, material numbers, material groups, units of measure, and conversion factors are part of the basic data.
All views that are not valid client-wide are only valid for the organizational units they are defined for. However, views can be extended resp. created for as many organizational units that you want them to be valid for. The following figure summarizes the main views that are relevant for the Design-to-Operate business process and their relationships to organizational levels.

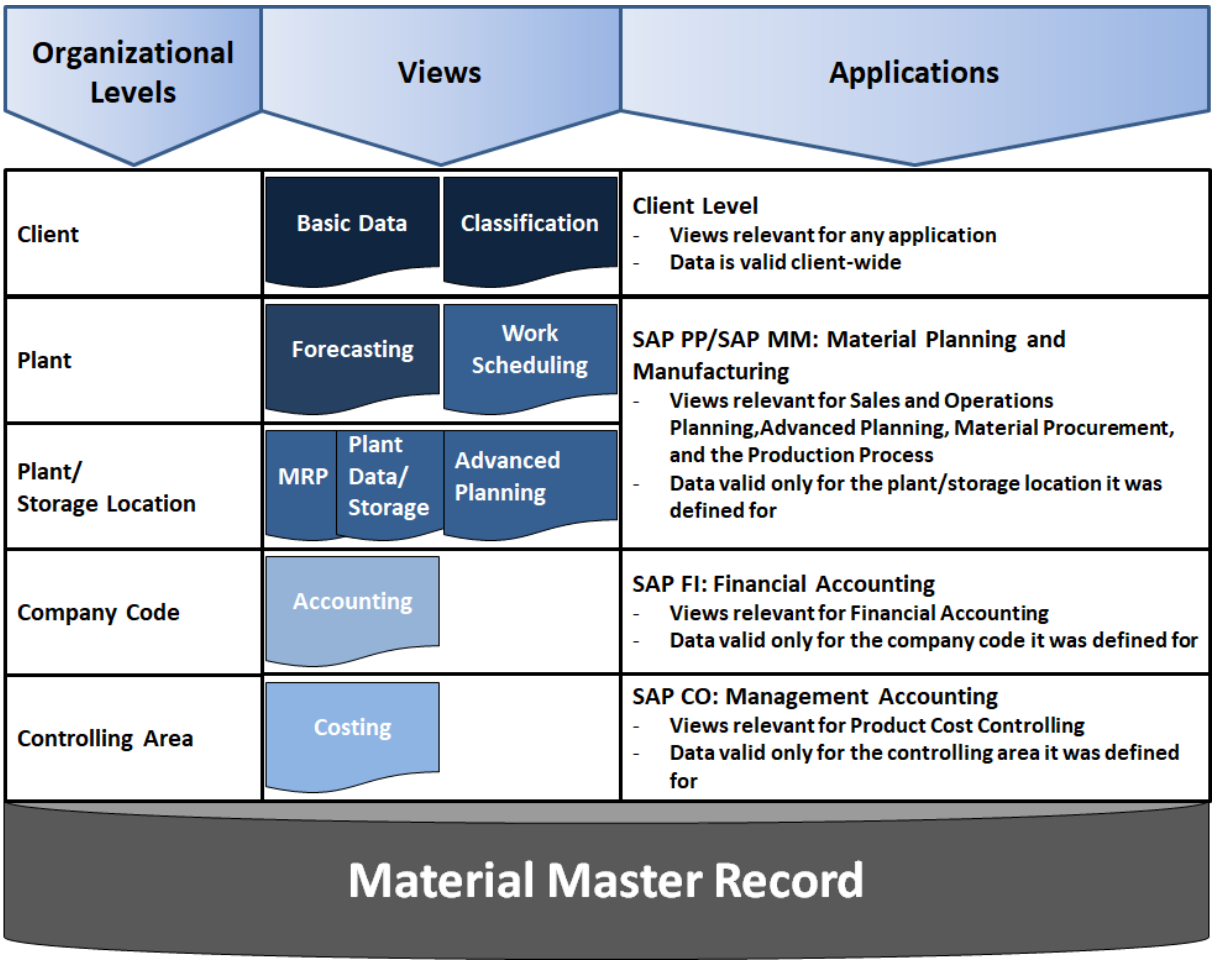


Figure 4: View and Organizational Aspects of the Material Master

However, consider that most storage-location-specific views and data are entered with reference to the plant. For instance, **Work Scheduling** (production execution), **MRP** (production planning), **Accounting**, and **Costing** views are **plant-related**. You have experienced that when creating your own materials. For the MRP, Work Scheduling, Accounting, and Costing views you always had to enter plant and storage location as organizational units. Consider that although company code and controlling area are in charge of accounting resp. costing, you never had to enter these organizational units. That is due to the fact that the assignment to the corresponding company code resp. controlling area is derived from the plant. That is, a plant is explicitly assigned to one company code and one company code is assigned to exactly one controlling area. Thus, when knowing the plant, the associated controlling area and company code can be easily derived.

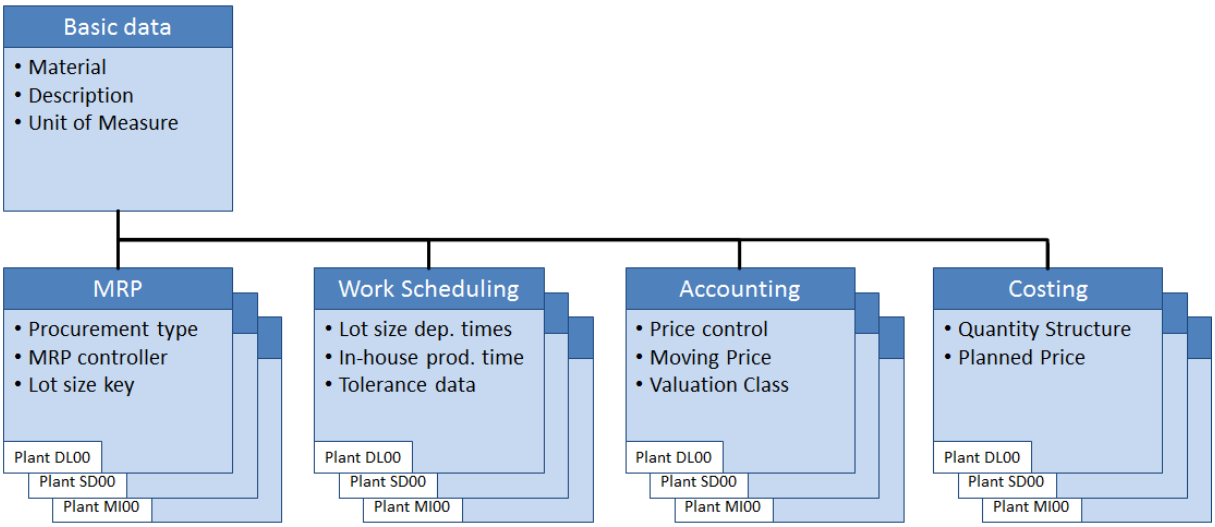


Figure 5: Data Structure of Material Master Records (SAP Online Library)

2.2.1.2 Parameters for Supply Chain Planning

Regarding material management and production planning the MRP 1-4 views are of particular relevancy. With the parameters set in these views you control the entire behavior of a material in all material planning and production planning processes. This could concern questions such as:

- How should requirements for a material be planned?
- Should materials be produced in-house, or should they be procured externally?
- Should a safety stock be considered?
- How should the planning strategy look like (make-to-stock, manufactured by lot size, individual orders etc.)?
- How should ATP (Available-To-Promise) checks be carried out?
- Which production procedures (make-to-stock production, Kanban, process manufacturing, etc.) should be used?

The following figures show the settings for the MRP views for the product ***Speedstar-xyyy*** and the parameters that are of particular interest.

View: MRP 1

Parameters influencing the Design-to-Operate business process on the MRP 1 view are:

- **MRP type** states how a material should be planned (provided e.g., for production). Amongst others, production types (MRP types) are MRP (PD), consumption-based, no planning, and MPS (master production scheduling).
- **Lot-Size Procedure**: The *lot size procedure* determines the lot size of a certain procurement proposal. The specific lot-sizing procedure thereby determines which quantity is produced without break or shifting of the production process. For instance, weekly lot sizes or exact lot sizes can be determined.

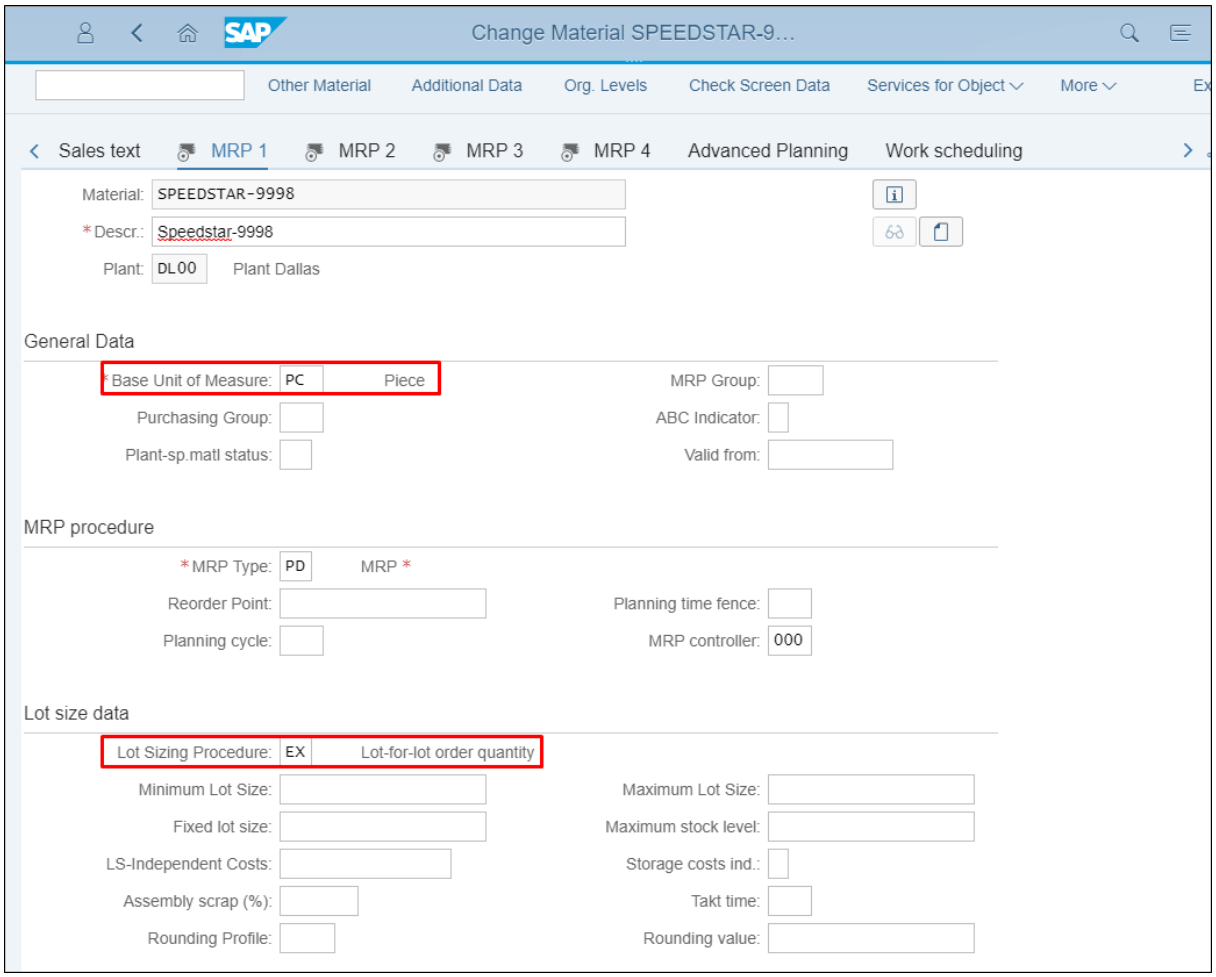


Figure 6: Planning Views: MRP 1: SAP-System-Screenshot

View: MRP 2

Parameters influencing the Design-to-Operate business process on the MRP 2 view are:

- **Procurement type**: The *procurement type* determines how materials are procured. You can either set E for in-house production or F for external procurement. X means that you can procure or produce the material.
  The Speedstar has the procurement type ***in-house production*** (E), whereas the components like Gearing have the procurement type ***external procurement*** (F). Thus, you cannot purchase the Speedstar using the procurement application.
- **Safety Stock**: The SAP system allows the creation of a **safety stock** in the material master. In case of a shortfall, either a purchase requisition or a planned order is created, or a notification is issued and sent to the person in charge. For instance, if you have a safety stock of 50 units of Gearings sets and the stock amount reaches 50 pieces, the system automatically creates a purchase requisition.

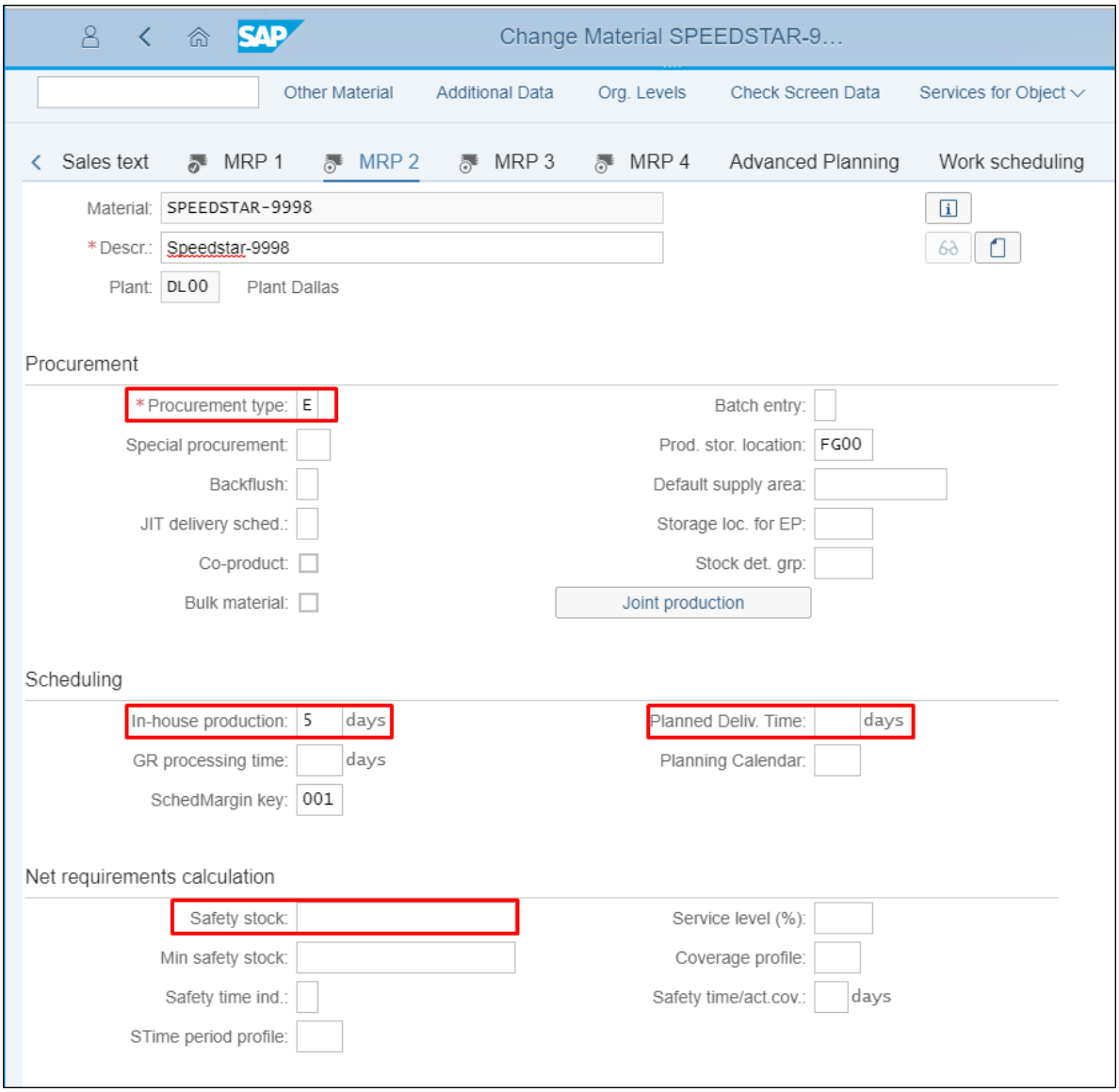


Figure 7: Planning Views: MRP 2: SAP-System-Screenshot

View: MRP 3

Parameters influencing the Design-to-Operate business process on the MRP 3 view are:

- **Strategy group**: The *strategy group* groups all the planning strategies that can be used for a particular material to control the behavior of *planned independent requirements*. The planning strategy represents the procedure used for planning a material and is (technically speaking) controlled by the MRP types.
- **ATP check**: The *ATP check* is carried out using the **availability check group**. For the Speedstar, we set the availability check group 02 (individual requirement). This means that the system checks availability every single time a requirement is created in applications such as production, planning or sales. For instance, if you create a sales order for Speedstars, the system checks immediately (after you entered the Speedstar in the sales order and pressed Enter) if the amount entered is available on stock.

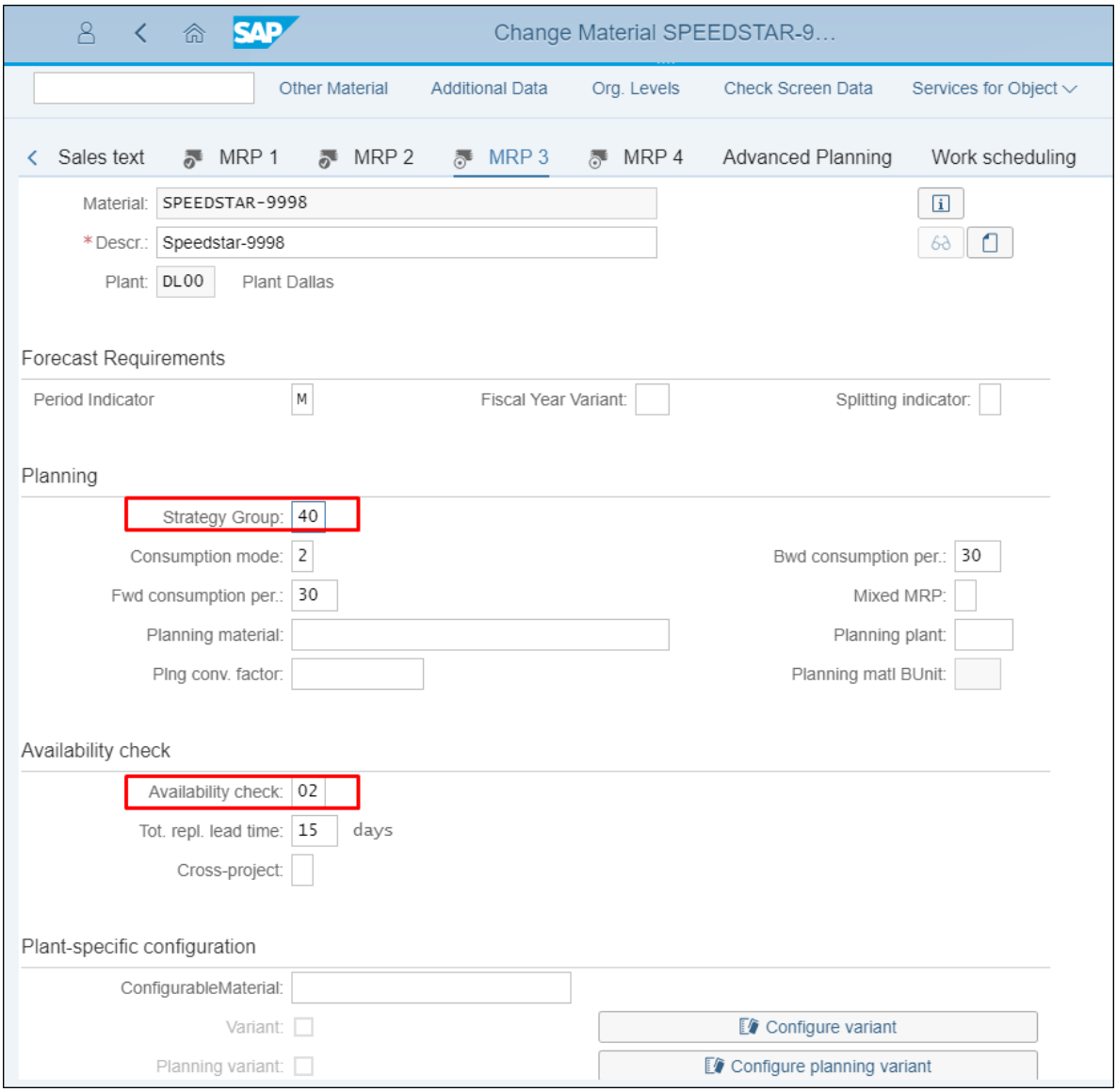


Figure 8: Planning Views: MRP 3: SAP-System-Screenshot

View: MRP 4

Parameters influencing the Design-to-Operate business process on the MRP 4 view are:

- **Production version**: You use the *production version* to determine which alternative ***BOM*** is used together with which ***routing*** (task list/master recipe) to produce a material or create a master production schedule. You can have several production versions for various **validity periods** and **lot-size ranges**.

  For instance, you could produce the same material using two different manufacturing technologies based on the number of items that you produce in a lot. Consider a case where it is cheaper (unit costs) to choose manufacturing procedure X over manufacturing procedure Y when producing less than 100 items of a material, while it is the other way around when producing more than 100 items. For these cases, you create two different production versions for the material with each having a different routing depending on the lot size.

  This field can also be maintained on the **Work Scheduling** view.

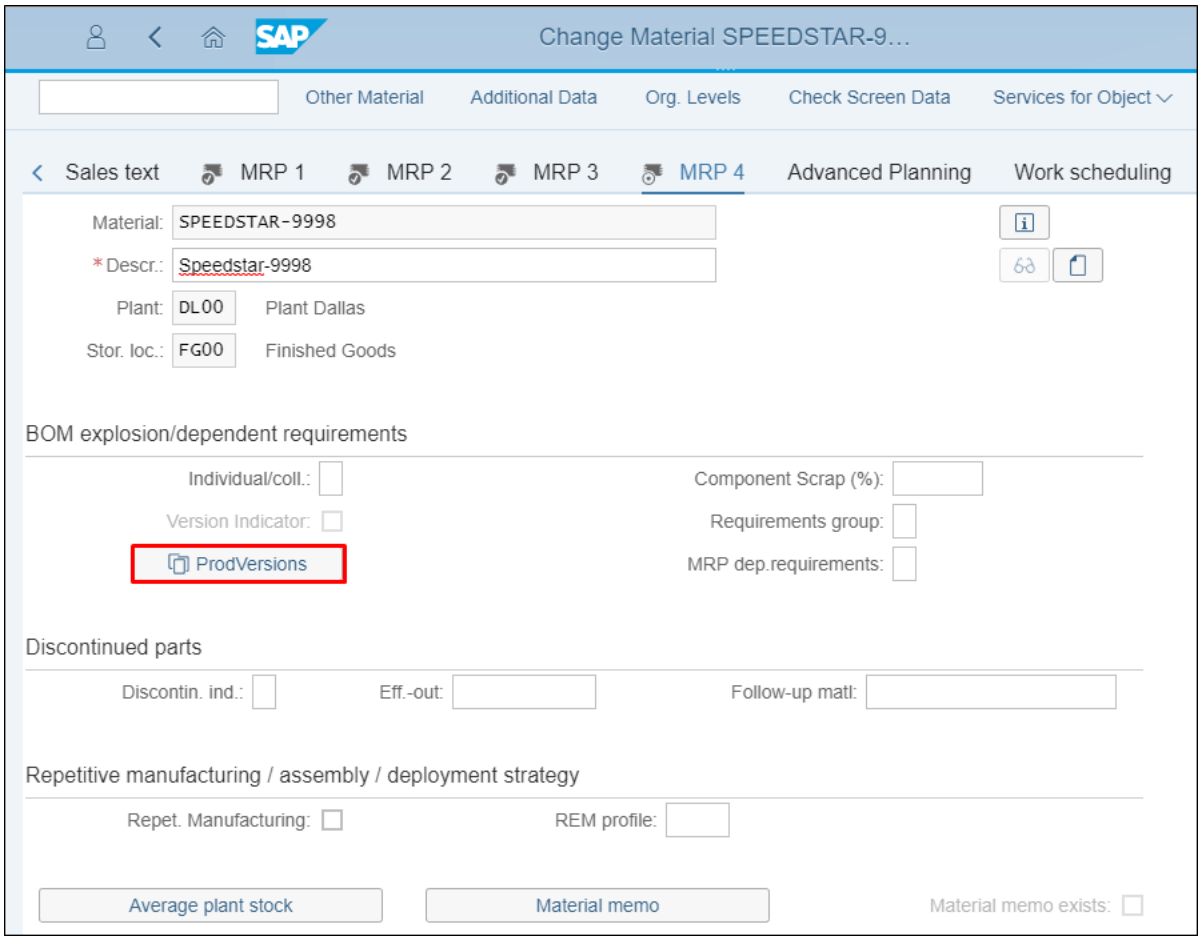


Figure 9: Planning Views: MRP 4: SAP-System-Screenshot

2.2.2 Bill of Materials (BoM)

The **bill of materials** (BoM) is a structured list of components that make up a product or assembly. It contains all materials used for the production of a particular product including assemblies (materials produced from different other materials themselves) or components. The list contains the object number (e.g., material number) of each component as well as the quantity and unit of measure of each component. BoMs are defined on ***plant***-level.

2.2.2.1 Bills of Materials Usage

BoMs are used for different purposes for finished or semi-finished products. Thereby, they contain important basic data for numerous areas of a company, for example:

- ***MRP***: To be able to plan materials required for the production of a product, the system must know what components the product consists of. This information is retrieved from the BoM.
- ***Material provisions for production***: To be able to produce a product, the system must withdraw the materials required from stock and provide them to the production process. This information is retrieved from the BoM.
- ***Material procurement***: To be able to provide the manufacturing process with the required components, these materials must be procured (purchased) first. The planning of material procurement is based on the explosion of the BoM of the parent product to retrieve the required quantities of the components for the manufacturing process. This information is retrieved from the BoM.

- ***Product costing***: To be able to calculate the production costs of a product, the system must know what components the product includes. This information is retrieved from the BoM.

The following figure displays the BoM of the finished product Speedstar. It consists of the following components

- 1 x Basis-module (HALB – Semi-finished Product)
  - 1x Carb-Frame (ROH – Raw Material)
  - 1x Gearing (HAWA – Trading Goods)
- 2x Wheels (ROH – Raw Material)

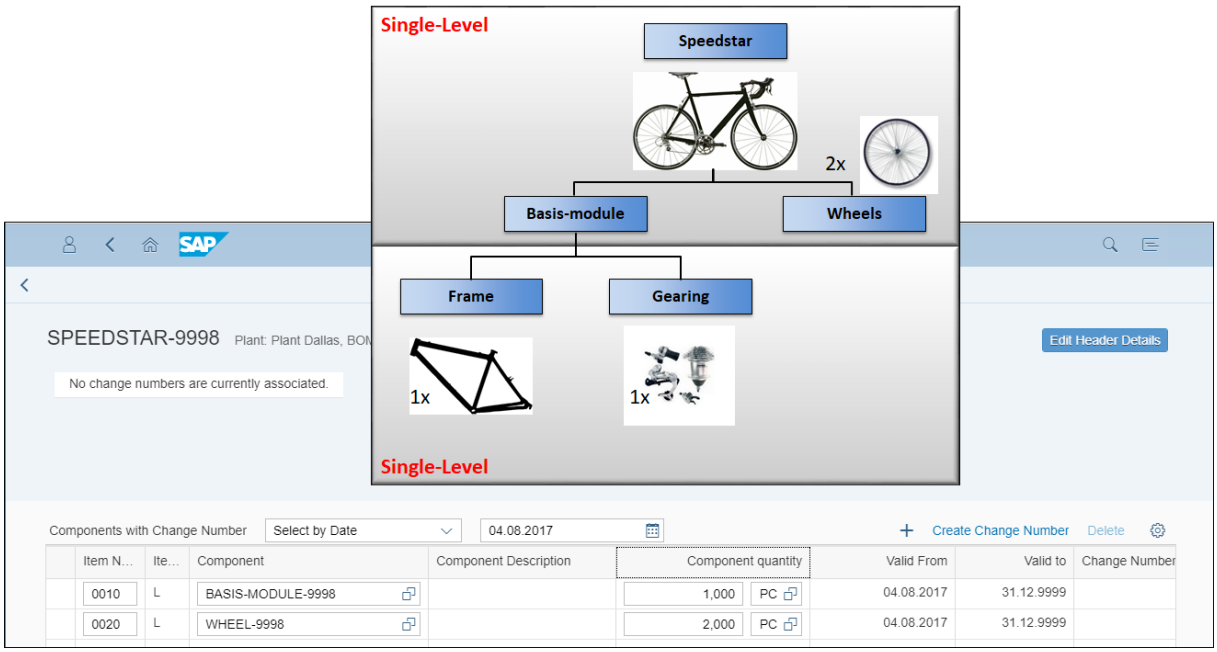


Figure 10: Bill of Materials: SAP-System-Screenshot

2.2.2.2 Bills of Materials Structure

A BoM consists of a BoM **header** and one or multiple BoM **items**.

BoM Header

On header level data that is valid for the entire BoM is entered. Thus the parameters set on header level are valid for each item of the BoM. The main parameters of the BoM header are:

- **BoM usage**: This key determines the area for which the BoM can be used. Examples are Production, Engineering/Design, Plant Maintenance, or Sales and Distribution.
- **Alternative BoM**: This number identifies one BoM out of a ***BoM group***. In addition to *simple BoMs*, that consist of only one BoM, so-called *multiple BoMs* can be created for a material consisting of multiple ***BoM alternatives*** that, e.g. can be valid for distinct lot-size areas for production processes.
- **Status**: The entry in this field describes the current processing status of the BoM. The status is used to control whether a BoM is **active** for a particular application (e.g., MRP).
- **Base quantity**: The number in this field determines the default quantity to which all item components relate.

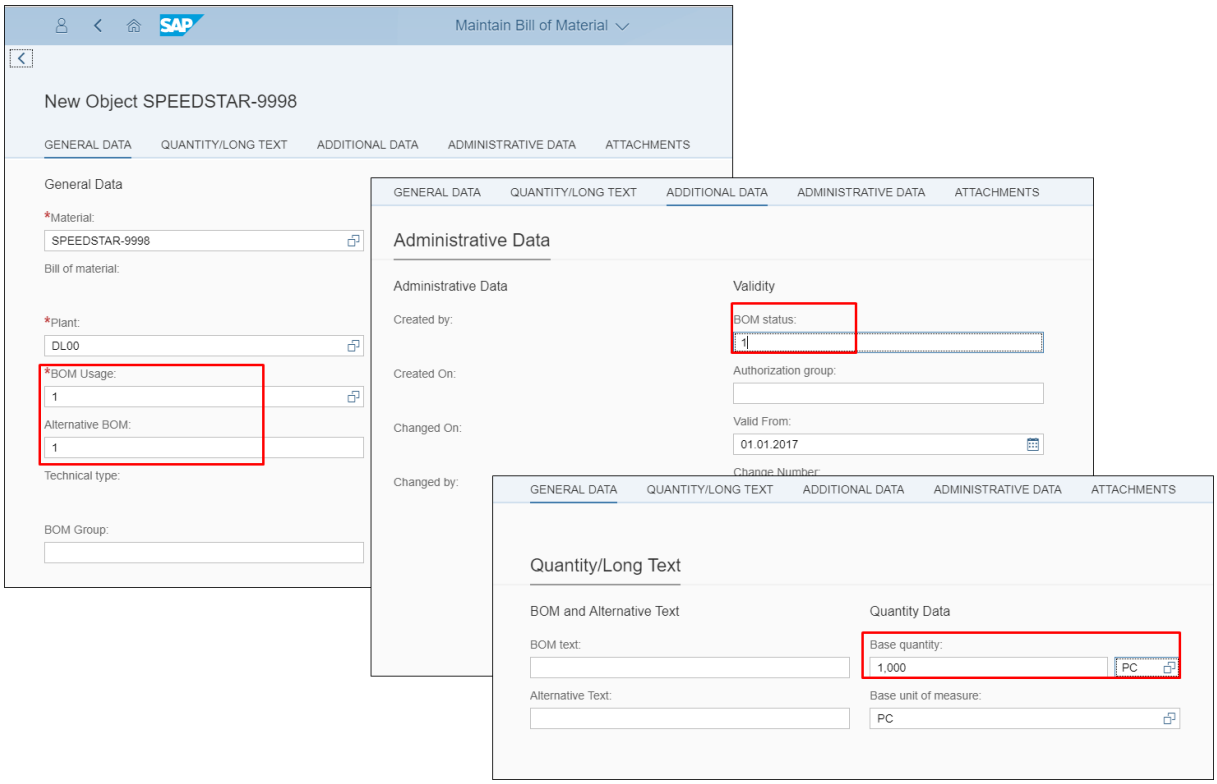


Figure 11: Bill of Materials Header: SAP-System-Screenshot

BoM Items

BoM items represent the components the material is made of that is produced based on the BoM. This means that the components that are necessary for producing a material are entered as items in the BoM.

When creating a BoM, the following information must be entered on item level for each item:

- The item category
- The material ID of the component
- The quantity

The BoM of a material can contain different types of items that are controlled by the **item category**. The item category is a categorization of the items in a BOM according to set criteria, such as whether they refer to an object (e.g., material master or document info record) or whether they are kept in stock. This item category defines the features and functions of an item and determines which specific item data is processed and controls further activities in the system. The following item categories are available in the SAP standard system. Custom item categories can be defined in the system's customizing:

Item Categories for Materials

Stock Item: BoM item is a material that is kept in stock as a component. They are managed in the warehouse and used in production. A material, which is a *stock item* in a BoM, must have a material master.

Non-stock Item: BoM item is a material that is not kept in stock before use, and that is only procured for a specific planned order or production order. Thus, *non-stock items* are assigned directly to a manufacturing order – not via the warehouse (e.g. consumable materials (cf. previous chapter). Purchase Requisition will need to be created for this type of item.

Variable-size Item (e.g., sheet of steel): If you want different-sized sections of a material (raw material) to be represented by one material number in BoM items, you use this item category.
Intra Item ("phantom material"): BoM item is a material that only exists temporarily, between two sub-processes in the production process. This item category is relevant to process industries (master recipes).

Further Item Categories

Class Item (place holder): In a BoM for a configurable material, a class item can be entered that contains a class of materials or documents. When configuring the material, one or more materials, according to the characteristic values assigned, replace the class.
Document Item (CAD drawing, Engineering Documents, etc.): Document items are supported in all BoM categories (for example, material BoM, equipment BoM), so that you can document the product or component in detail.
Text Item: BoM item is a text and allows entering a text of any length required.

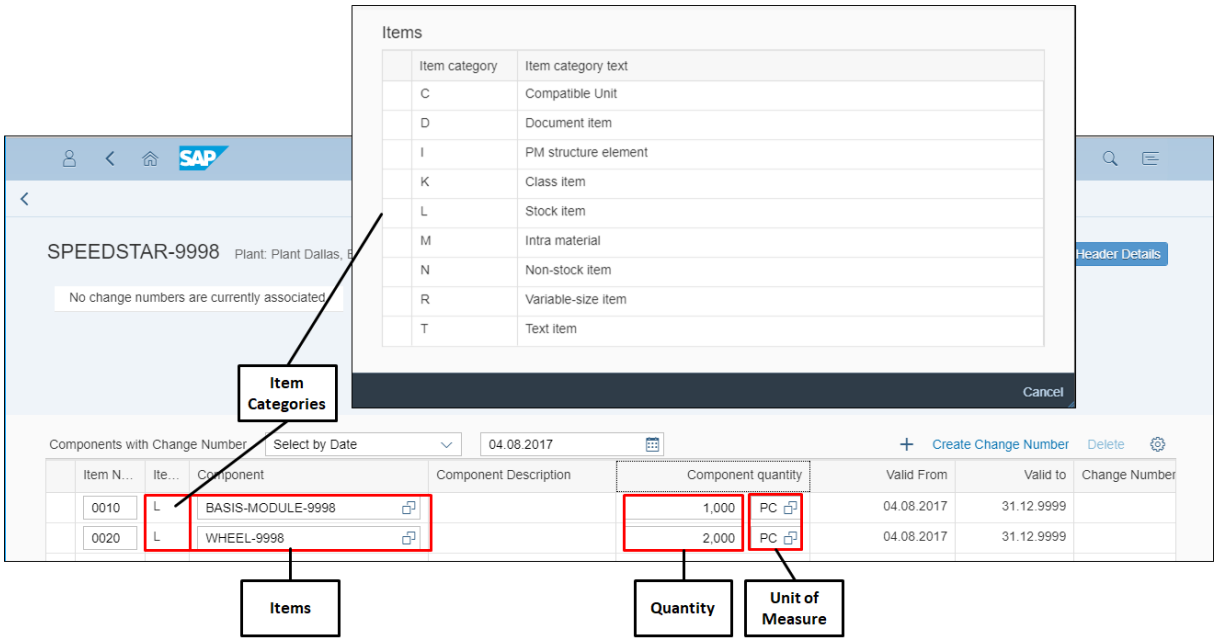


Figure 12: BoM Items and Item Categories: SAP-System-Screenshot

2.2.2.3 Single-level vs. Multi-level Bill of Materials

In the SAP system, BoMs are always created as **single-level** BoMs. That means that only one level of components is contained in the BoM of a material. However, assemblies (that contain further components, assemblies, etc.) can also be listed in a BoM as an item, resulting in a multi-level production. This means that **multi-level** BoMs are created as combination of multiple single-level BoMs.

In the following figure, you can see two single-level BoMs. In a single-level BoM, an assembly is described with its components and quantities. The BoM of the Speedstar contains two items of which one is an assembly (the Basis-module assembly), which in turn has its own BoM with two further components. Thus, the Speedstar features a multi-level BoM structure as the combination of the BoM of the Speedstar and the BoM of the Basis-module.

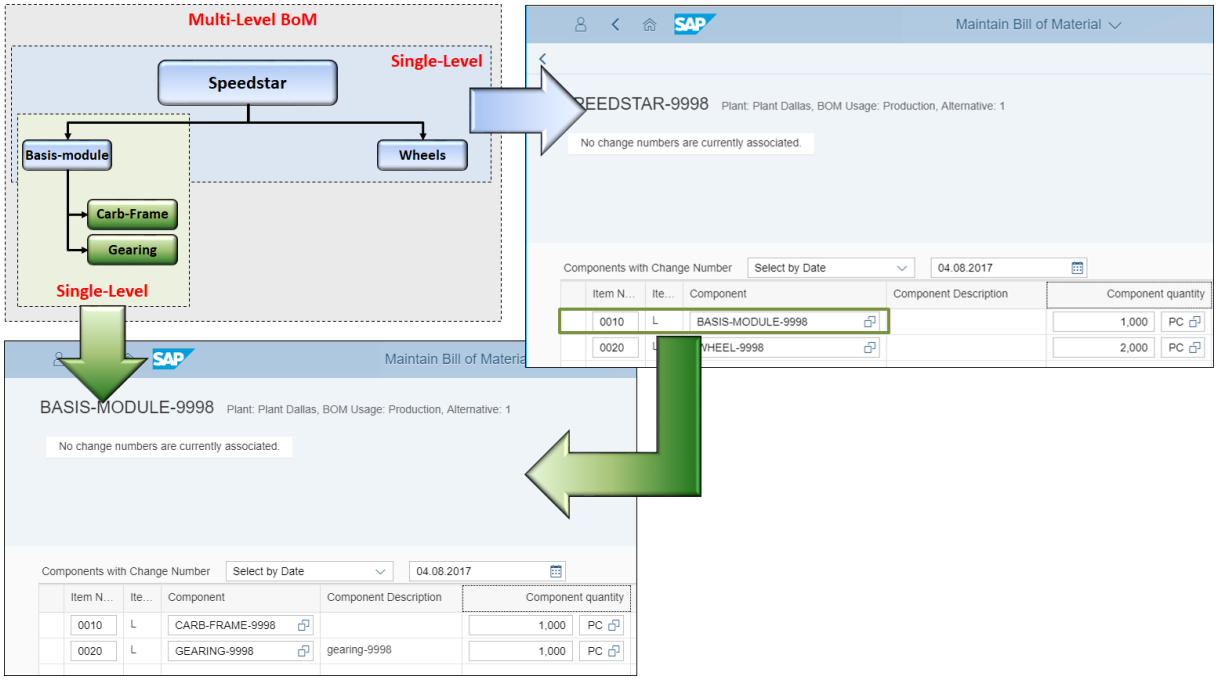


Figure 13: Multi-level BoM Speedstar: SAP-System-Screenshot

When a **multi-level BoM** is used in **MRP** or **Product Cost Controlling**, the BoMs of each level are exploded automatically so that the requirements for all components and components of components are determined. Multi-level BoMs are also exploded when **master data evaluation** is performed in the corresponding master data reports.

2.2.3 Routings

You define a routing on plant level with reference to a material. The routing describes all the steps (operations and sequences) that are required to produce (manufacture) the material it is created for. Thus, a routing is a description of what **operations** (series of sequential or parallel process steps) have to be carried out and in what order to produce a **material** (product). Besides information about the **operations** and their order, a routing also contains details about the work centers at which these operations are carried out.

2.2.3.1 Routing Structure

Like the BoM, a routing consists of a header and an "item" area. The header area contains data that is valid for the entire routing, while each "item" depicts an operation of the routing and describes the production process step that is carried out at that stage.

The following figure illustrates the **header** area of the routing for the material Speedstar. It is the first screen displayed, when you open the routing in transactions CA02 (change routing) or CA01 (create routing) or the corresponding Fiori UX App.

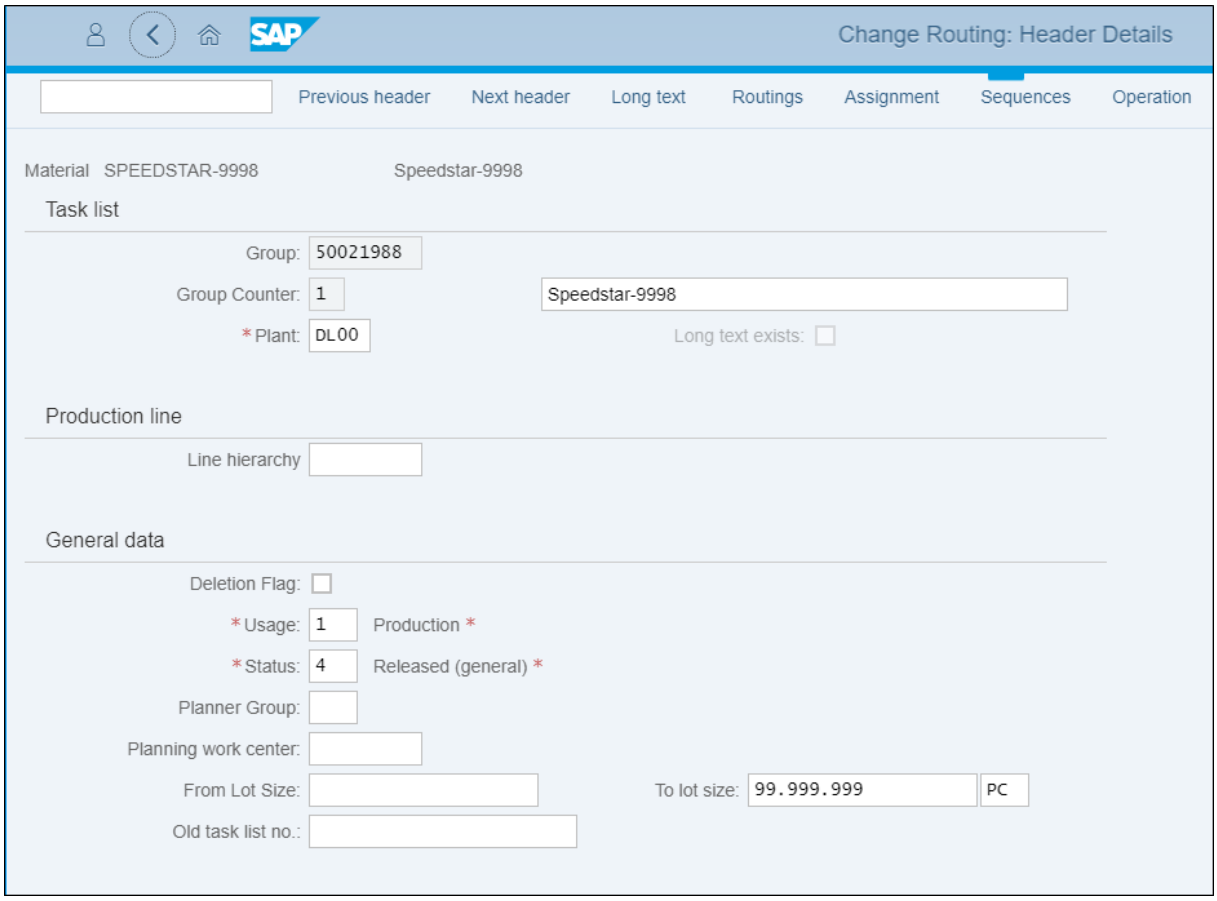


Figure 14: Routing Header: SAP-System-Screenshot

The main entries in the header screen are:

- **Group**: When defining a routing for a material, a unique number is generated that identifies the routing(s) of a specific material.
- **Group counter**: Within this routing group number the first routing receives the *group counter* 1. If further routings (e.g. with different settings, lot sizes or operations, etc.) are created for the same material, they are stored within the same routing group number while incrementing the group counter (2, 3, etc.).
- **Plant**: A routing is defined on the level of plants. The entry made here identifies the plant for which the routing is valid.
- **Usage**: Like the BoM, a routing can be used in different business processes (e.g., production, engineering/design, or plant maintenance, etc.)
- **Status**: Like the BoM, a routing possesses a status that indicates the processing status of a task list. For instance, a task list could be in the creation phase or has already been released.
- **Lot Size**: The entries in these fields determine for which lot sizes a routing is valid. For instance, a routing could be valid for production lot sizes from 1 to 100, while another routing (with a different group counter) containing different operations could be valid for bigger lots.

On “item” level, the **operations** of the routing are described. Therefore, a routing contains the following main information

- The **operations** (work steps) and their **sequence** to be carried out during production

- The **activities** (activity types) to be performed in the operations and the **times** each activity is performed as a basis for determining dates (schedules), capacity requirements, and costs. Each operation in the routing may contain its own base quantity, to which these time elements may refer.
- The **work centers** on which the operations (activities) are carried out

Each operation describes a step in the production process of the material. The following figure displays the overview of the operations in the routing for the Speedstar and the details for the second operation (0020). For instance, in operation 0020, 60 minutes of activity type LABOR (manual work by a worker) is performed on work center ASSY1000 (Assembly Work Center) to assemble the Speedstar.

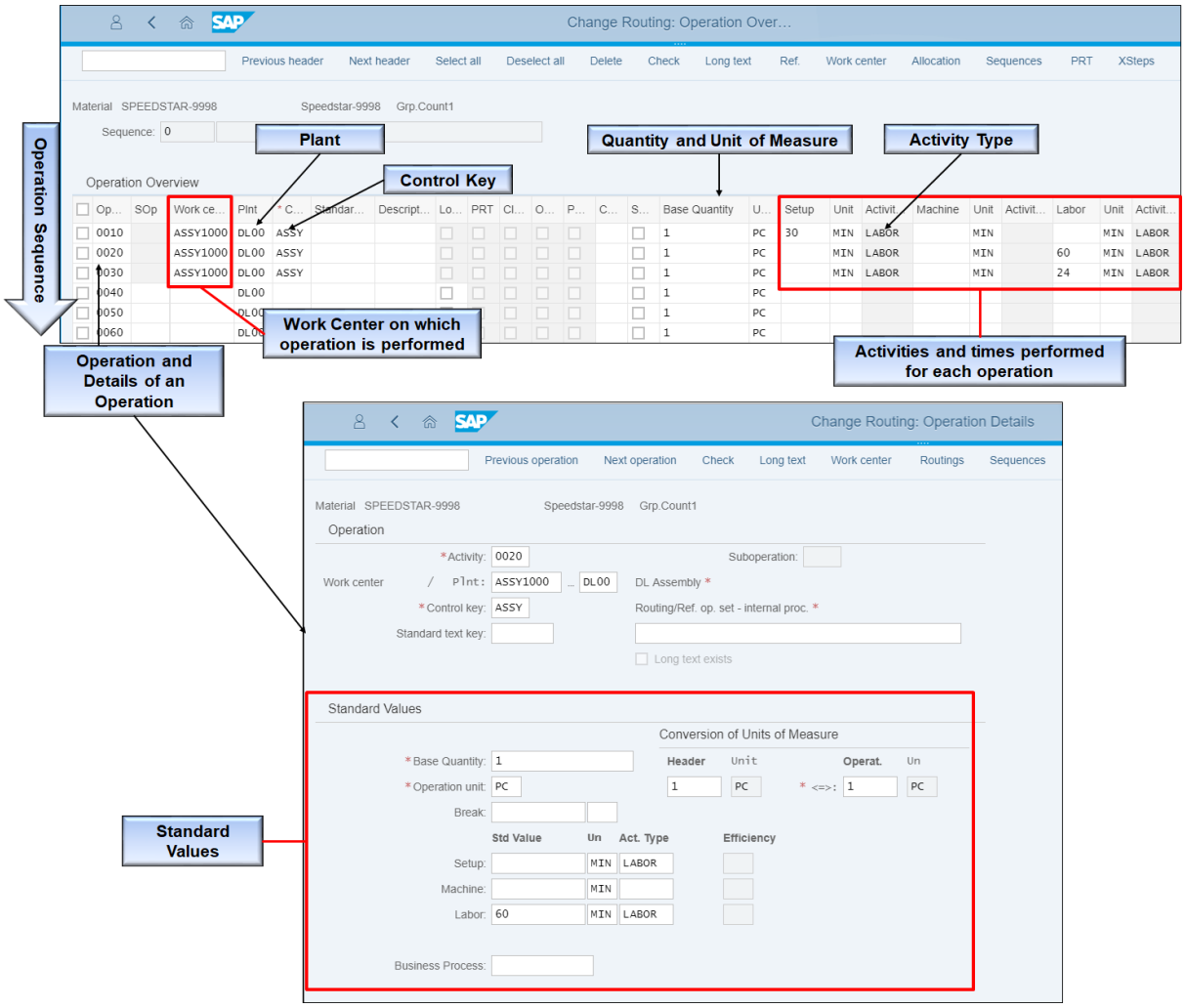


Figure 15: Routing Operations: SAP-System-Screenshot

On the details view of operation 0020 you can see the **Standard Value** area. In the fields of this area different standard values can already be pre-occupied by values set as standard in the particular work center (also see next chapter). A standard value could e.g. be a time element such as 15 minutes on machine X. In the routing definition, the standard values of the work center can be overwritten with new values that are only valid for the particular operation within this routing. Overwriting a standard value in a routing does not affect the standard value setting in the work center.

Another important field is the **base quantity**. Each step of a routing refers to the quantity of the material entered in this field (e.g. the time this operation must be performed for 1 Speedstar).
In the operation overview screen, you can press the button Sequences to navigate to a further screen, where additional operation sequences can be defined. There is always a **standard sequence** within a routing, which describes the standard sequence of operations to be performed in the production process. In addition to the standard sequence, parallel or alternative sequences can be defined. **Parallel sequences** are used if work steps should be carried out simultaneously. **Alternative sequences** are used, for example, if there are differences between make-to-stock production and a specific sales order for a product regarding the operations required for the production process.

2.2.3.2 Routings and Work Centers

As mentioned afore, each operation in a routing is assigned to a **work center** on which the operation is performed. The standard values that need to be maintained within the operation are controlled by the standard value key, which is defined in the work center. The ***standard value key*** of the work center determines which time elements (standard values) are considered in the planning process (e.g., setup time, machine time). The ***scheduling formulas*** stored in the work centers define the duration of operations regarding time elements in the **routing.**
There are corresponding **formulas** for setup, machine, manual labor, etc. for an operation stored at a work center. Thereby, those process steps are executed for which a formula is stored (e.g., machine times might be not necessary for an operation).
If multiple **capacities** (e.g., personnel capacities, machine capacities) are stored, the ***scheduling basis*** determines which capacity is relevant to a particular scheduling.

2.2.3.3 Routings and BoMs

The production of a particular product is described using a **routing** and a **BoM**. While the BoM describes the materials that are necessary to manufacture a product, a routing describes the operations that must be performed to manufacture the product. Within the routing, you can assign **BoM materials** that are used in the production process to individual operations. This ensures that the materials that are determined in the material's BoM are provided to the production process only at the time when they are required. The procurement of these components will then be planned in a way that they are available at the beginning of the specific operation.

If there is no specific allocation to an operation, BoM components are assigned to the first operation of the routing. **Component assignment** in the ***routing*** is expedient in case e.g. expensive components are delivered just in time for production, or in case a component is included in the production process later (e.g., in routing 1) because prior to that, it needs to be produced in a different routing (e.g., routing 2).

Besides BoM components, you can also assign **production resources and tools (PRT)** to the operations of a routing. PRTs are location-independent facilities required for production, e.g. a measuring instrument or a support.

2.2.4 Work Centers (Resources)

In the SAP system operations are carried out at a work center within a plant. A work center is an "organizational unit" that defines where and when an operation like welding, assembling or any kind of activity is performed. It is a location within a plant, where value-added work (operations or activities) is accomplished. Thereby, work centers can represent the following real-world work centers, for example:

- Employees or groups of employees
- Machines or groups of machines
- Assembly lines

Thus, a work center is, generally, a specific geographical location in the plant, for example, a specific machine or department in a plant. Along with bills of material and routings, work centers belong to the most important master data in the production planning process. There is a close relationship between routings and work centers that we have already mentioned in the previous chapter. Specifically, the operations that are defined in a routing take place at work centers of a plant. That is, a work center specifies where production steps that are defined in a routing ultimately take place. For Product Cost Controlling, the routing and the work center determine the costs of operations and transfer these to the cost center in SAP CO that is assigned to the work center (see next chapter Product Cost Controlling). Aside from routings, work centers may also be used in processes other than production process. Examples are networks, inspection plans (Quality Management) or maintenance routings.

2.2.4.1 Functional Scope of Work Centers

The purpose of work centers is to control all aspects of operations performed in a company from a logistical point of view. The data in work centers is, therefore, used for scheduling, capacity planning, and facilitating running operation in routings, maintenance operations, as well as project networks. Furthermore, costing data for the performed operations is transferred to the assigned cost center for documentation in SAP CO. Consequently, the data in work centers is used by multiple other SAP applications. Examples are:

- ***Scheduling***: Operating times and formulas are entered in the work center as default time elements, so that the duration of an operation can be calculated and included in production planning.
- ***Capacity planning***: The available capacity and formulas for calculating capacity requirements are entered in the work center. A work center can have the following capacity types:
    - Labor
    - Machine
    - Output
    - Emissions

  Capacities are used in Capacity Requirements Planning, detailed scheduling and costing.
- ***Facilitating operations***: Various default values for operations can be entered in the work center that are used by routings as default values (which can be overwritten).
- ***Costing***: Formulas are entered in the work center, so that the costs of an operation can be calculated. Therefore, a work center is assigned to a cost center in the Controlling application of the SAP system.

2.2.4.2 Work Center Master Data

Work centers are defined within plants and contain the following resource-related data that are arranged in different tabs:

Basic data

On the **basic data** screen, general data for the work center is entered:

- name and description for the work center
- **Work Center Category**: This key distinguishes work centers by their category (e.g., production work center, maintenance work center) and determines which data can be maintained in the master record for the work center.
- **Person Responsible**: This key determines the person or a group of persons that are responsible for maintaining the master data of this resource.
- **Usage**: This key controls in which type of task lists the work center or, more generally, operating resources like work centers or production resources/tools can be used.
- **Standard value key**: This key defines and gives a dimension (e.g., time or area) to one of up to six standard values. The system uses standard values as parameters with origin "standard value" in formulas to calculate execution time, capacity requirements and costs. Standard value keys can be e.g. Setup, Machine, Labor. You have to assign values (e.g., 30 minutes) to the standard values in the task list of the routing.

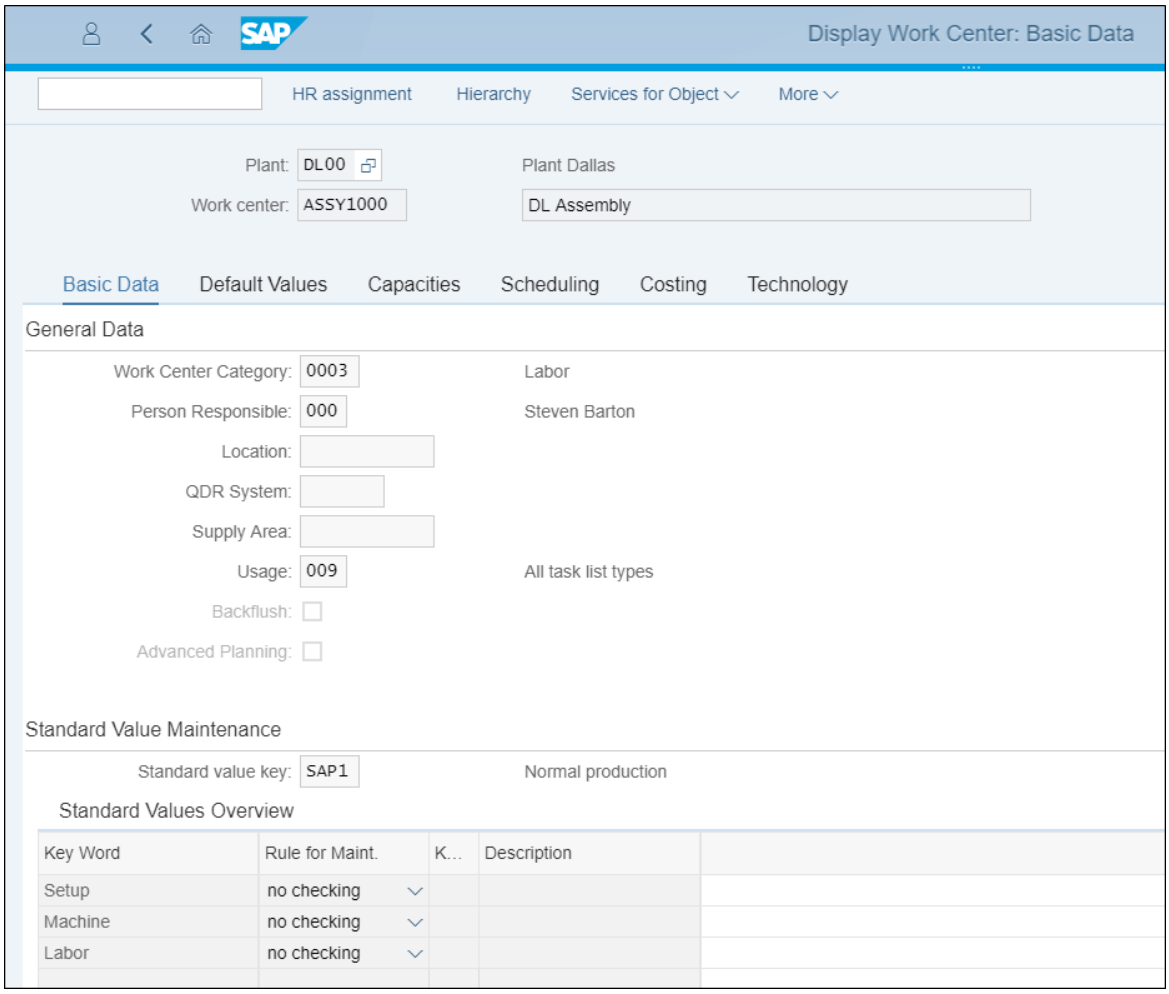


Figure 16: Work Center Master Data: Basic Data: SAP-System-Screenshot

Default Values

A ***standard value*** is a planned value used to carry out an operation. For instance, you have entered the following execution times in the routing of your Speedstar:

- Setup time of 30 minutes for operation 0010 at work center ASSY1000
- Labor time of 60 minutes for operation 0020 at work center ASSY1000
- Labor time of 24 minutes for operation 0030 at work center ASSY1000

Consequently, these standard values are used in ***costing***, ***scheduling*** and ***capacity requirements planning*** to calculate costs, execution times and capacity requirements.

The standard values mentioned above for the routing can also entered as ***default values*** for an operation directly in the work center master data. Thereby, the system copies data maintained in these fields into the routing, rate routing, master recipe or production/process order, or references these data.

Example: The control key in this tab determines which business transactions should be executed for the object (e.g., material in production process) that belongs to the task list or order (e.g., scheduling or costing). In work center ASSY1000 the control key is ***ASSY*** (Routing/Ref. op, set - internal production), thus, routing activities that use work center ASSY1000 are assigned "internal production" processing by default, since this default value is copied from the work center into the routing. You can change the control key assigned by this default setting manually in the routing (or production order, etc.)

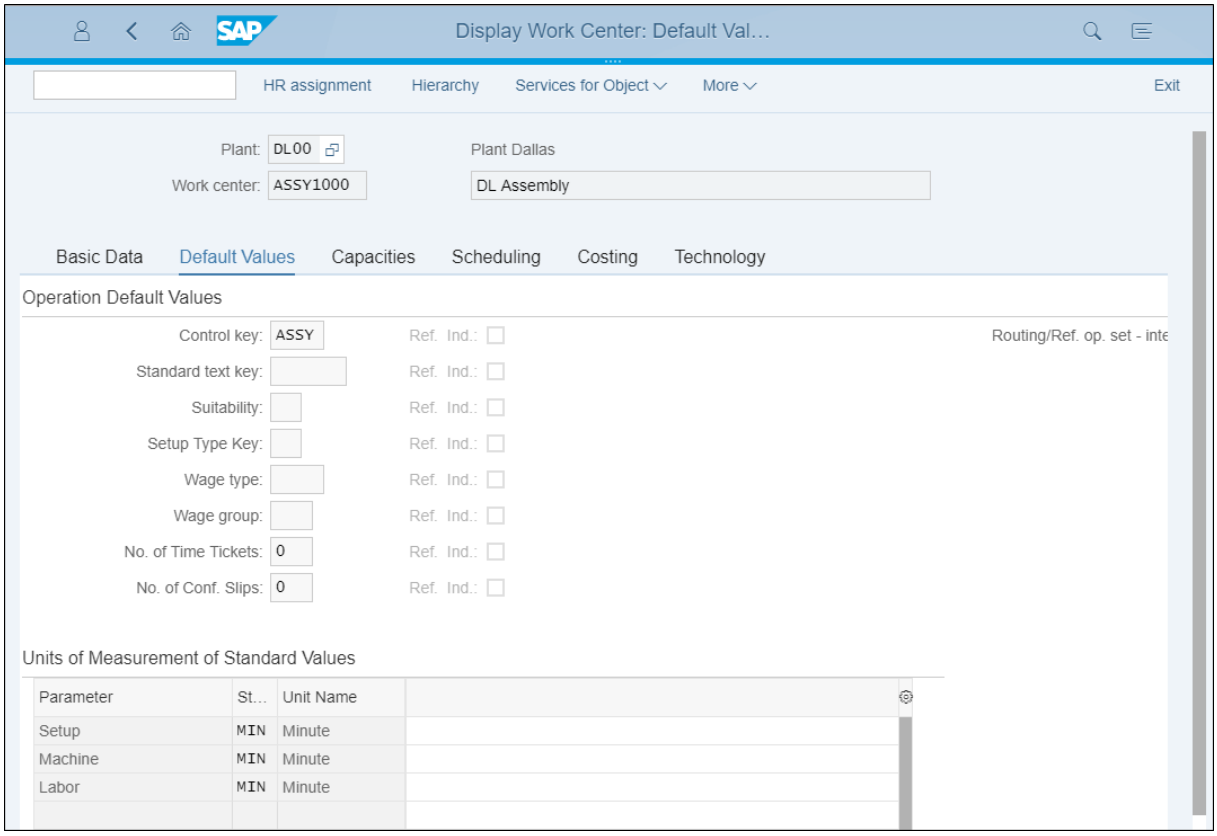


Figure 17: Work Center Master Data: Default Values: SAP-System-Screenshot

Capacities

The available **capacities of resources** are the basis for ***scheduling*** production orders. Furthermore, they are required for ***capacity planning*** and ***shop floor control***.

On this tab, you determine what ***capacity types*** are allowed for the work center and how capacities are calculated. For instance, you can assign the capacity type ***person*** to a work center and, thus, determine that only manual work by an employee is accomplished on this work center.

Formulas like **Setup formula** are used to calculate the time or other resources needed to setup this work center for a production process. A setup formula could be e.g.: *Setup time unit * Quantity of operations*.

In that case, the system would multiply the standard setup time (e.g., 10 minutes to prepare the machines) with the times this operation must be executed (e.g., 3 times).

When the system accumulates all operations using the formulas, it can provide the total capacity needed to accomplish a given task. Then the system compares the **required capacity** with the **available capacity** on a work center and uses this data for scheduling the production processes.

The **available capacity** is defined as the product of the available ***Operating time*** (in our example this is 24 hours a day on work center ASSY1000) and the ***number of individual capacities*** on the work center (in our example 999).

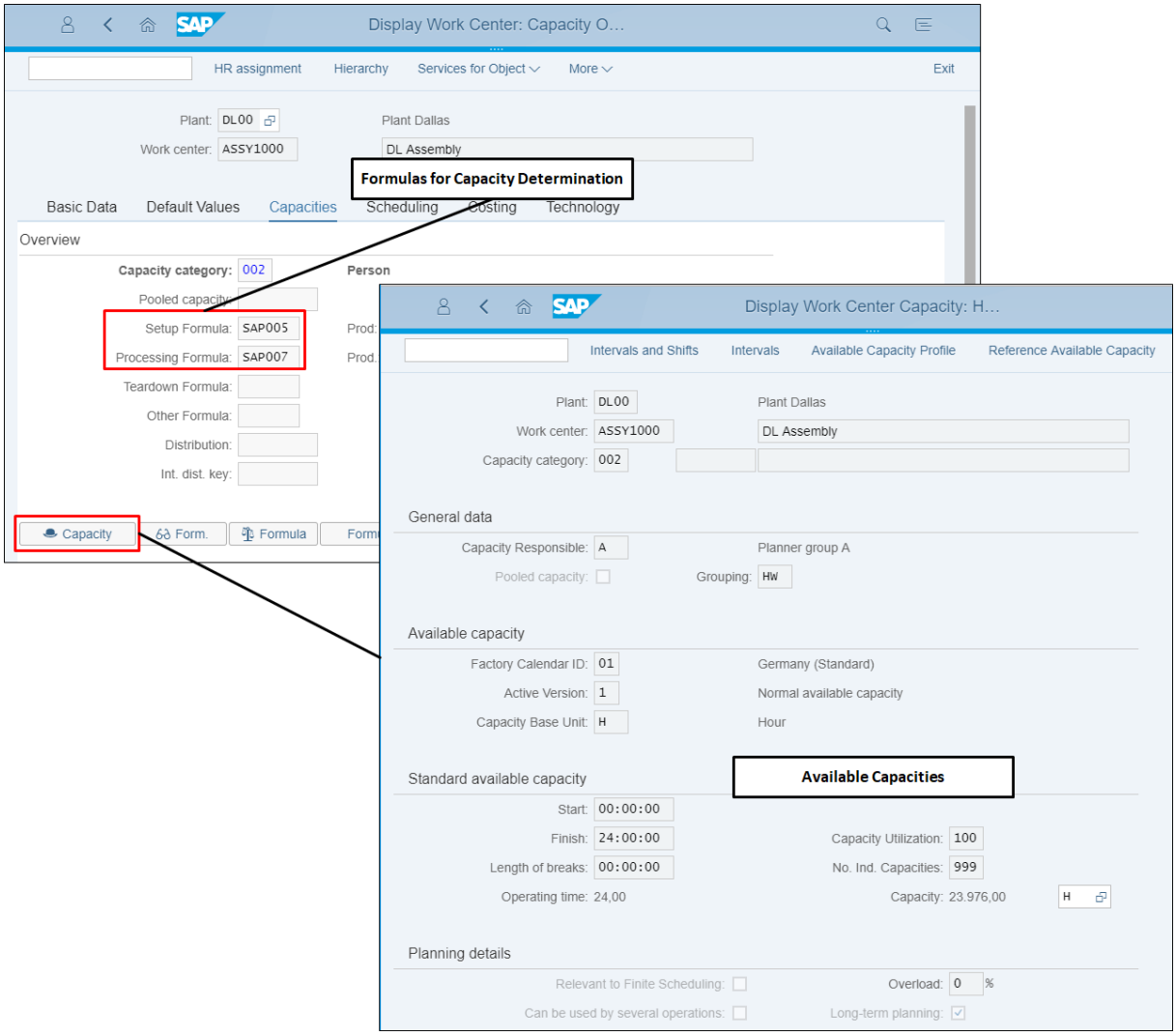


Figure 18: Work Center Master Data: Capacities: SAP-System-Screenshot

Scheduling

Scheduling also uses the capacities and the same formulas to calculate the time schedule for production processes.

For calculating the required **execution times** of an operation during **production order scheduling**, the ***available capacity*** of several possible resource capacities is taken as basis of scheduling. To calculate ***costs***, ***execution times*** and ***capacity requirements*** of operations carried out at a work center/resource, you need to enter the applicable ***formula key*** in the corresponding screens.

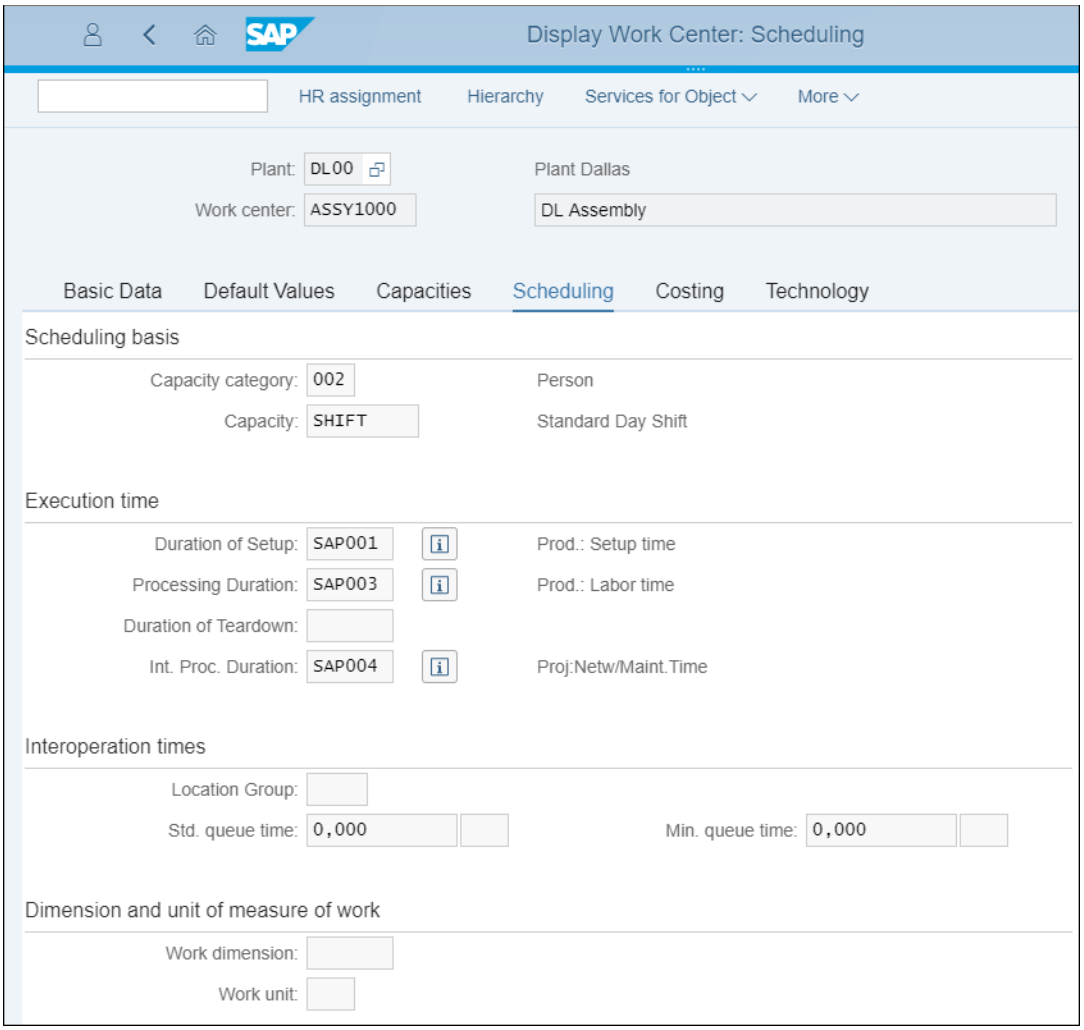


Figure 19: Work Center Master Data: Scheduling: SAP-System-Screenshot

Costing

The main setting that is made in this tab, is the assignment of the work center to **cost center** of the company. This establishes the link between the logistics resource (work center) and ***Controlling (SAP CO)***. Furthermore, the activity types used for the individual activities in the work center/routing operations (Setup, Machine, Labor) are assigned here.

In the following figure you can see the Costing tab of the Assembly work center ASSY1000 in plant DL00 (Dallas). You can see that this work center is assigned to the cost center NAPR1000 (Production Costs) in controlling area NA00 (North America) and that the activities performed on this work center are of activity type LABOR.

This integration point between SAP PP and SAP CO is particularly important for calculating production costs as it allows the processing of production order costs.
When processing production orders, costs are accumulated on this work center. These costs are accounted on the assigned cost center in SAP CO. Each consumption of resources (material, activity, etc.) in a company generates costs. Costs are defined in the SAP system as costing element types. In case of activities (e.g., assembling) **activity types** (e.g., activity type LABOR in your routing = wage hours) are defined. Activity types are then assigned to ***cost element types*** to determine the "price" of this activity. Planned prices for an activity on a work center are determined in the Controlling (SAP CO) application of the SAP system. We will discuss this later in the course.
For instance, the activity type LABOR costs you 50$ per hour (salary of the employee assembling the components) and you consume 0,5 units (in this case 30 minutes) of this activity to assemble the product. Thus, this operation (in the routing) generates 25$ of costs on the work center. These costs are transferred to the assigned cost center and accounted in SAP CO.

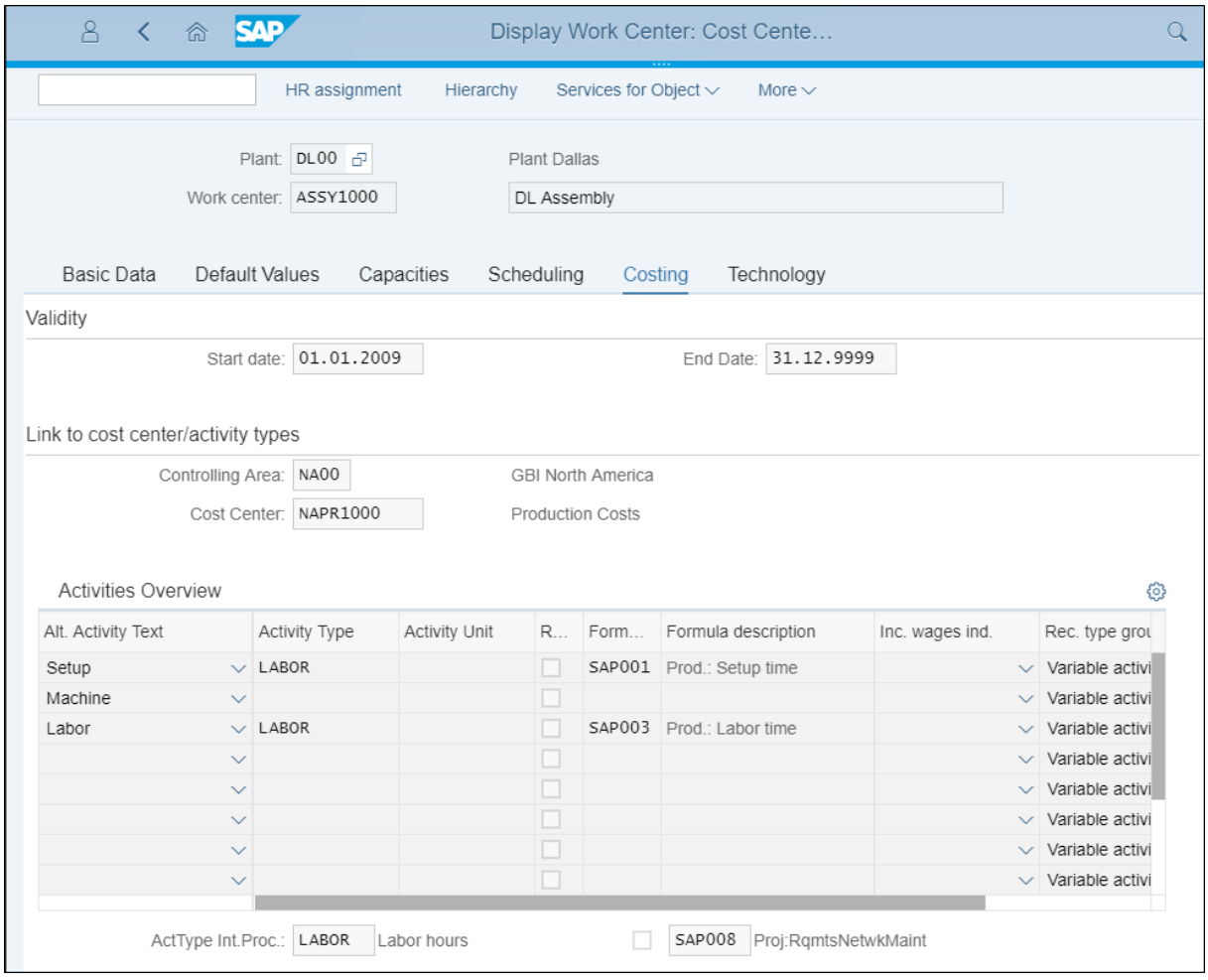


Figure 20: Work Center Master Data: Costing: SAP-System-Screenshot

HRMS Assignment

Finally, by pressing the button HR assignment, you can switch to the Human Resources Management System view of the work center. On this special data view, you can assign the work center to the organizational model of the company in SAP HCM (Human Capital

Management). This allows you to assign employees, positions, qualifications and other objects from the SAP HCM application to a work center in order to keep personnel data (e.g., working times), work center data (e.g., operations performed by employees in a production order) as well as cost center data (e.g., costs occurred during these operations) aligned.

2.2.5 Excursus: Controlling Master Data

You have already learned that the SAP system is a highly integrated software system. The Design-to-Operate business process has multiple integration points with other SAP applications. One of the main integration points with the Management Accounting application (SAP CO – Controlling) is constituted with the SAP CO sub-component Product Cost Controlling (SAP CO-PC). In this chapter, we will explain some central master data of SAP CO, which are later used in the sub-component Product Cost Planning (SAP CO-PC-PCP) to calculate material production costs in the Design-to-Operate business process.

For calculating product and production costs, the following master data that we introduced in this teaching unit, play a central role:

- Materials and Bill of Materials (BoM)
- Routings
- and Work Centers

While the above-mentioned master data is used to describe the components, the operations, and the locations that are involved in the manufacturing of a product, it is controlling-related master data that determines the costs of the manufacturing process. These controlling master data types are:

- Cost Elements
- Cost Centers
- and Activity Types

2.2.5.1 Cost Elements

One of the biggest innovations in SAP S/4HANA is the new data model for G/L accounts and cost elements that leads to even greater integration between the SAP FI and SAP CO applications. In this chapter, we will introduce this new approach and the motivation behind it. Costs can incur on many ways in a company. For instance, when a company pays the salaries of its employees then this is, on the one hand, posted in Financial Accounting (SAP FI: debit and credit postings on particular **accounts**) and, on the other hand, documented in Management Accounting (SAP CO: **cost element** posted to a particular costing object, such as cost center). SAP FI and SAP CO are the two applications in the SAP system that have the closest integration. In some aspects SAP CO and SAP FI could even be viewed as only different perspectives on the same business process.

In the following we will first describe how cost elements are used in SAP S/4HANA.

2.2.5.1.1 Expenditures and Cost

In Accounting theory, there are two approaches for value determination in a company.

The first approach, which is mainly used in Anglo-Saxon countries, sees the values in Financial Accounting and Management Accounting as equal, whereby, Management Accounting provides only additional reporting possibilities by separating Financial Accounting documents by further characteristics, such as segments, profit centers, and projects in a "coding block". As a result, Profit and Loss Statement as well as Balance Sheets can be issued per segment, profit center or project.

The second approach, which is mainly used in central European countries, uses Management Accounting based on costs and revenues. Thereby, costs are expenditures which fulfill the following characteristics:

- The expenditure is related to the company's business
- The expenditure is exactly assigned to a certain period and, thus, is source specific
- The expenditure is valuated

Neutral Expenditures and Additional Costs

For instance, if a company donates money to an organization, it is an expenditure but not costs in the sense of this approach as it is not related to any of the company's businesses. These types of expenditures are referred to as "neutral expenditures". They do not meet the above-mentioned definition and are only reflected in Financial Accounting but not in Controlling.

The other way around, there are also additional cost types that are not reflected in Financial Accounting as there is no financial document for those postings. Examples are:

- A company owns its own office buildings and, thus, does not pay rent. However, these buildings (assets) or the hypothetical rent you could get for them, are still production costs and need to be reflected in the costs of the products produced by the company. Here, the missing rents are added to the production costs as additional costs (so-called imputed costs) in Management Accounting but are not reflected in Financial Accounting as there is no "legal" document that post these costs (e.g. invoices).
- A company has invested huge amounts of money in production facilities. This money could hypothetically also be invested on the capital market and produce income returns. In this case, the "not realized returns" are costs of the invested money (so-called opportunity costs) and for accurate cost accounting may also be reflected in Management Accounting as additional costs.
- A company has invested in production facilities and posts the depreciations on these assets in Financial Accounting. How depreciations are calculated is regulated in each country by the law and the Financial Accounting Standards (e.g., HGB, GAAP, IFRS), which are also subject to changes in time. Accordingly, different parallel accounting approaches in Financial Accounting may reflect different depreciation values for the company's assets depending on the specific depreciation areas (e.g. USA, Germany, etc.) and often do not reflect the "true" value of the assets the company possesses. A viable approach could be to set up a separate depreciation calculation in Management Accounting. This costing-based depreciation could be higher than the depreciation

values calculated with the legal financial-based calculations. The difference could then again be considered as additional costs (as so-called neutral expenditures) in Controlling.

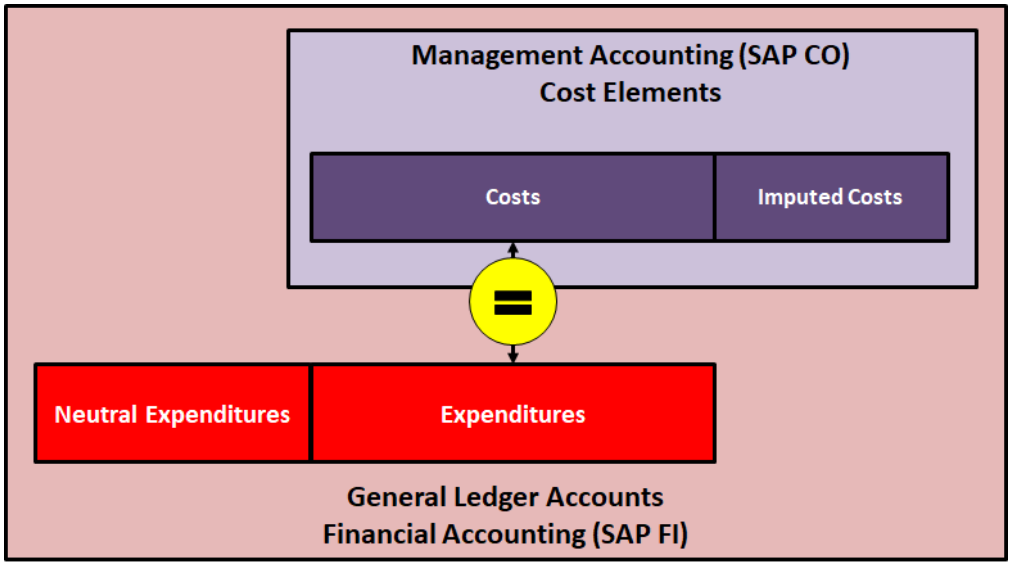


Figure 21: General Ledger Accounts and Cost Elements (SAP Online Library)

2.2.5.1.2 General Ledger Accounts and Cost Elements

With SAP S/4HANA it is now possible to implement both approaches. Therefore, revenues, expenditures and costs are represented by financial accounts and separated by the account type. Based on these account types, the accounts used in Controlling are called cost elements.

In SAP ERP only primary cost elements of the Controlling application (SAP CO) have a corresponding General Ledger account in the Financial Accounting application (SAP FI). Secondary cost elements in SAP ERP are used only in company internal accounting procedures and are not reflected in SAP FI postings or G/L accounts.
In SAP S/4HANA all cost elements correspond to G/L accounts and are now created centrally. That is, primary as well as secondary cost elements are now created directly as FI accounts. The transaction codes used in SAP ERP to create primary cost elements (KA01) and secondary cost elements (KA06) are obsolete in SAP S/4HANA and redirect to the G/L account creation transaction FS00.

The following figure schematically illustrates the relationship between cost elements and G/L accounts.
The benefit of the new data model of SAP S/4HANA is that only one master data record is required, which reflects FI-accounts as well as primary and secondary cost elements alike: the **G/L account**. Accordingly, all cost element types are now part of the cart of accounts.
If you create a G/L account that represents costs, you will always have to assign a CO object such as a cost center, a project, an internal order, or a CO-PA segment. Secondary costs are exclusively used in Management Accounting to identify internal cost flows such as assessments or settlements. Reports, such as the trial balance, will display all posted costs (primary and secondary costs).

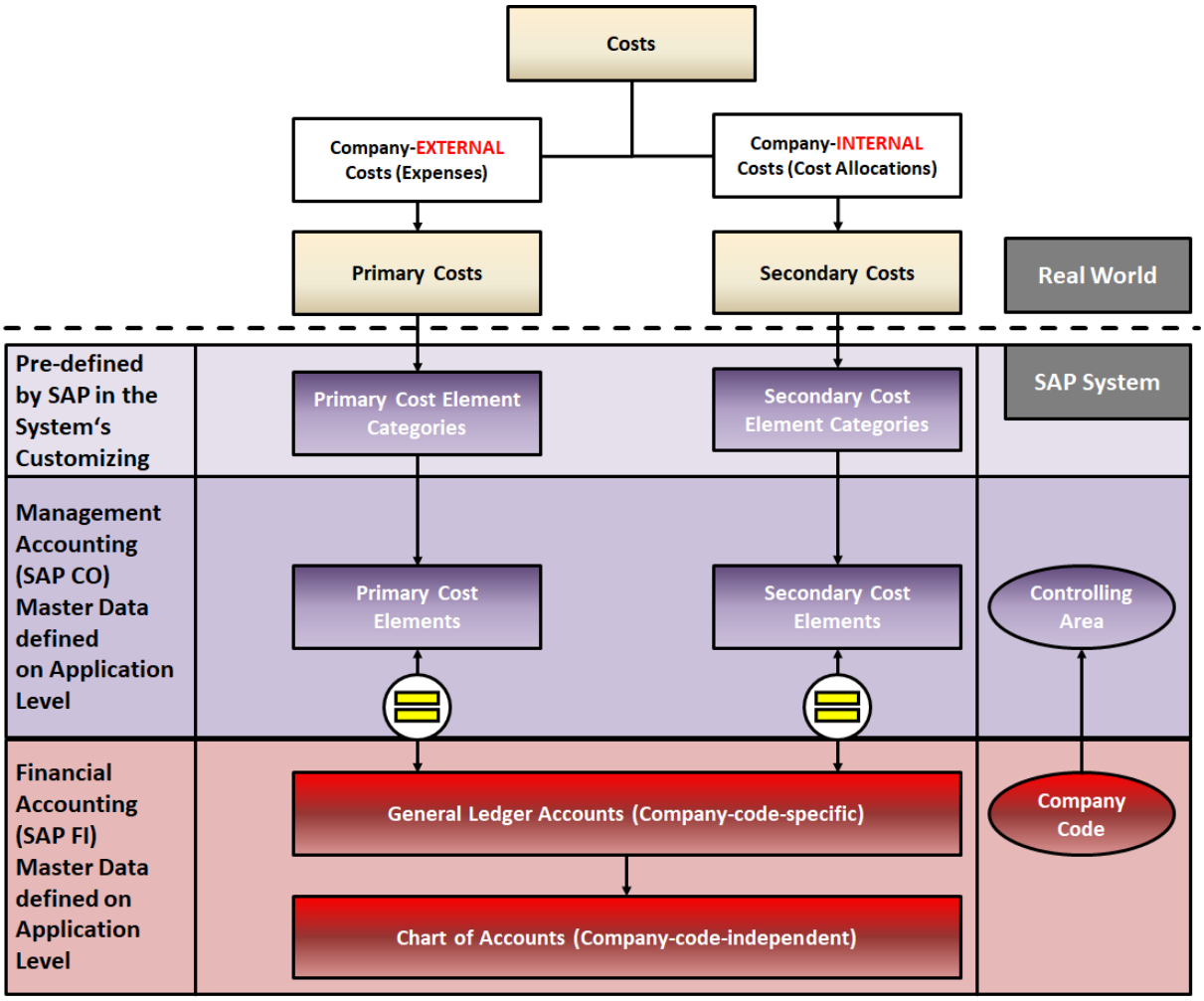


Figure 22: General Ledger Accounts and Cost Elements in S/4HANA (SAP Online Library)

The main field to classify the type of account is the **Account Type** field on the creation screen of a G/L account. This field (technical name GLACCOUNT_TYPE) has been added to the Universal Journal database table for the account master data and can be occupied with one of the following entries:

- **X – Balance Sheet Account**: This account type is used for the classic balance sheet accounts, to which business transactions post to. The balance of a balance sheet account is carried forward at the fiscal year-end.
- **N – Non-operating Expense or Income**: Profit and Loss accounts of this account type are used for non-operating expenses and revenues such as those parts of the P&L statement that never been associated with a cost center, order, or profitability segments in the past, that is, income statement accounts that record expenses or gains from activities that are not part of the main purpose of the company (e.g., gains realized from financial investments by a manufacturing company).
- **P – Primary Costs or Revenues**: Profit and Loss accounts of this account type are used for primary cost elements (or revenue), thus, all expenses posted from external sources to the company accounts. Examples are employee salaries in Cost Center Accounting, material expenses in Order and Project Accounting, or revenues and sales deductions in Profitability Analysis.

- **S – Secondary Costs**: The main innovation in SAP S/4HANA is that secondary cost elements are now also created as G/L accounts. Secondary cost elements are income statement accounts that functions as a cost element for secondary costs. Secondary costs result from company-internal value flows, such as internal activity cost allocations, overhead allocations, and settlement transactions.
- **C – Cash Account**: A cash account is a G/L account that can be assigned to more than one house bank account. Since each house bank account requires a G/L account to which payment transactions are posted, using cash accounts helps to reduce the number of such G/L accounts significantly.

The following figure illustrates the General area of the G/L account creation screen in SAP Fiori UX and highlights the new field Account Type. Also note that there is a new account group for secondary cost elements which determines the fields and layout of the G/L account when a secondary cost element is created.

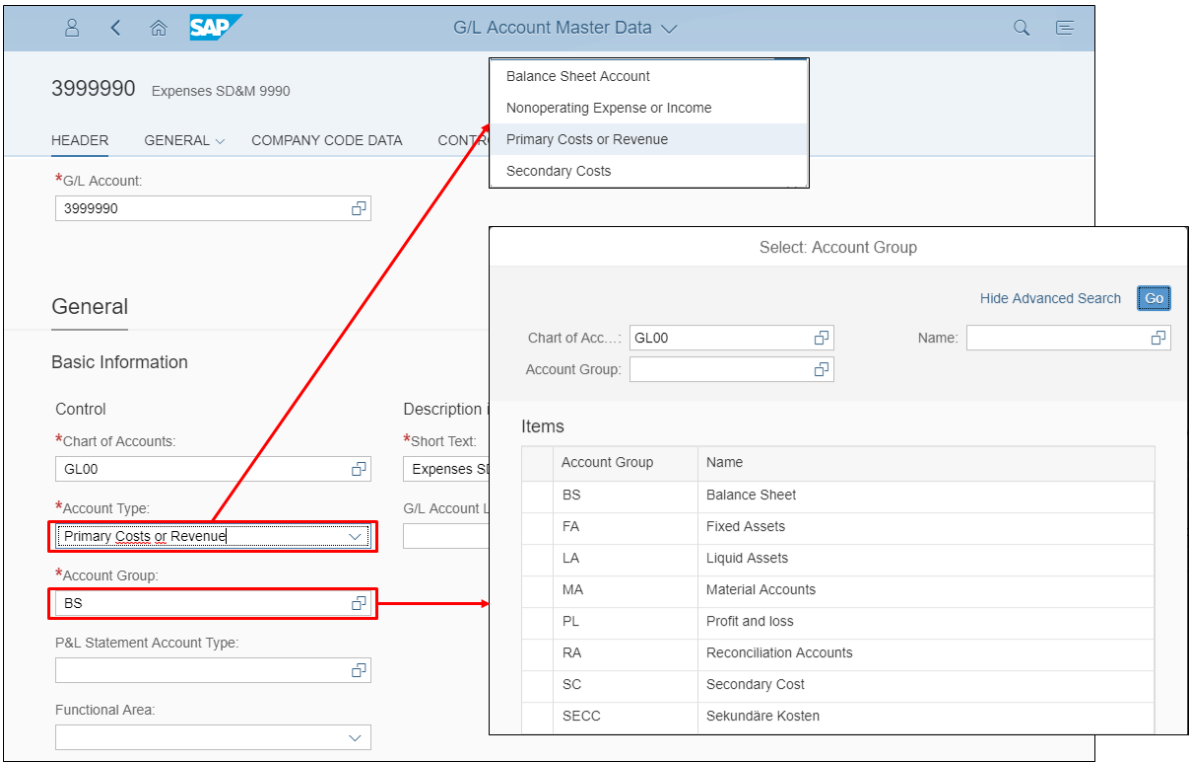


Figure 23: G/L Account Creation in SAP S/4HANA (1): SAP-System-Screenshot

Controlling-Area-specific Data

Expense accounts to which costs are posted for cost accounting purposes must be created with G/L Account Type **P (Primary)** or **S (Secondary)**. This ensures that all postings to this type of expense accounts always arrive in Management Accounting at the same time on a Management Accounting object, such as cost center, internal order, or project. An exception to this rule is the Cost Element Category 90, which can be assigned to **Balance Sheet Accounts (X)** to allow performing, e.g., plan or actual comparisons and manage plan values, budgets, and commitments on capital investments.

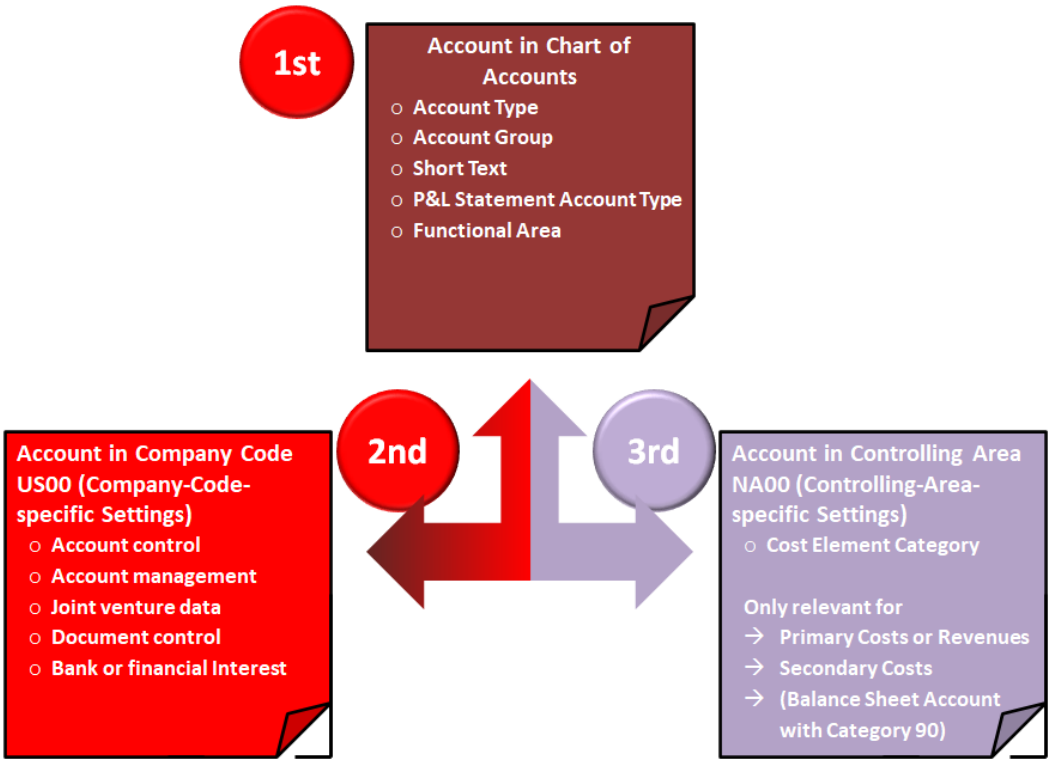


Figure 24: Controlling-Area-specific Data

The controlling-area-specific data segment of the G/L account master data is, thus, only needed for Secondary Costs and Primary Costs or Revenue accounts. In this screen area, you therefore assign a **Cost Element Category**. The cost element category is among the most important entries in the cost element master data as it classifies a cost element according to its usage or origin. That is, it determines which account can be used for which business transaction in Controlling (CO). Examples of cost element categories are:

- Material cost elements
- Settlement cost elements for orders
- Cost elements for allocating internal activities

The following figure shows the cost element category 43, which is used for secondary cost elements, if the cost element is to be utilized for internal activity allocations

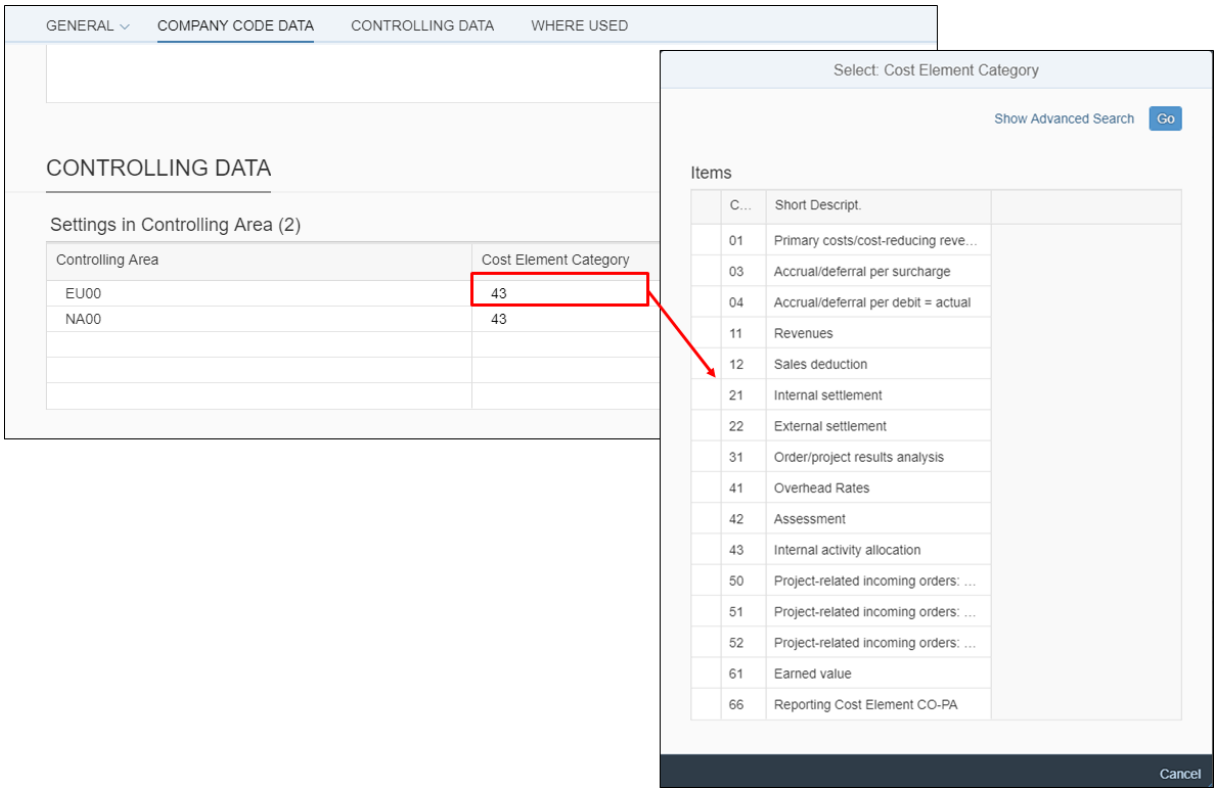


Figure 25: G/L Account Creation in SAP S/4HANA (2): SAP-System-Screenshot

2.2.5.2 Cost Centers

A cost center is an organizational level (even though technically it belongs to master data) within a controlling area that represents a clearly delimited location of cost occurrence. Cost centers are not responsible for revenue generation. Within each cost center one or multiple value-added activities are performed.

Furthermore, Cost Centers allow for a differentiated assignment of overhead costs to company activities based on the utilization of the respective organizational area (cost determination function) and they allow for a differentiated controlling of costs occurring within a company (cost control function).

Setting up cost centers can be based on several criteria. A cost center can be distinguished, for example, by functional requirements, allocation criteria for cost allocation to other costing objects, types of activities or services performed on the cost center, or geographical aspects as well as responsibilities. The approach should be consistent throughout the company. As a typical approach, a company can define a cost center for each low-level organizational level that has responsibility for managing costs. Examples for possible cost centers are car pool, marketing department, sales department, security department, or maintenance department.

By using Cost Center Accounting (CO-OM-CCA) in the SAP system, you can determine **where** costs incur in a company. When costs incur, they are assigned or posted to the appropriate cost center. These costs can include payroll costs, rent and utility costs, or any other costs relevant to a cost center. The posting and assignment of costs to cost centers makes managerial accounting possible, which is a vital step for utilizing other CO components.

Defining Cost Centers

A cost center is defined on **controlling-area-level** and can only belong to one controlling area. However, the same cost center (with the same ID) can be defined in a different controlling area as well.

General data

General data of a cost center encompasses the following information:

- Controlling area
- Name and description
- Validity period (The cost center master data record is time dependent).
- Name of the responsible person or user of the cost center
- The department to which the cost center is assigned
- Cost center category

Cost Center Category

The cost center category determines which ***activity types*** a cost center can use. Therefore, in the master data of an activity type one or more cost center categories are assigned. The activity type may then be used only by cost centers of the appropriate categories. You can define cost center categories in Customizing and set default values for the "Lock" and "Record quantity" indicators, for transfer to cost center master data. Furthermore, cost center categories can be used for reports and evaluations. Examples for cost center categories are production cost center, service cost center, or administration cost center.

Organizational Assignments

Cost centers are generally embedded in the organizational structure of a company. Therefore, different assignments to the organizational model can be set:

- **Hierarchy Area (see also next point: master data groups)**: The cost center hierarchy field displays the standard hierarchy node to which the cost center is assigned. This field is mandatory if the cost center is to be used as a control feature in CO-OM-CCA (Overhead Cost Controlling). Each controlling area must have a unique standard hierarchy that includes every cost center created in that controlling area.
- **Company Code**, **Business Area** and **Segment**: The company code and business area fields represent the close integration between Management Accounting and Financial Accounting. If multiple company codes are assigned to one controlling area, the company code to which the cost center belongs must be specified in the master data of the cost center. If a business area is used for that company code (as defined in Financial Accounting), the business area must also be specified in the cost center master record.
  If **segment reporting** is required, the segment can be derived from the profit center to which the cost center is assigned.
- **Functional Area**: The functional area is required to create a profit and loss account in Financial Accounting using cost-of-sales accounting. Examples of structure criteria are manufacturing, administration, sales, or research and development
- **Profit Center**: The profit center field identifies the purpose of the cost center, such as production, service, sales, and administration. If Profit Center Controlling is active,

revenues and costs generated on a cost center lead to statistical postings on the associated profit center.

- **Currency**: In this field, the default currency for the cost center is entered.

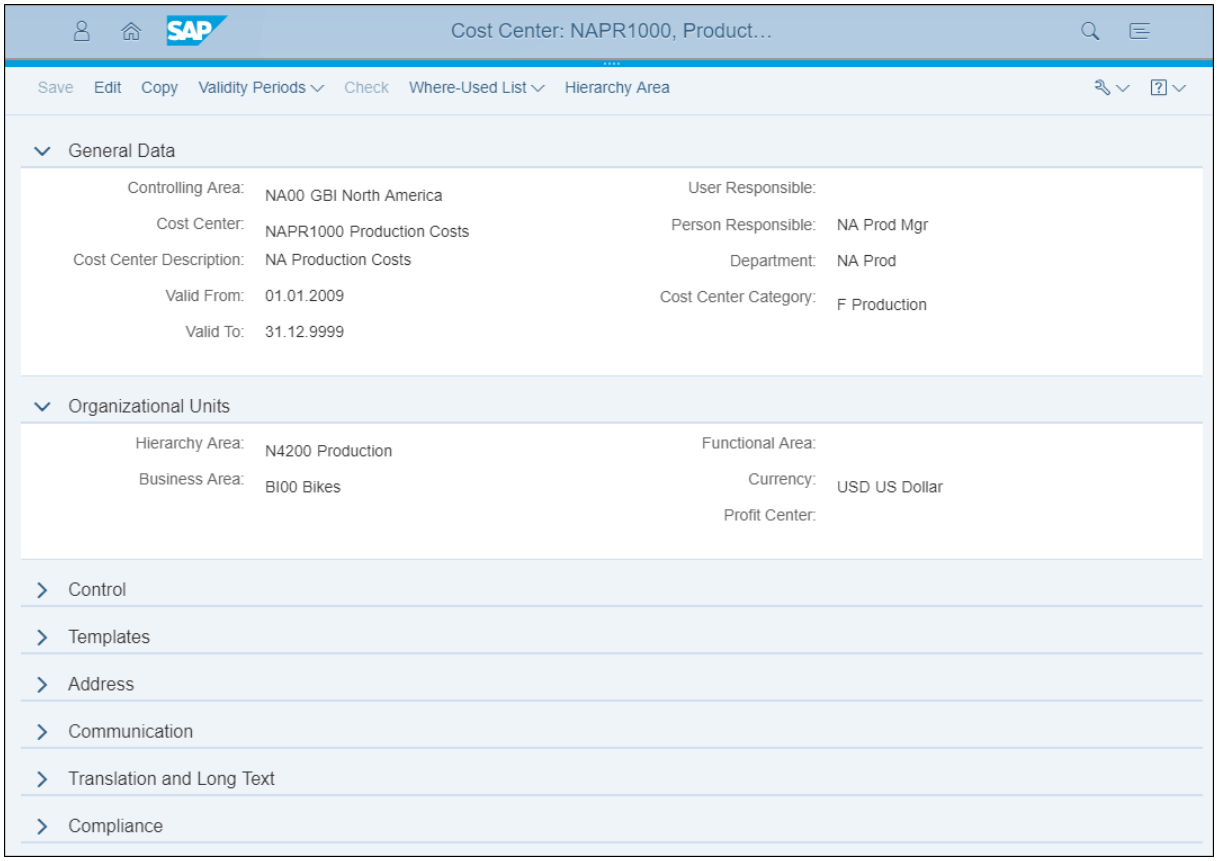


Figure 26: Cost Center Master Data: SAP-System-Screenshot

2.2.5.3 Activity Types

An **Activity Type** is a unit in a controlling area that classifies the activities performed in one or multiple cost center of a company. Thus, you use activity types to define the productive output quantity of cost centers, which are usually measured in a time or unit increment. For instance, activity types in a production cost center could be machine hours, or manual labor performed by employees.

The ***cost center categories*** entered in the activity type master data controls, to which cost centers the activity types can be assigned. SAP allows entering up to eight different cost center categories in the activity type master data. Alternatively, you can leave the assignments unrestricted by entering an asterisk (*).

Another important setting in the activity type master data is the ***allocation cost element***. This ***secondary*** cost element is used as default value for allocating costs that incur, when the activity type performed on a cost center. You can overwrite the default value within cost center planning, when the activity type is used the very first time in planning. The allocation cost element must have been created in the cost element master data as a secondary cost element of category 43 (Allocate activities/processes), before it can be used as cost element for an activity type.

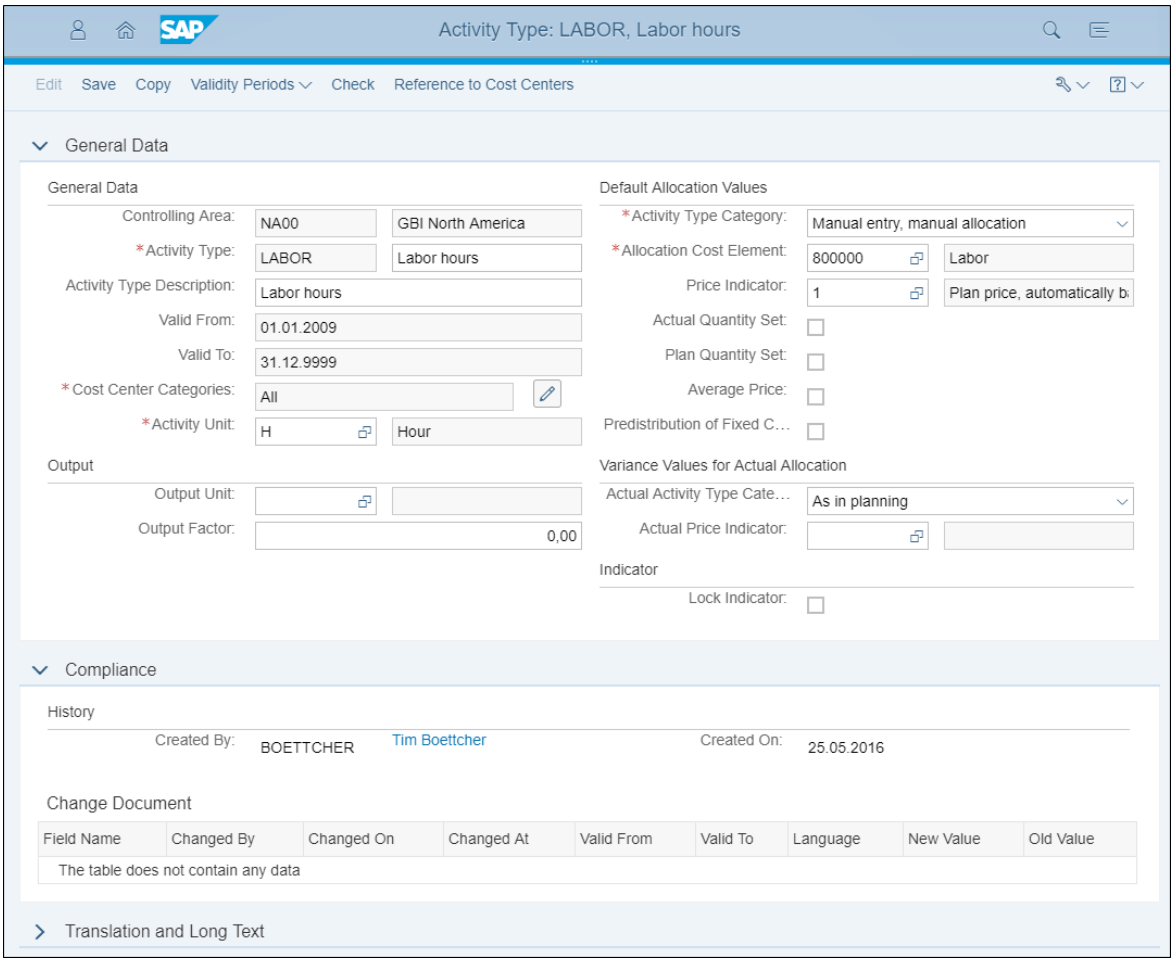


Figure 27: Activity Type Master Data: SAP-System-Screenshot

2.2.5.4 Cost Centers and Activity Types

Once the basic setup of an activity type master data record is done, it can be assigned to cost centers for cost center planning or in allocation of actual costs. If a cost center provides services for other cost centers, orders, and processes, this means that the resources of the cost center are used. The costs of these resources need to be allocated to the receivers of the activity. Activity types serve as tracing factors for this cost allocation.

In cost center planning, you can assign activity types to cost centers in order to plan output capacities and prices for the activities (work) performed by that cost center. This is done in transaction KP26 or Fiori UX App *Set Activity Price*.

The following figure displays the cost center-planning screen of the App *Set Activity Price*. In the example, you can see the activity type LABOR being planned with 100.000 hours and the planned price of 50$ per hour on cost center NAPR1000. The planned price set for the activity type on the cost center can be either entered ***manually*** by an employee or be ***calculated by the system*** based on different calculation methods in cost center planning that the SAP system provides.

Generally, you enter planned prices for an activity type manually only in cases where the price determination is easy. Examples for scenarios where you manually enter activity type prices are:

- The planned price for an activity type on a cost center is determined within the company and does not depend on internally produced activities of other cost centers.
- The planned price for an activity type is determined by an external supplier and not on any costs of the company's cost centers.

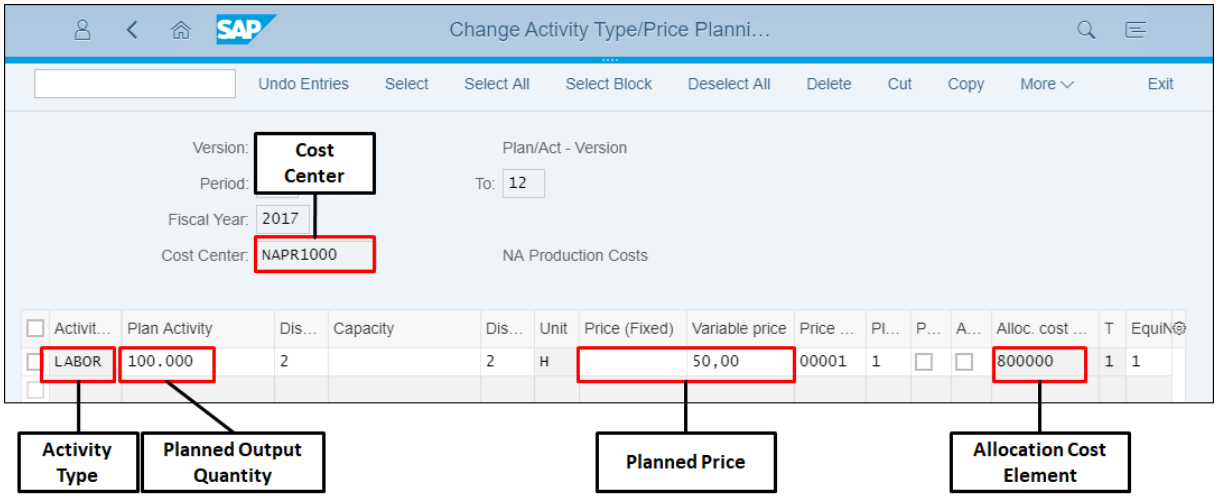


Figure 28: Cost Center Planning: SAP-System-Screenshot

Cost center NAPR1000 can now provide its resource (LABOR) to other cost centers, order (maintenance, production, internal, etc.), or business process. In this way, the costs for the provided resource can flow to other cost objects such as internal orders, production orders, and Activity-Based Costing (ABC) processes. This is referred to as **Cost Allocation**. Cost allocation is one of the main tasks of Controlling. Thereby, the costs that incur on a cost center must then be allocated to the receivers that consume the activity, using the consumed activity type as tracing factors for the cost allocation.

For instance, if cost center NAPR1000 provides 1 hour of the activity type LABOR to the production of our Speedstar, this means that the resources (e.g. employees of the cost center assembling Speedstars) of the cost center NAPR1000 have been used and cost of 50$ incurred on the cost center. However, cost center NAPR1000 is the provider (***sender***) of the activity and the production order for the material Speedstar is the ***receiver*** of the activity. Hence, the costs of the performed activity must be also sent to the receiver.

The SAP system provides many different methods for cost allocation of which some are simple and others are very complex depending on the cost allocation logic that needs to be implemented.

Direct Activity Allocation

Direct Activity Allocation is the simplest way of cost allocation. In direct activity allocation, the quantity of the activity, such as the hours of an activity performed, is entered either manually

or automatically into the SAP system. In transaction KB21N or Fiori UX App *Direct Activity Allocation*, you can manually perform a direct activity allocation. Here, you enter

- The cost center that provides the activity (sender)
- The activity type that is provided
- The costing object (order, cost center, WBS element, network, etc.) that consumes the activity (receiver)
- The quantity of the activity performed

The SAP system then valuates the allocated activity amount by using the sender's price for the activity type. When direct activity allocation is used, the system retrieves the ***plan price*** (from KP26) for the combination cost center and activity type to perform this calculation. The plan price is multiplied by the consumed quantity to retrieve the total amount with which the receiver cost object is ***debited*** and the sender cost center is ***credited***. The **secondary cost element** used for this credit/debit posting in Controlling is retrieved from the activity type's master data.

Example of Cost/Activity Allocation using Direct Activity Allocation
Cost center ***NAPR1000*** has the activity type ***LABOR*** assigned to it. The activity type LABOR hours is allocated using cost element (*secondary cost element type*) Labor Costs (800000) and costs 50$ per hour. One unit (hour) of this activity type is performed for production order 1000001. Thus, the production order that consumes the activity must "pay" for it.

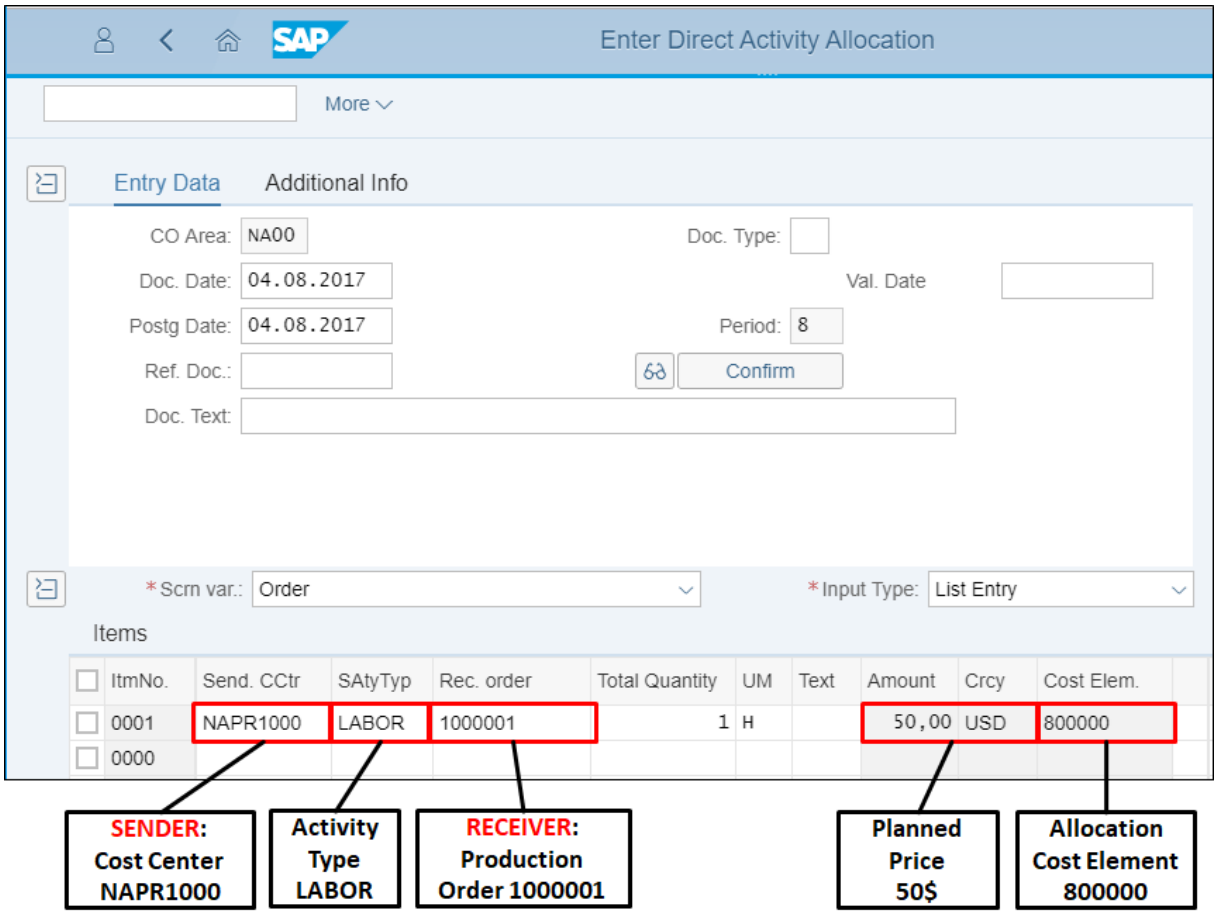


Figure 29: Direct Activity Allocation: SAP-System-Screenshot

The costs of the activity are allocated to the activity receiver (production order) using the activity as ***tracing factors for this cost allocation***. That means that the system checks:

- how much the activity type costs that the cost center performs: 50$ per hour
- multiplies the cost rate with the performed units (e.g., hours): 1h * 50$
- and allocates the costs using the cost element type assigned to the activity type to the receiver: 50$ of cost element 800000

Now, the receiving cost object (production order) receives a cost position (debit) with the cost element type 800000 and the activity sender is credited with the same amount.
The following figure illustrates this posting in the App *Direct Activity Allocation*.

2.2.6 Work Centers and Cost Centers

We have already explained the connection between work centers in SAP PP (Production Planning) and cost centers in Management Accounting (SAP CO). In the following figure you can see this integration aspect

- ***Change Routing***
  Work center ASSY1000 is used in the routing of the Speedstar and provides 30 minutes of labor for the setup operation and a combined 84 minutes of labor for manual operations to manufacture a Speedstar.
- ***Change Work Center***
  Work center ASSY1000 is assigned to cost center NAPR1000 in the work center's master data (Costing tab) and it uses the activity type LABOR for its setup and labor operations as default assignment.
- ***Change Activity Type/Price Planning***
  Cost center NAPR1000 in turn provides activity type LABOR at a price of 50$ with the cost element 800000 to other cost objects (such as a production order)

This information is used in Product Cost Planning (SAP CO-PCP) as well as in the determination of production costs within production orders in Cost Object Controlling (SAP CO-COC).

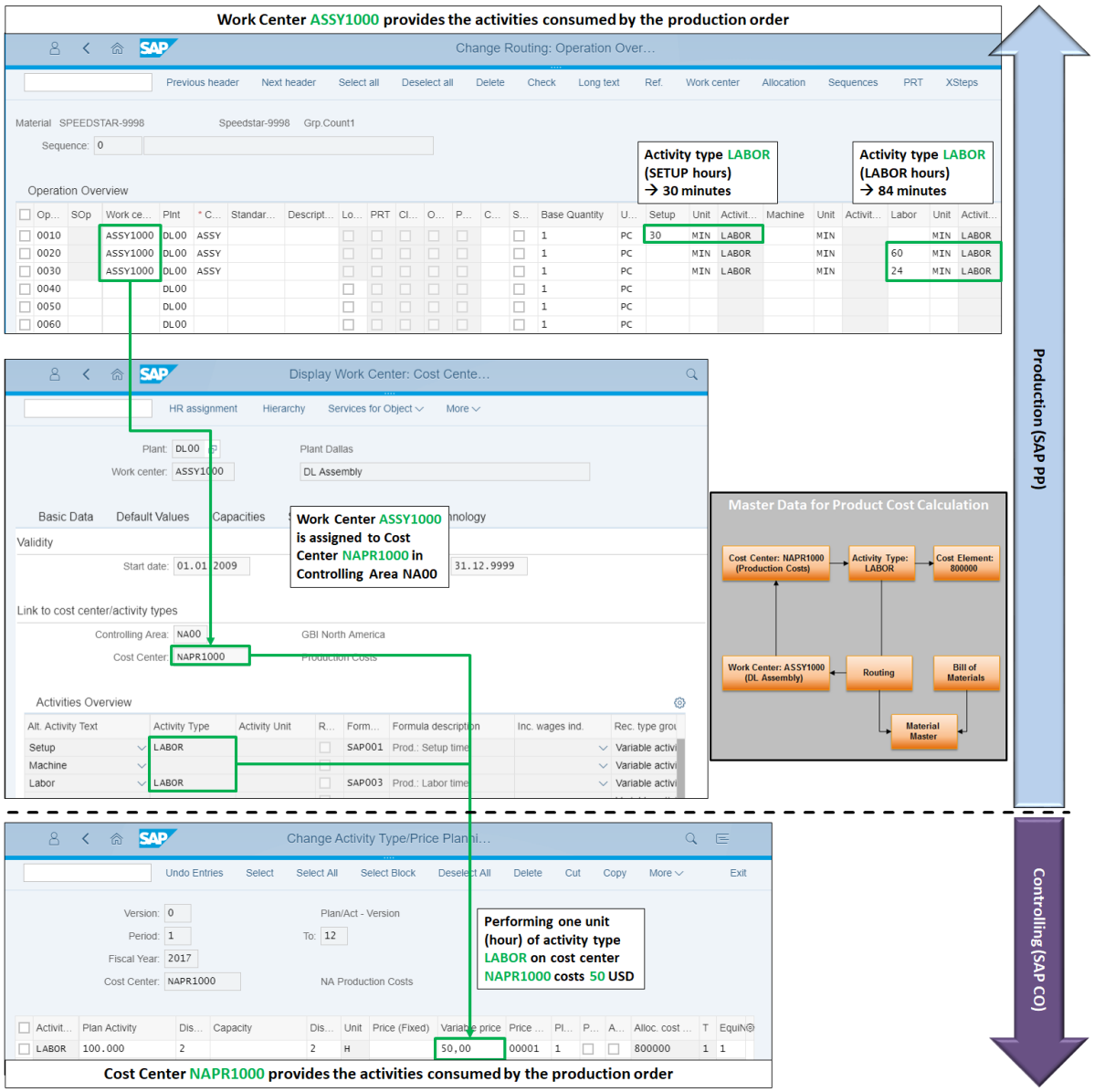


Figure 30: Work Center and Cost Centers: SAP-System-Screenshot

2.3 Practice: Master Data for Design-to-Operate Business Process

PRACTICE

In this chapter, you will maintain master data required for the following steps of this case study. The figure shows the process steps you will carry out:

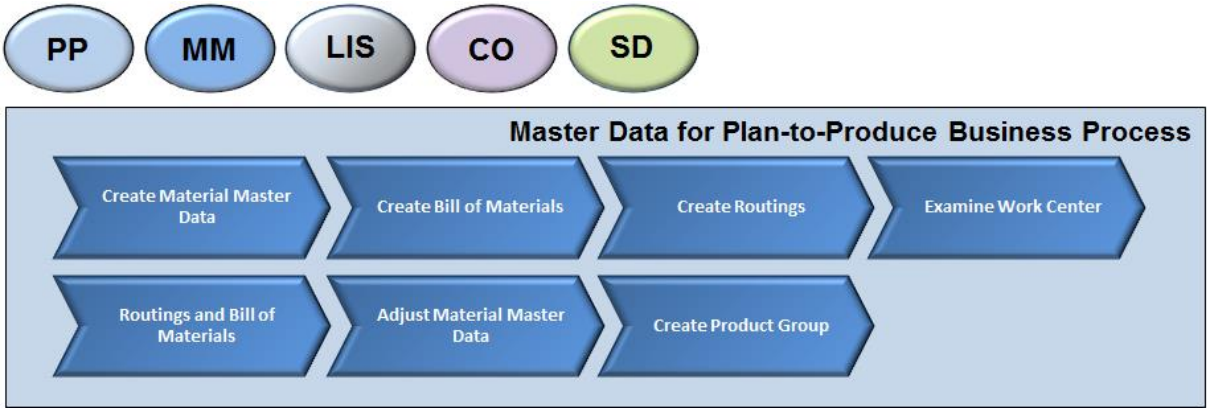


Figure 31: Process Overview: Master Data for Design-to-Operate Business Process

2.3.1 Create Material Master Data

In the unit *Source-to-Pay in SAP S/4HANA* you already created the material master records of the Speedstar, including its components. To get a feeling for the specific views and data fields, check once again your entries in the material master of the Speedstar for correctness.

2.3.1.1 Display Material Master Records

To display material master, select within the tile group **Script 2 – Design-to-Operate** the app ***Display Material***.

NOTE

You can maintain material master records via the respective app or directly via SAP Easy Access Menu. The SAP Easy Access Menu was presented in script 0 in detail. The most common changes regarding material master records are:

- *In case you forgot to create a view, you can change this by using the transaction **MM01** (Transaction for **creating** material master records). Do not use **MM02** (Transaction for **changing** material master records) in that case. **MM02** can only be used for views that already have been created in the system.*
- *If you want to change the Standard price, use the transaction **MR21 (Price Change)**. Enter **US00 (Global Bike Inc.)** as Company Code and **DL00 (Plant Dallas)** as Plant and confirm. Enter the respective material and the new price in the specific fields, confirm and save your data.*

1. Enter your material ***Speedstar-xyyy***. Press *Enter*.
2. Select the views ***Basic Data 1, MRP 1, MRP 2, MRP 3,*** and ***Accounting 1***.

3. In the next screen, enter **Plant *DL00*** and **Storage Location *FG00***. This screen is only displayed because, except for the Basic Data 1 view, all other views selected are plant-specific.
4. Go to the ***MRP 1*** view. You can see that the selected **MRP Type** is ***MRP (PD)***. This means that the required material is determined based on e.g. sales figures and reservations, or production requirements are created by the system.
5. Switch to the ***MRP 2*** view: You can see that the field **Procurement type** contains an ***E***. When you click in the field and call up the **F4-help**, you will see that the entry determines the ***In-house production*** of the material. Further options that are SAP standard are ***External procurement (F), Both procurement types (X)*** and ***No procurement.***
6. Switch to the ***MRP 3*** view. In this view, you can see that the **Availability check** for the Speedstar is carried out based on ***Individual requirements (02)***.
7. Finally, go to the ***Accounting 1*** view. In this view you can see with which value the material is recorded in accounting (management accounting). This view is predominantly a controlling view. Leave the material master data of the Speedstar.

Management decided to launch another product along with the Speedstar – the Speedstarlett. This alternative model is supposed to be of high value as well. However, it is supposed to be slightly less expensive. Moreover, it is a bicycle designed for women.
The ***Speedstarlett*** features an ***aluminum frame*** in contrast to the carbon frame of the Speedstar. Apart from that, all assemblies are identical. Create independently three new material master records (***Speedstarlett, Basis-Module2, Alu-Frame***).
You can use the material master records of the Speedstar, the Basis-Module, and the Carb-Frame as reference material to copy from them.

2.3.1.2 Material Master Record: Speedstarlett

Create the Speedstarlett with reference to the Speedstar. Therefore, within the tile group **Script 2 – Design-to-Operate** select the app ***Create Material***.

1. You are now in the **Create Material** dialog. Enter the following data:
   - **Material** ***Speedstarlett-xyyy***
   - **Industry sector** ***Mechanical engineering***
   - **Material type** ***Finished Product***
   - **Copy from** your material ***Speedstar-xyyy***
   - Press *Enter*.
2. In the next step, select the following **views**:
   - ***Basic Data 1***
   - ***Basic Data 2***
   - ***Sales: Sales Org. Data 1***
   - ***Sales: Sales Org. Data 2***
   - ***Sales: General/Plant Data***
   - ***MRP 1-4***
   - ***Work Scheduling***
   - ***Accounting 1***
   - ***Accounting 2***

- ***Costing 1***
- ***Costing 2***

Confirm the dialogue ( ).

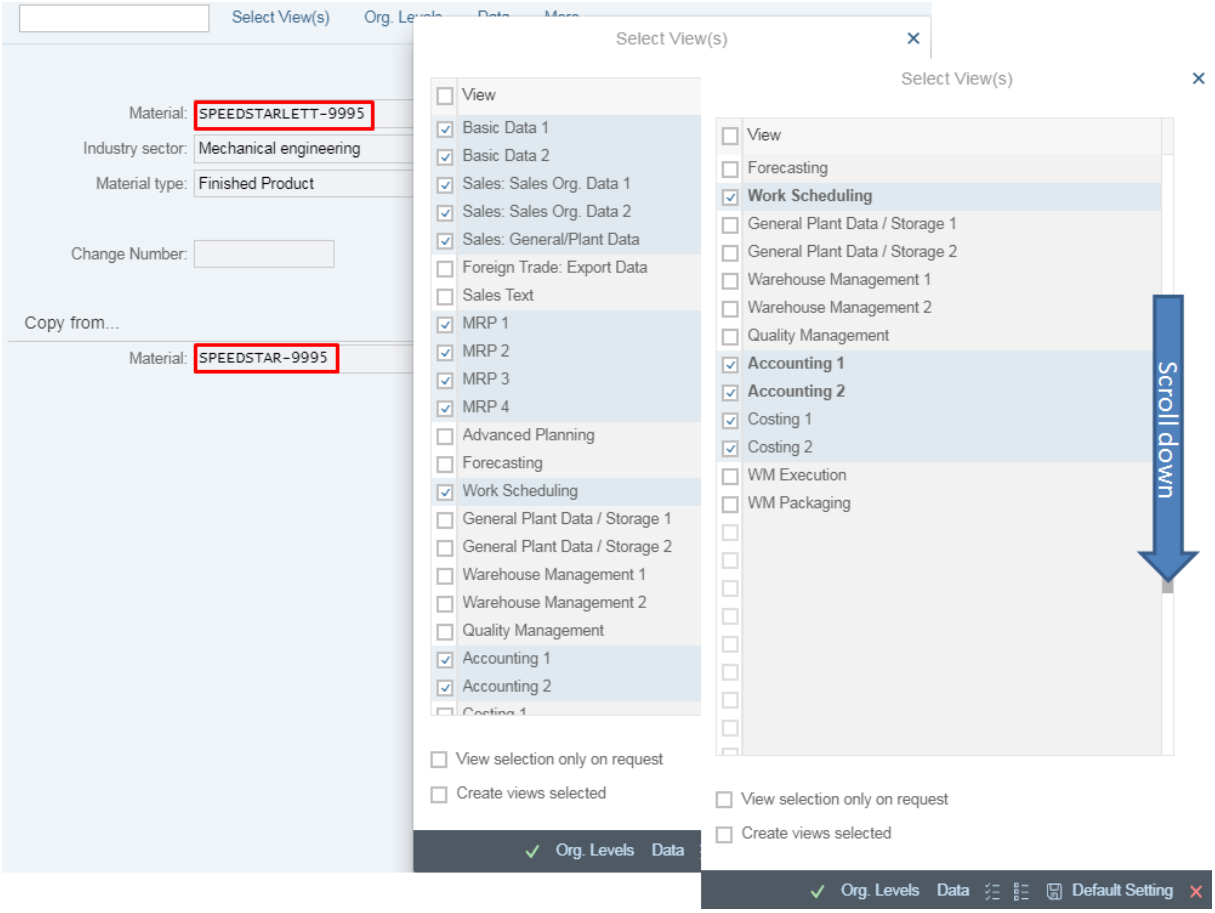


Figure 32: Create Finished Product Dialog (Speedstarlett) (1): SAP System-Screenshot

3. The following dialogue comprises information about the organizational unit, for which you are supposed to create the material. Since you want to copy from a reference you must, additionally, enter the organizational units of the material you want to copy from:
   - **Plant** ***DL00 (Dallas)***
   - **Storage Location** ***FG00 (Finished Goods)***
   - **Sales Organization** ***UW00 (US West, Wholesale)***
   - **Distribution Channel** ***WH (UW00, Wholesale)***
   - **Copy from** Plant ***DL00 (Dallas)***
   - **Copy from** Storage Location ***FG00 (Finished Goods)***
   - **Copy from** Sales Organization ***UW00 (US West, Wholesale)***
   - **Copy from** Distribution Channel ***WH (UW00, Wholesale)***
   - Complete the dialog with *Enter* or .

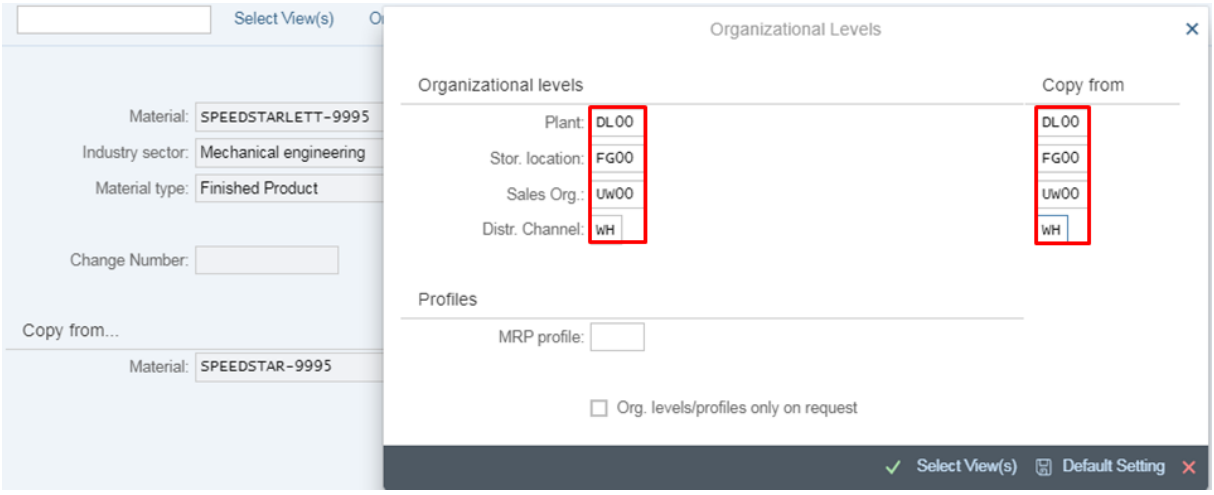


Figure 33: Create Finished Product Dialog (Speedstarlett) (2): SAP System-Screenshot

4. **Basic Data 1** view: **Material Description *Speedstarlett-xyyy*** – press *Enter*
5. **Basic Data 2** view: no changes – press *Enter*
6. **Sales: sales org. 1** view: no changes – press *Enter*
7. **Sales: sales org. 2** view: no changes – press *Enter*
8. **Sales: General/Plant** view: **Gross Weight *20*; Net Weight *17*** – press *Enter*
9. **MRP 1** view: no changes – press *Enter*
10. **MRP 2** view: no changes – press *Enter*
11. **MRP 3** view: no changes – press *Enter*
12. **MRP 4** view: no changes – press *Enter*
13. **Work scheduling** view: no changes – press *Enter*
14. **Accounting 1** view: **Standard price *2500*** – press *Enter* (2x)
15. **Accounting 2** view: no changes – press *Enter*
16. **Costing 1** view: no changes – press *Enter*
17. **Costing 2** view: no changes – press Additional Data
18. Maintain the short descriptions for the language keys DE and EN (in two separate rows):
    - **EN** ***Speedstarlett-xyyy***
    - **DE** ***Speedstarlett-xyyy***
    - press Save.

2.3.1.3 Material Master Record: Basis-Module 2

Now create the Basis-Module**2** on your own in the same way by copying it from the Basis-Module:

Therefore, within the tile group **Script 2 – Design-to-Operate** select the app ***Create Material***.

1. Enter the following data:
   - **Material** ***Basis-Module2-xyyy***
   - **Industry sector** ***Mechanical engineering***
   - **Material type** ***Semifinished Product***
   - **Copy from** your material ***Basis-Module-xyyy***
2. View selection:

- ***Basic Data 1***
- ***Basic Data 2***
- ***MRP 1-4***
- ***Work Scheduling***
- ***Accounting 1***
- ***Accounting 2***
- ***Costing 1***
- ***Costing 2***

3. Organizational data:
   - **Plant** ***DL00 (Dallas)***
   - **Storage Location** ***FG00 (Finished Goods)***
   - **Copy from** Plant ***DL00 (Dallas)***
   - **Copy from** Storage Location ***FG00 (Finished Goods)***

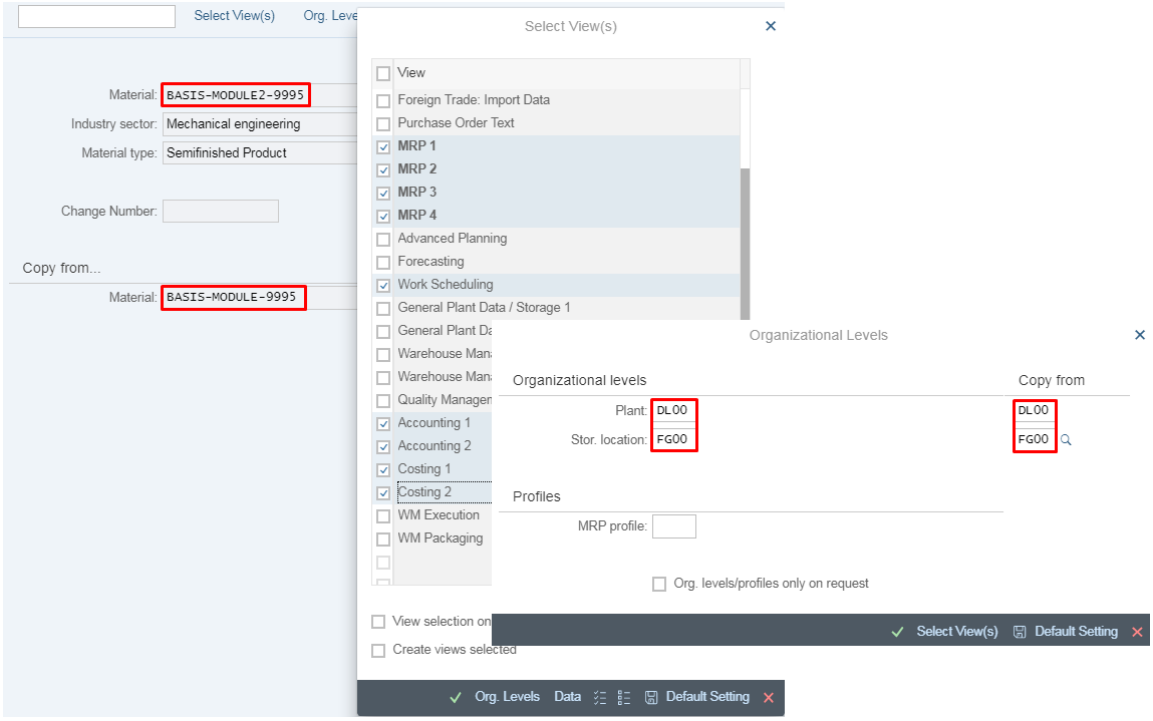


Figure 34: Create Semi-finished Product Dialog (Basis-module2): SAP System-Screenshot

4. **Basic data 1** view:
   - **Material Description** ***Basis-Module2-xyyy***
   - **Gross Weight** ***15 KG***
   - **Net Weight** ***13 KG***
5. **Basic data 2** view: no changes – press *Enter*
6. **MRP 1** view: no changes – press *Enter*
7. **MRP 2** view: no changes – press *Enter*
8. **MRP 3** view: no changes – press *Enter*
9. **MRP 4** view: no changes – press *Enter*
10. **Work Scheduling** view: no changes – press *Enter*
11. **Accounting 1** view: **Standard price *1500*** – press *Enter* (2x).
12. **Accounting 2** view: no changes – press *Enter*

13. **Costing 1** view: no changes – press *Enter*
14. **Costing 2** view: no changes – press Save

2.3.1.4 Material Master Record: Aluminum Frame

Finally, create the Alu-Frame with reference to the Carb-Frame:
Therefore, within the tile group **Script 2 – Design-to-Operate** select the app ***Create Material***.

1. Enter the following data:
   - **Material** ***Alu-Frame-xyyy***
   - **Industry sector** ***Mechanical engineering***
   - **Material type** ***Raw materials***
   - **Copy from** your material ***Carb-Frame-xyyy***
2. View selection:
   - ***Basic Data 1***
   - ***Basic Data 2***
   - ***Purchasing***
   - ***MRP 1-4***
   - ***Accounting 1***
   - ***Costing 1***
3. Organizational data:
   - **Plant** ***DL00 (Dallas)***
   - **Storage Location** ***FG00 (Finished Goods)***
   - **Copy from Plant** ***DL00 (Dallas)***
   - **Copy from Storage Location** ***FG00 (Finished Goods)***

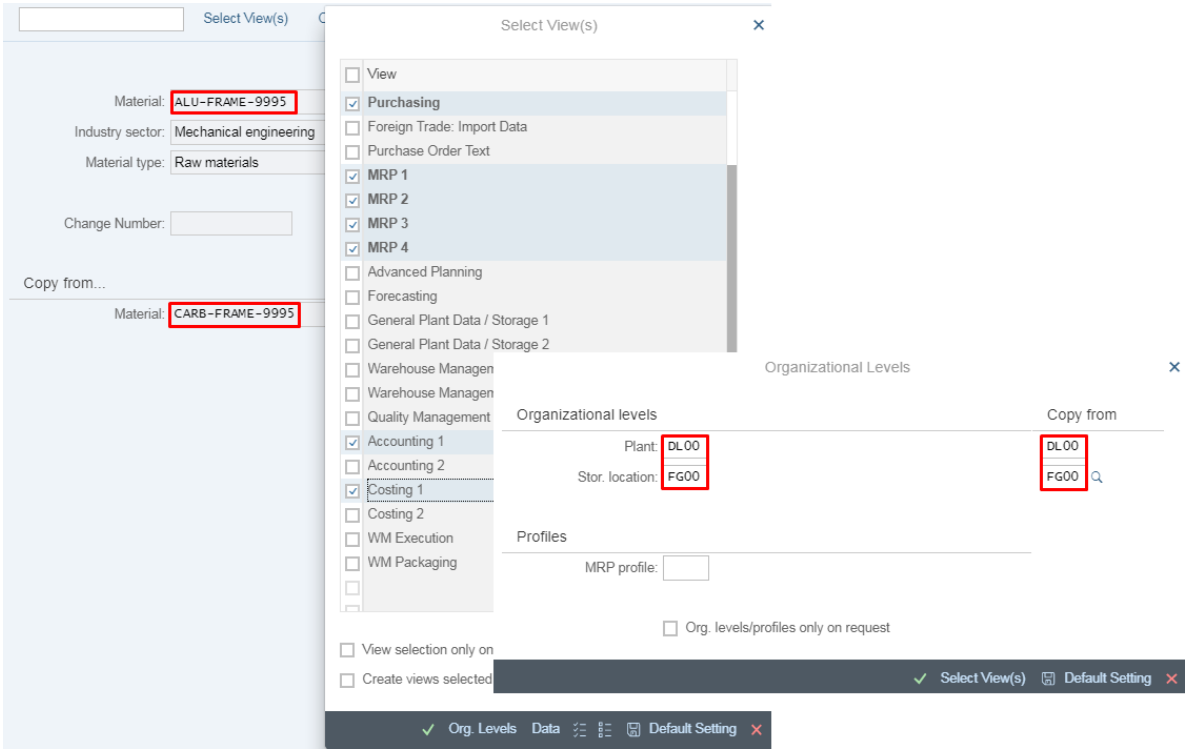


Figure 35: Create Raw Material Dialog (Alu-frame): SAP System-Screenshot

4. **Basic data 1** view:	**Material Description**	***Alu-Frame-xyyy***
	Gross weight	***10 KG***
	press *Enter*	
5. **Basic data 2** view:	no changes – press *Enter*	
6. **Purchasing** view:	no changes – press *Enter*	
7. **MRP 1** view:	no changes – press *Enter*	
8. **MRP 2** view:	no changes – press *Enter*	
9. **MRP 3** view:	no changes – press *Enter*	
10. **MRP 4** view:	no changes – press *Enter*	
11. **Accounting 1** view:	**Standard price *250*** – press *Enter* (2x)	
12. **Costing 1** view:	no changes – press Save	

Now that all material master records are maintained, you need to create the master data required for production.

2.3.1.5 Change Material

A quick delivery of sales orders is important regarding the two racing bicycles **Speedstar-xyyy** and **Speedstarlett-xyyy**. Since the production of the bikes requires a certain amount of time, production has to be planned in advance. Thus, production should be carried out before you receive a sales order. You are supposed to plan production using **pre-planning with assembly**. Accordingly, change the strategy group in the MRP 3 view to strategy group ***40***, planning with final assembly.
Choose
Therefore, within the tile group **Script 2 – Design-to-Operate** select the app ***Change Material***.

1. Enter material ***Speedstar-xyyy*** and press *Enter*.
2. Select the ***MRP 3*** view and confirm.
3. Enter plant ***DL00***, storage location ***FG00*** and confirm.
4. Enter ***40*** in the **Strategy Group** field.
5. ***Save*** your modification.
6. **Repeat** the steps 1-5 for the **Speedstarlett-xyyy** **on your own**.

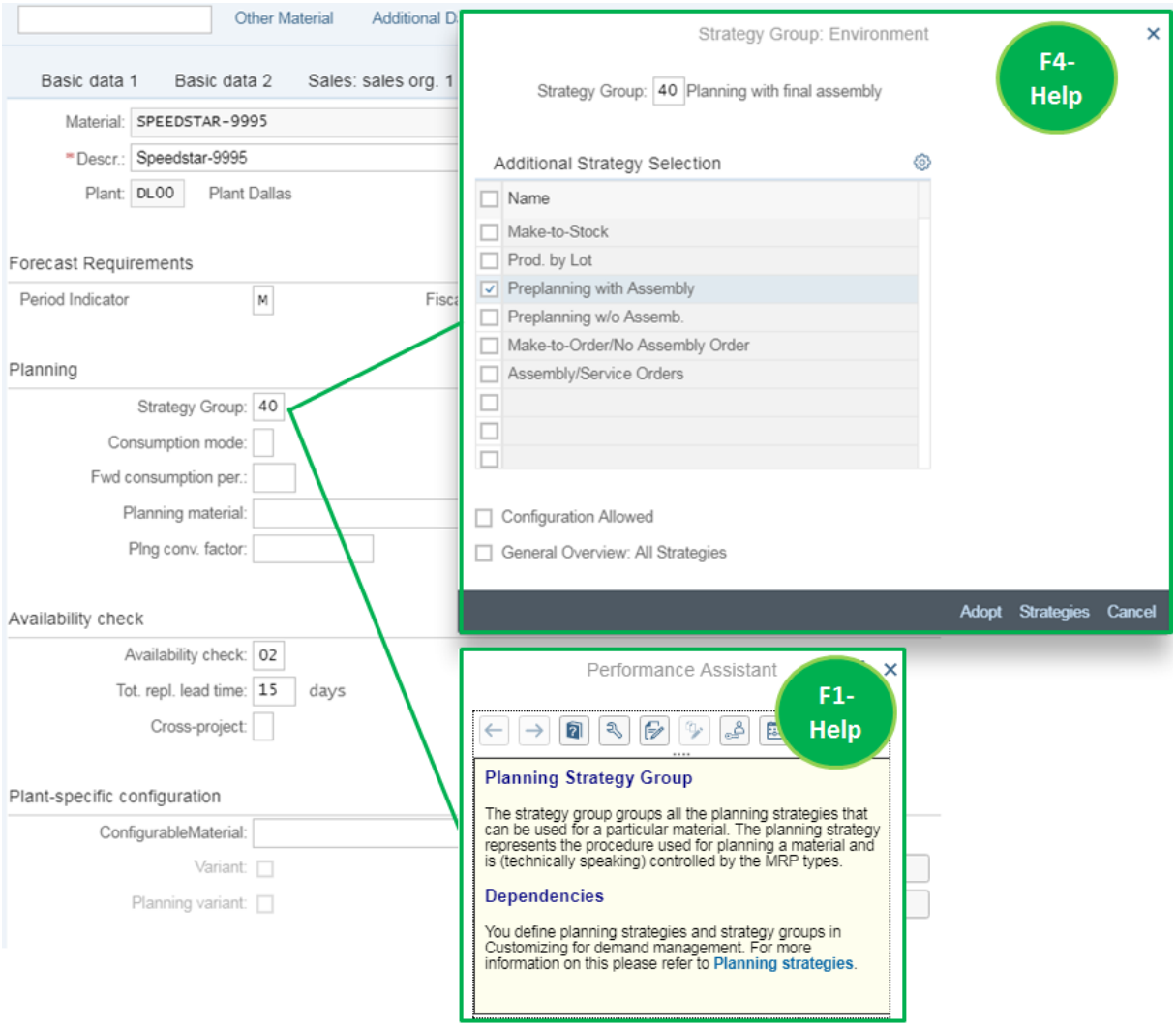


Figure 36: Strategy Group for MRP: SAP-System-Screenshot

2.3.2 Create Bill of Materials

In the theory part, you have learned that the Bill of Material is used to define the structure of a finished product. This structure contains all the components needed to produce the finished product. The BoM is not only necessary for the production application (SAP PP) but also for the Material Planning in SAP MM. BoM is used in SAP MM to create all dependent material requirements for the production process. That is, when a requirement is created for the Speedstar, SAP MM explodes the complete BoM to create requirements for the Speedstar's components (Basis-Module, Wheels etc.).

In the following, you are going to create the BoMs for:

- Basis-Module
- Basis-Module2
- Speedstar
- Speedstarlett

2.3.2.1 BoM for Basis-Module

You start with the BoM for the Basis-Module, since the Basis-Module not only contains components such as Gearing and Carb-Frame, but also is itself a component of the Speedstar.

Consider that in SAP S/4HANA you can only create single-level BoMs. That is, you create a single-level BoM for the Basis-Module containing one level of components and subsequently create a single-level BoM for the Speedstar containing the Basis-Module. In that way you create multiple-level BoMs.

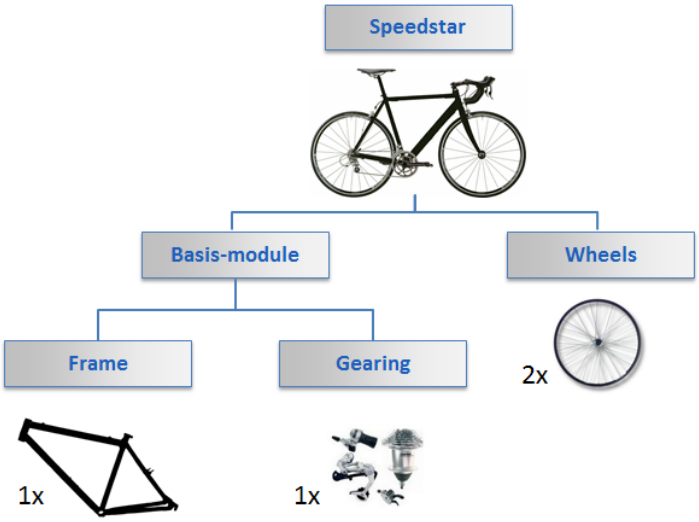


Figure 37: Speedstar BoM

To create a BoM, call up the following transaction:

Therefore, within the tile group **Script 2 – Design-to-Operate** select the app ***Maintain Bill Of Material***.

1. Click on the ***Create BOM*** button and enter the following data:
   - **Material** ***Basis-Module-xyyy***
   - **Plant** ***DL00 (Dallas)***
   - **BoM usage** ***1 (Production)***
   - Continue by clicking ***OK***.

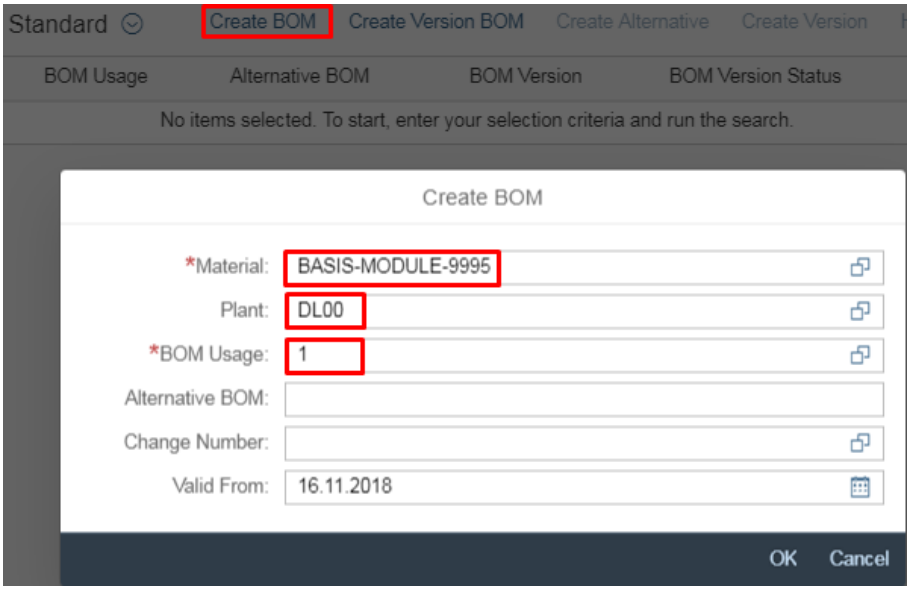


Figure 38: BoM Creation for Basis-module (1): SAP-System-Screenshot

You know from the scenario description that the basis-module consists of the following stock-item materials: Carb-Frame-xyyy and Gearing-xyyy.

2. Now, you are in the *Maintain bill of Material* view. Since your BOM contains two items, you have to press + (Add) twice, first. Enter the following data:

NOTE

*If necessary, increase the width of the **item category** column enter the entry **L**.*

Item	Item Category	Component	Quantity
0010	*L (Stock Item)*	*Carb-Frame-xyyy*	*1*
0020	*L (Stock Item)*	*Gearing-xyyy*	*1*

3. Confirm with ***Enter***.

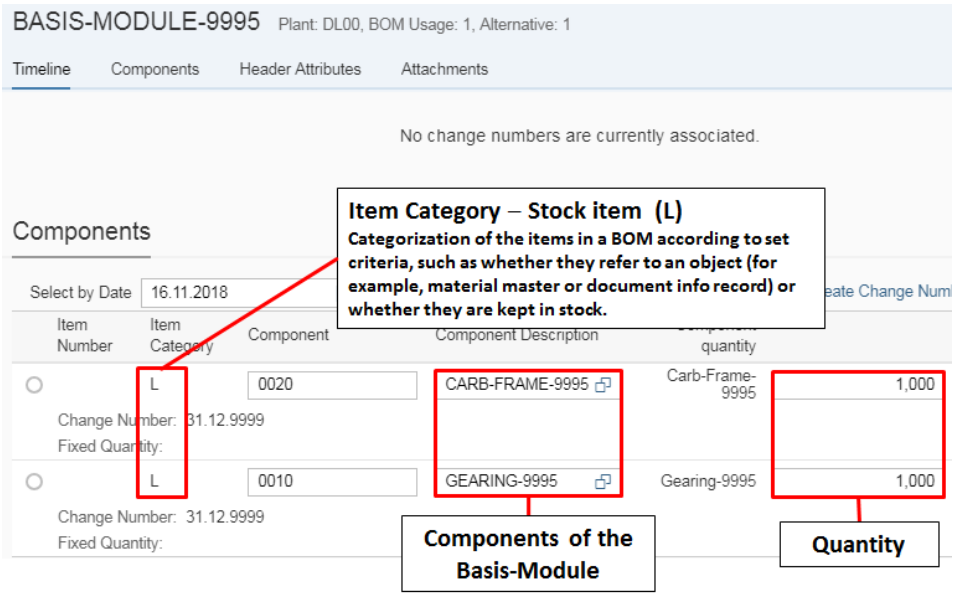


Figure 39: BoM Creation for Basis-module (2): SAP-System-Screenshot

4. ***Save*** your entries.
5. You receive a notification that Material BOM was saved.

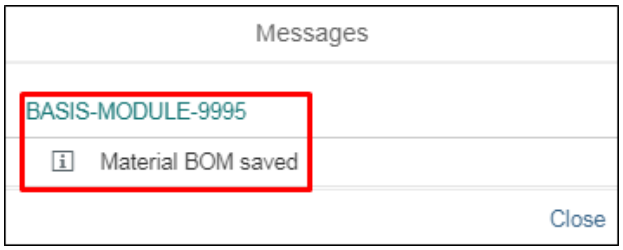
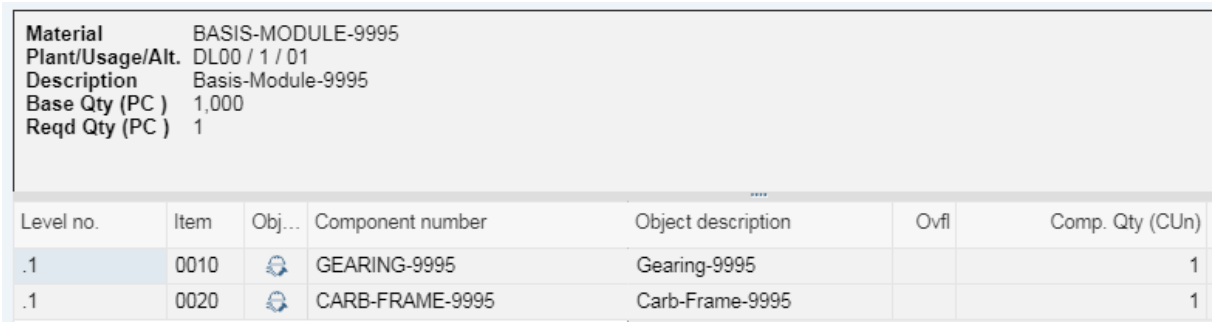


Figure 40: BoM Creation for Basis-module (3): SAP-System-Screenshot

6. To double-check your newly created BoM, display the BoM explosion. Therefore, within the tile group **Script 2 – Design-to-Operate** select the app ***Display Multilevel BOM Explosion***.
7. Enter the material ***Basis-Module-xyyy*** and plant ***DL00 (Dallas)***. **BoM Application** is general production ***PP01***.
8. In addition, within the **Segmentierung** area, check ***Ignore Seg***.
9. Click on ***Execute*** and confirm the system notification. You can now see the BoM in list form.

For your comparison:
The following figure shows the BoM for ***Basis-module-9995 (created by your tutor)***.



Material	BASIS-MODULE-9995
Plant/Usage/Alt.	DL00 / 1 / 01
Description	Basis-Module-9995
Base Qty (PC)	1,000
Reqd Qty (PC)	1

Level no.	Item	Obj...	Component number	Object description	Ovfl	Comp. Qty (CUn)
.1	0010		GEARING-9995	Gearing-9995		1
.1	0020		CARB-FRAME-9995	Carb-Frame-9995		1

Figure 41: BoM Basis-module: SAP-System-Screenshot

2.3.2.2 BoM for Basis-Module 2

Next, create the BoM for the Basis-Module2. After that, this option will be used for the production of the Speedstarlett. Therefore, within the tile group **Script 2 – Design-to-Operate** select the app ***Maintain Bill Of Material***.

1. Click on the ***Create BOM*** button and enter the following data:
   - **Material** ***Basis-Module2-xyyy***
   - **Plant** ***DL00***
   - **BoM usage** ***1 (Production)***
   - Continue by clicking ***OK***.

The only difference to the BoM of Basis-module is that you have Alu-Frame instead of Carb-Frame as a component.

2. Press + (Add) two times and enter the following data:

Item	Item Category	Component	Quantity
0010	*L (Stock Item)*	*Alu-Frame-xyyy*	*1*
0020	*L (Stock Item)*	*Gearing-xyyy*	*1*

3. **Save** your entries.

Now that you created the BoMs for the Basis-Modules, you have to create the BoMs for the finished products.

2.3.2.3 BoM for the Speedstar

Within the tile group **Script 2 – Design-to-Operate** select the app ***Maintain Bill Of Material***.

1. Click on the ***Create BOM*** button and enter the following data:
   - **Material** ***Speedstar-xyyy***
   - **Plant** ***DL00***
   - **BoM usage** ***1 (Production)***
   - Continue by clicking ***OK***.

You know from the scenario description that the Speedstar consists of the following stock-item materials: Basis-Module-xyyy and Wheel-xyyy (x2).

2. Press + (Add) two times and enter the following data:

Item	Item Category	Component	Quantity
0010	*L (Stock Item)*	*Basis-Module-xyyy*	*1*
0020	*L (Stock Item)*	*Wheel-xyyy*	*2*

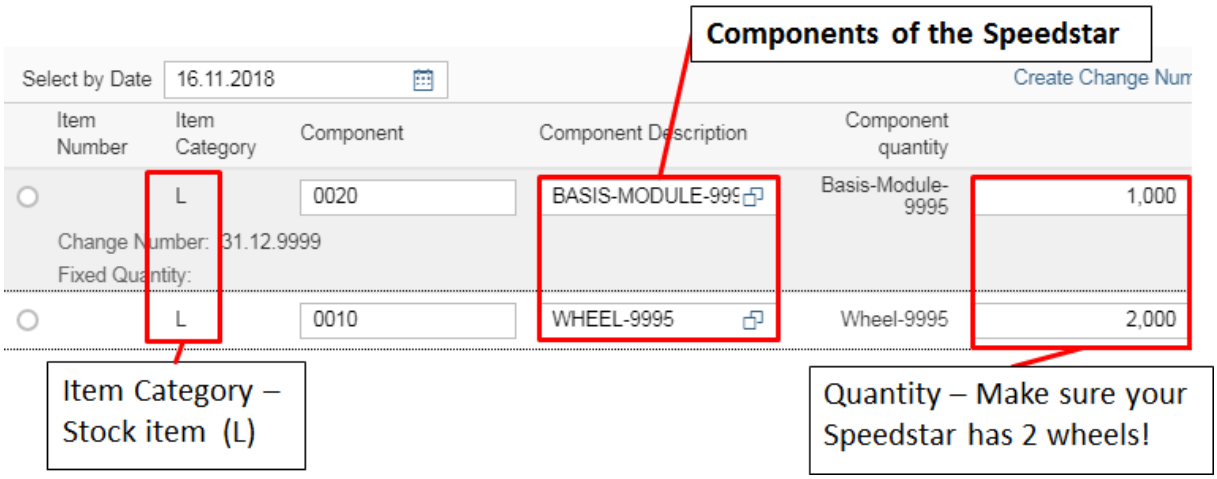


Figure 42: BoM Creation for Speedstar: SAP-System-Screenshot

3. ***Save*** your entries.
4. Display the BoM. Therefore, within the tile group **Script 2 – Design-to-Operate** select the app ***Display Multilevel BOM Explosion***.
5. Enter the Speedstar as **Material** (***Speedstar-xyyy***) and **Plant** ***DL00 (Dallas)***. **BoM application** is general production ***(PP01)***.
6. In addition, within the **Segmentierung** area, check ***Ignore Seg***.
7. Click on ***Execute*** and confirm the system notification. You can now see the BoM in list form.

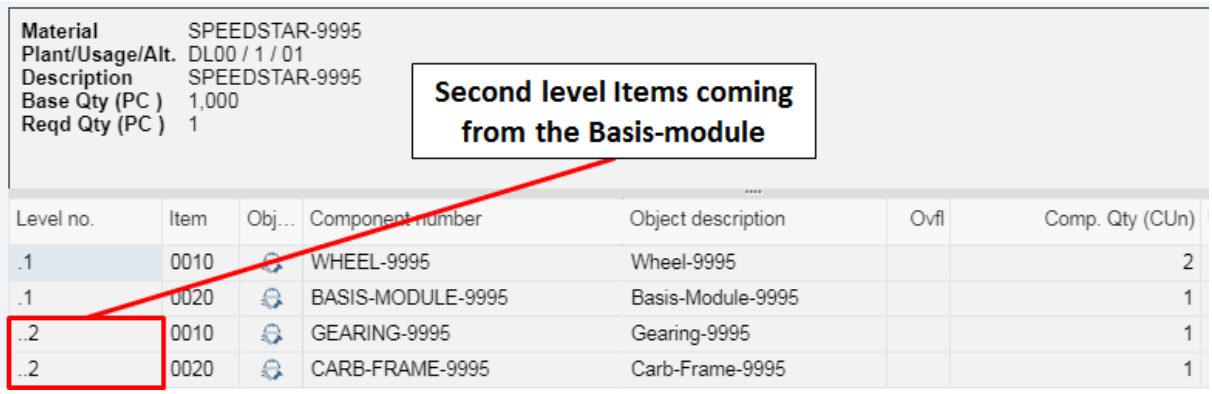


Figure 43: BoM Speedstar: SAP-System-Screenshot

You can see from the figure that the BoM of the Speedstar is a multi-level BoM.

2.3.2.4 BoM for the Speedstarlett

Within the tile group **Script 2 – Design-to-Operate** select the app ***Maintain Bill Of Material***.

1. Click on the ***Create BOM*** button and enter the following data:
   - **Material** ***Speedstarlett-xyyy***
   - **Plant** ***DL00***
   - **BoM usage** ***1 (Production)***
   - Continue with ***OK***.

You know from the scenario description that the Speedstarlett consists of the following stock-item materials: Basis-Module2-xyyy and Wheel-xyyy (x2). The only difference relative to the Speedstar is the Basis-Module2-xyyy.

2. Press + (Add) two times and enter the following data:

Item	ICt	Component	Quantity
0010	*L (Stock Item)*	*Basis-Module2-xyyy*	*1*
0020	*L (Stock Item)*	*Wheel-xyyy*	*2*

3. ***Save*** your entries.

2.3.3 Create Routings

As you should know already, a routing is the description of a manufacturing sequence for the production of materials or the creation of services, respectively.
Moreover, additional control parameters are provided in the SAP S/4HANA system. Amongst others, these are:

- use of work centers
- time allocations
- use of production resources

During your manufacturing run, you have to produce 4 distinct items. These are the two assemblies ***Basis-Module-xyyy*** and ***Basis-Module2-xyyy,*** as well as the two finished products

Speedstar-xyyy and ***Speedstarlett-xyyy***. Correspondingly, you have to create four routings. Hereby, all items are carried out at work center ASSY1000 (DL Assembly).
To simplify matters, the four operational procedures are identical and consist of merely three steps. Usually (in the real world), operational procedures are more complex and contain multiple steps.

2.3.3.1 Create Routing for Basis-Module

Within the tile group **Script 2 – Design-to-Operate** select the app ***Create Routing***.

1. Enter the following data:
   - **Material** ***Basis-Module-xyyy***
   - **Plant** ***DL00***
   - Continue by clicking ***Enter*** or Continue.
2. The routing is supposed to be used for production and has the status released (thus, can be actively used). Enter the following data:
   - **Usage** ***1 (Production)***
   - **Overall Status** ***4 (Released)***
   - Next, click the Operation button (**Operation overview**).

You can see the **Operation** overview. You have no activity maintained yet.

3. From the Information above, you know that all the activities in the production process take place at the same work center (ASSY1000). Enter the following data:

Operat.	Work center	Control key
0010	*ASSY1000*	*ASSY*
0020	*ASSY1000*	*ASSY*
0030	*ASSY1000*	*ASSY*

4. Press ***Enter***. You might receive a message that a standard text is not maintained in customizing. Skip the message.

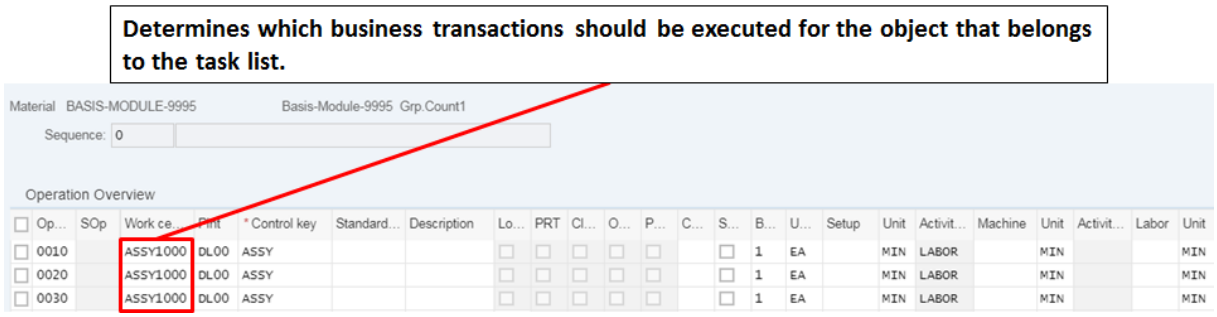


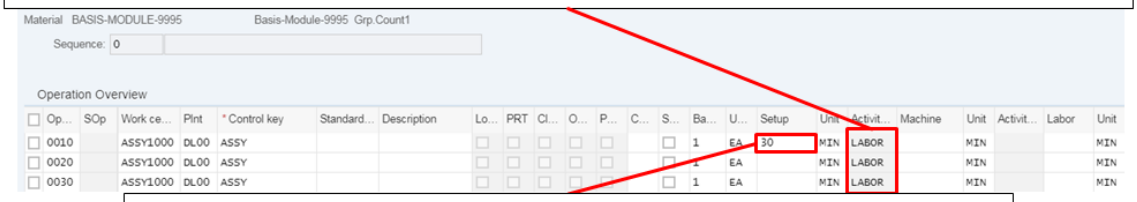
Figure 44: Routing – Operations Overview: SAP-System-Screenshot

5. Next, within the Operation overview, scroll to the right and enter ***30*** minutes for row **operation 0010** and **Setup** column. Confirm with ***Enter***.

If Setup column is not displayed, you have not confirmed with Enter or you did not scroll to the right.

Activity types describe the activity produced by a cost center and are measured in units of time or quantity. In activity type planning, control data determines whether the activity price for evaluation of the activity type is manually set or is derived iteratively through activity price calculation.

That means, that the activity type is used in calculating the price of this production step. The calculation is done in controlling application (SAP CO). The price of the activity type LABOR (Setup hours) is also determined in SAP CO. This price depends on many factors, which will be disclosed in the Controlling teaching unit.



The standard time the activity type specified should last.
Basically, that means that this step (setting up the machines) should take 30 minutes

Figure 45: Routing – Operation Details: SAP-System-Screenshot

6. Then, enter ***60*** minutes for **operation 0020** and **Labor** column.
7. Finally, enter ***24*** minutes for **operation 0030** and **Labor** column.
8. Compare your created routing with the following figure.

For your comparison:

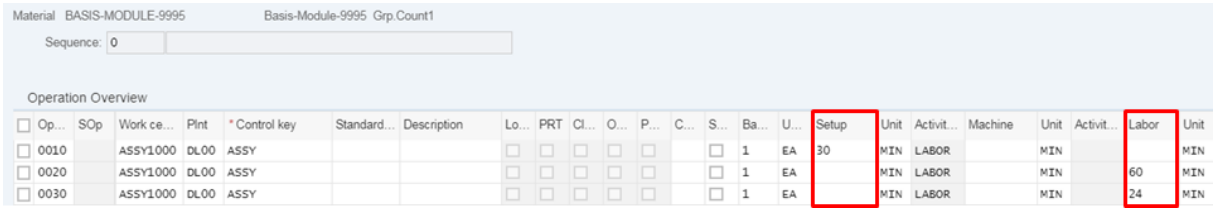


Figure 46: Routing Basis-module: SAP-System-Screenshot

Pay attention, that you have entered the correct values within the **Setup** and **Labor** columns. If the figure is equal to your data, ***save*** your routing (Save). List the routing number (group number) displayed by the system in the status bar.

Routing Number 1 (Basis-Module):

*Subsequent changes regarding a routing can be made via the app **Change Routing**.*
*If you have forgot to write down the routing number, you can find it out via the app **Change Routing**. Within the app, delete any entries in the **Group** field, enter the respective material/plant and press (**without** confirming with Enter)* Header*. The entry in the **Group** field corresponds to the respective routing number.*

2.3.3.2 Create remaining Routings

Now, create the other three routings (Basis-Module2-xyyy, Speedstar-xyyy, Speedstarlett-xyyy).

The remaining routines will include the same data that you have already entered when you create the routing for the Basis-Module.

1. Within the tile group **Script 2 – Design-to-Operate** select the app ***Create Routing***.
   - **Material** ***Basis-Module2-xyyy***
   - **Plant** ***DL00***
   - Make sure that the *Group* field is **empty** and confirm with ***Enter***.
2. The routing is supposed to be used for production and has the status released (thus, can be actively used). Enter the following data:
   - **Usage** ***1 (Production)***
   - **Overall Status** ***4 (Released)***
   - Next, click the Operation button (**Operation overview**).
3. From the Information above, you know that all the activities in the production process take place at the same work center (ASSY1000). Enter the following data:

Operat.	Work center	Control key
0010	*ASSY1000*	*ASSY*
0020	*ASSY1000*	*ASSY*
0030	*ASSY1000*	*ASSY*

4. Next, within the Operation overview, scroll to the right and enter ***30*** minutes for row **operation 0010** and **Setup** column. Confirm with ***Enter***.
5. Then, enter ***60*** minutes for **operation 0020** and **Labor** column.
6. Finally, enter ***24*** minutes for **operation 0030** and **Labor** column.
7. Compare your created routing with the following figure.

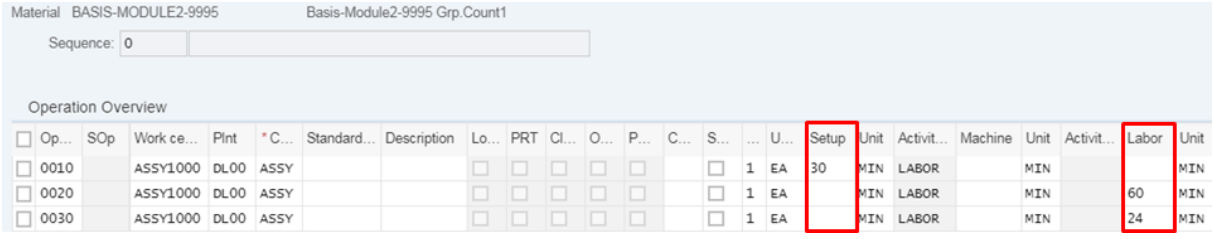


Figure 47: Routing Basis-Module2: SAP System-Screenshot

8. ***Save*** your data and write down your routing number regarding Basis-Module2-xyyy on your data sheet.

Routing Number 2 (Basis-Module2):

Now, create the routings for Speedstar and Speedstarlett **on your own**. Make sure that while creating the routings the *Group* field is **empty**! Write down your routing numbers on your data sheet, too.

Routing Number 3 (Speedstar):

Routing Number 4 (Speedstarlett):

Thus, all required master data for the manufacturing run are maintained.

2.3.4 Examine Work Center

The operations for the production of the Speedstar are carried out at **work center ASSY1000**. You are interested in the master data of this work center and want to get an overview of the settings at this work center. Additionally, you will look at the list of operations in the routing. Since material components may be required during the production process, you will assign a material to an operation.

First, display the master data for **work center ASSY1000**. Therefore, within the tile group **Script 2 – Design-to-Operate** select the app ***Display Work Center***.

1. Enter plant ***DL00*** and work center **ASSY1000**.
2. Confirm by pressing ***Enter***.
3. You are now in the maser data record of work center ASSY1000. Answer the following questions and list the answers on your data sheet:

   - Which **six** tabs are displayed for the work center?

   - The **Work Center Category** is a key that distinguishes the work centers by their category (e.g., production work center and maintenance work center). The work center category determines which data can be maintained in the master record for the work center. Look at the information on the ***Basic Data*** tab.
     What is the ***Work Center Category?***

   - Go to the ***Capacities*** tab. Here you determine what type of capacities (labor, machine, person etc.) and how much capacity (working hours, machine hours, personnel hours) the work center has and how the capacities are calculated and allocated (divers formulas). You can take a look at formulas by clicking in one of the formula fields (e.g., Processing formula) and then pressing 

     .
     Which ***Capacity category*** and ***description*** is assigned to the work center? Note that more than one capacity category can be assigned to a work center.

   - Press the capacity header button (

) to see the overview data for this work center capacity.
     Which ***Factory calendar ID*** is assigned to this work center (for this capacity type)?

At what ***time*** does operation at this work center start and end each working day? (for this capacity type)?

- Go to the ***Costing*** tab. On the costing tab all data related to cost accounting (integration with SAP CO) are defined. For instance, the *Cost Center*, which accounts for the costs accumulated on this work center, the responsible *Controlling Area* and the Activity Types (describe the activity produced by a cost center and are measured in units of time or quantity) are stored here.
  Which ***Cost Center*** is assigned to the work center?

  Close the register tab by pressing ***Exit*** and turn back to the Home page of SAP Fiori Launchpad.

2.3.5 Routings and Bill of Materials

Now that you have an overview of **work center ASSY1000**, take a closer look at the routing for the Speedstar. Therefore, within the tile group **Script 2 – Design-to-Operate** select the app ***Change Routing***.

1. Enter material ***Speedstar-xyyy*** and plant ***DL00***. Make sure that the **Group** field is empty.
2. Choose (without pressing ***Enter***) the ***Header*** (Header) button.
3. Answer the following questions and list the answers on your data sheet:

   - The **Status** key of a routing is used to indicate the processing status of a task list. For example, you can indicate whether the task list is still in the creation phase or has already been released. Note that certain transactions are dependent upon the status of the task list. For example, you can only include a reference operation set in a routing if the routing has the status "Released (general)".
     What is the ***Overall Status*** of this routing?

   - The task list **Group** is a key for identifying a group of routings. You can use groups, for instance, to identify two routings that have different production steps for one material. The **Group Counter** key and the task list **Group** key uniquely identify a task list. In Production Planning and Control, for example, it serves to identify alternative production processes in task lists and is used to make a distinction between similar task lists. For instance, the Group Counter can be used to identify different lot-size ranges.
     Which is the task list ***Group*** and the ***Group Counter***?

   - The range for the lot size is given through a lower and upper limit. For instance, you could specify for a routing that it is only valid for lot sizes between 1 and 3000 pieces. That might be necessary if you have different production procedures (hence, routings) depending on the amount of products you have to produce.
     For which ***Lot Size*** range (empty field corresponds to value 0) is this routing valid?

- A Sequence in a routing is a sequence of operations sorted according to operation number. Sequence categories in routings are: Standard, Alternative and Parallel. Switch to the ***Sequence Overview*** screen (Sequences).
  Which ***Sequences*** are mentioned?

- Select the ***Standard Sequence*** row and switch to the ***Operation overview*** screen (Operation). You can now see the operations that you already maintained yourself. Select the first operation (0010) and choose ***More → Details → Operation Detail*** from the menu.
  What are the ***Base Quantity*** and the ***Unit of Measure*** for this operation?

If the Operation Overview is empty, the routing was maintained incomplete. In this case you can add the necessary data directly in the current view.
*Also check the other routings (Speedstarlett, Basis-Module and Basis-Module2) via **Change Routing** app.*

- ***Standard Values*** are used in costing, scheduling, and capacity planning to calculate costs, execution times, and capacity requirements. With the standard value you determine how long or how much of an activity is consumed in this (routing) operation. The ***Base Quantity*** determines the quantity of the material to be produced to which the standard values of the operation refer.
  What is the ***Standard Value (Std Value)*** and the measurement ***Unit (Un)*** of the Setup time required for the base quantity?

2.3.6 Adjust Material Master

Before you start with the production planning process, you need to perform some changes to your material master records. Incoming **sales orders** (concrete requirements) are supposed to consume **planned independent requirements** (estimated future requirements) from production planning. That is, when you receive a sales order, the planned independent requirements of this period should be lowered by that amount. Therefore, you need to set the consumption mode in the material master data of the Speedstar and the Speedstarlett. The **consumption mode** controls the direction of requirements consumption of the time axis.
In addition, you will create Production Versions for your material master records Speedstar, Speedstarlett, Basis-Module and Basis-Module2.
Within the tile group **Script 2 – Design-to-Operate** select the app ***Change Material***.

1. Enter material ***Speedstar-xyyy*** and confirm with *Enter*.
2. Select the **MRP 3** and **Work Scheduling** view and confirm with ✓.
3. Enter plant ***DL00*** and storage location ***FG00***.
4. Enter the following data:
   - **Consumption mode** ***2***
   - **Bwd. consumption per.** ***30***
   - **Fwd. consumption per.** ***30***

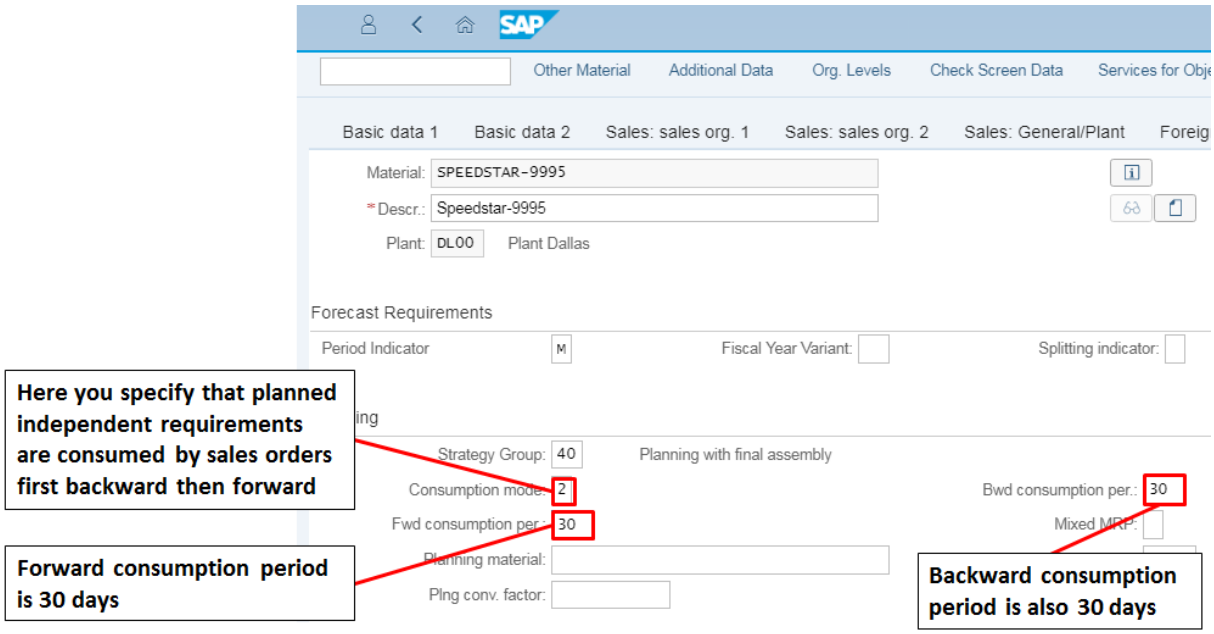


Figure 48: Consumption Mode and Consumption Period: SAP-System-Screenshot

NOTE

By these settings, sales orders that are supposed to be covered at a particular date are consumed with planned independent requirements 30 days before or after that particular date. By default, backward consumption is carried out so that the sales order consumes planned independent requirements of the last 30 days.

5. Confirm with ***Enter***.
6. Within the **Work scheduling** view, press the ProdVersions button.
7. Enter the following data:

Version	***0000***
Production Version Text	***Speedstar-xyyy***
Valid from	***current date***
Valid to	***31.12.9999***

8. Next, double-click on the entry within the ***Version*** field.

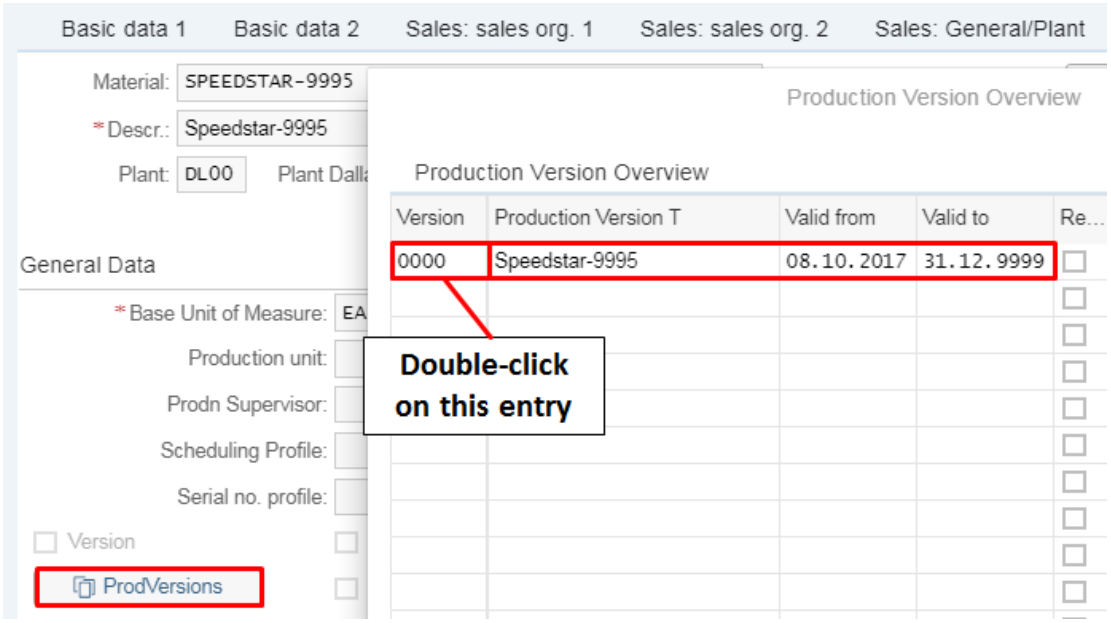


Figure 49: Create Production Versions (1): SAP-System-Screenshot

9. A popup **Production Version Details** opens. From the popup **Task List Type**, select the entry ***Routing*** and in the **Group** field, enter your ***routing number for Speedstar-xyyy***.
10. Enter ***1*** for **Group Counter**, **Alternative BOM** and **BOM Usage**. Then, press the ***Check*** button.

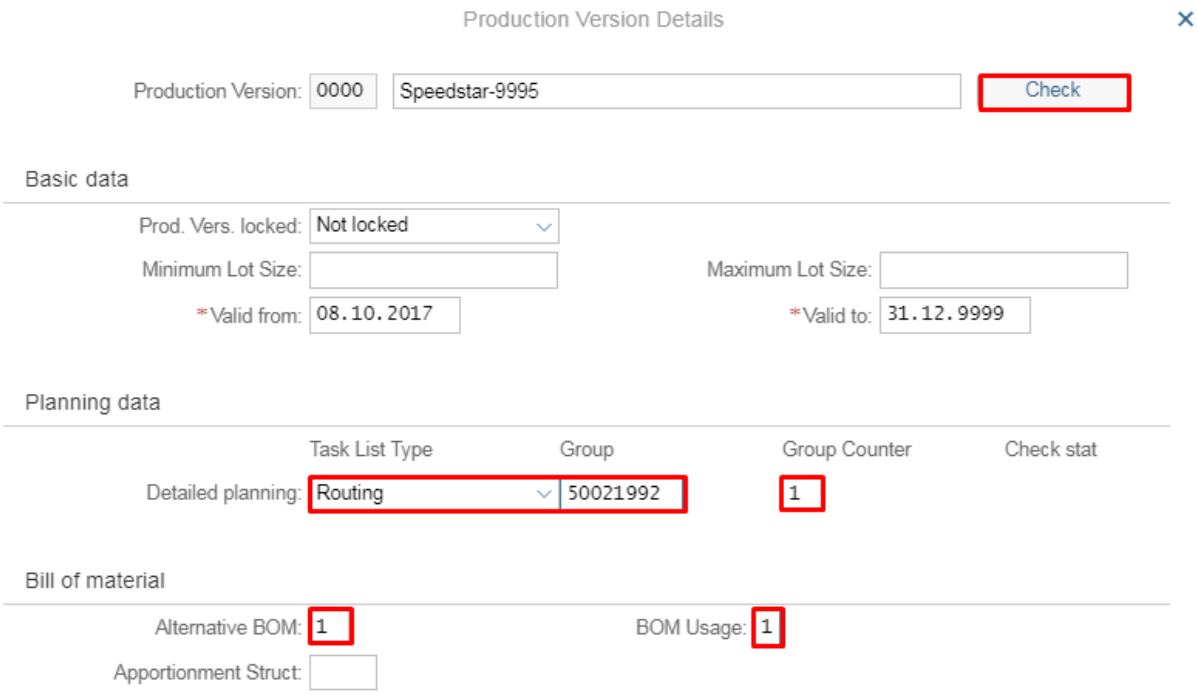


Figure 50: Create Production Versions (2): SAP-System-Screenshot

11. You should receive the notification: ***Task lists exists / BOM exists***. Otherwise, check your entries again.
12. Close the popup (check status should be green), press ***Continue*** **twice** and ***save*** your changes.

13. **Repeat** steps **1-12** for the material ***Speedstarlett-xyyy*** (of course, you have to use your Routing number of your Speedstarlett-xxyy in this case).

Now, adjust the material master records your Basis-Module and Basis-Module2. For these materials, you only have to adjust the Work Scheduling view.

1. Enter your material ***Basis-Module-xyyy*** ein and confirm with *Enter*.
2. Select the **Work Scheduling** view and confirm with  .
3. Enter plant ***DL00*** and confirm.
4. Within the **Work scheduling** view, press the 

button.
5. Enter the following data:

Version	***0000***
Production Version Text	***Basis-Module-xyyy***
Valid from	***current date***
Valid to	***31.12.9999***

6. Next, double-click on the entry within the ***Version*** field.
7. A popup **Production Version Details** opens. From the popup **Task List Type**, select the entry ***Routing*** and in the **Group** field, enter your ***routing number for Basis-Module-xyyy***.
8. Enter ***1*** for **Group Counter**, **Alternative BOM** and **BOM Usage**. Then, press the ***Check*** button.
9. You should receive the notification: ***Task lists exists / BOM exists***. Otherwise, check your entries again.
10. Close the popup (check status should be green), press ***Continue*** **twice** and ***save*** your changes.
11. **Repeat** the last steps (**1-10**) for the material ***Basis-module2-xyyy*** (of course, you have to use your Routing number of your Basis-Module2-xyyy in this case).

2.3.7 Create Product Group

The two racing bicycles ***Speedstar*** and ***Speedstarlett*** are supposed to be combined in one product group. Product groups generally allow for the combination of similar products in a structure and facilitate maintenance in the system. Correspondingly, your first task is to define the product group ***racing-bicycle***, which contains both *materials* Speedstar and Speedstarlett.

To create a production group, call up within the tile group **Script 2 – Design-to-Operate** select the app ***Create Product Group***.

In the *Create Product Group: Initial Screen*, enter the following data:

1. **Product group** ***Racing-Bike-xyyy***
2. **Description** ***Racing-Bicycle-xyyy***
3. **Plant** ***DL00***
4. **Base Unit** ***EA***
5. **Members** ***select the Materials radio button***
6. Confirm with *Enter*.

The market research department expects sales of the product group to consist of 60% Speedstar sales and 40% Speedstarlett sales. Enter the following data:

If only one row is displayed, use the zoom function of your browser to minimize the view. Alternatively, you can adjust the view via CTRL + scrolling the mouse wheel at the same time.

1. First row
   - **Member number** ***Speedstar-xyyy***
   - **Plant** ***DL00***
   - **Aggr. fact.** ***0***
   - **Proportion** ***60***
2. Second row
   - **member number** ***Speedstarlett-xyyy***
   - **Plant** ***DL00***
   - **Aggr. fact.** ***0***
   - **Proportion** ***40***
3. Press *Enter*.

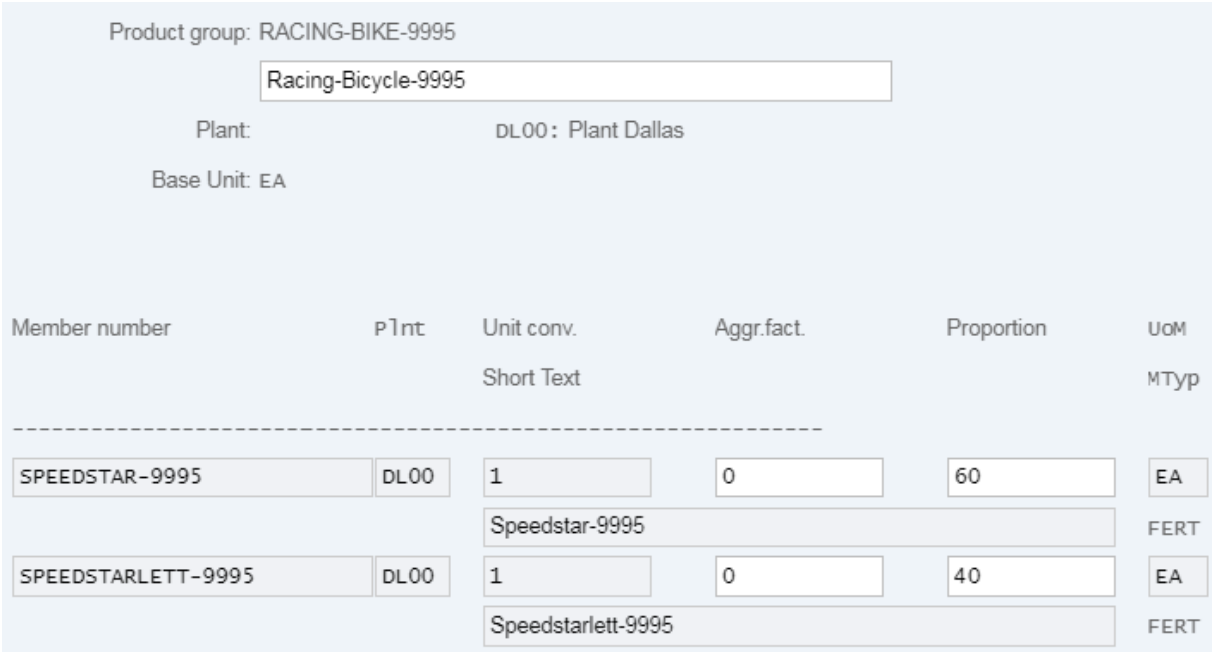


Figure 51: Create Product Group: SAP-System-Screenshot

4. *Save* the product group.

3 Design-to-Operate Business Process

The following figure illustrates the already introduced Design-to-Operate business process in the SAP system. In this section, you will first deal with ***Production Planning***, which is the first part of this business process. In the second part of this section we will deal with the ***Production Scheduling and Shop Floor Control*** (Produce Material and Perform Periodic Processing) process steps.

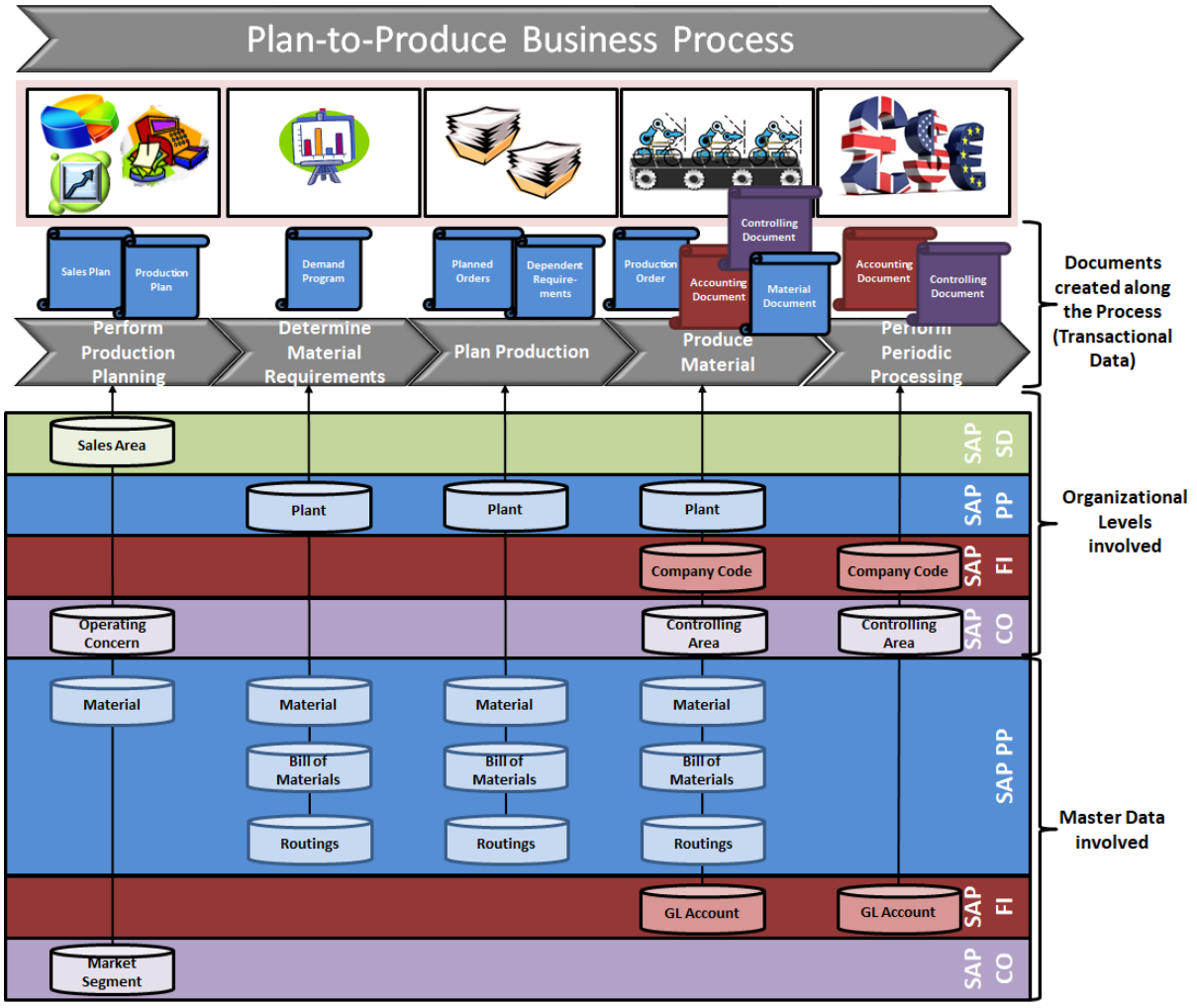


Figure 52: Business Process Example: Design-to-Operate

3.1 Theory: Production Planning in S/4HANA

This chapter introduces the first part of the production planning and control process (Design-to-Operate). The production planning process encompasses sales forecasts, sales plan, and production plan creation as well as transferring the resulting demand plan to the material requirements planning. Material Requirements Planning (MRP), then determines the materials required for production and therefore creates planned orders, purchase orders, and/ or purchase requisitions.

The "control" part (production execution) is discussed in a later chapter. In this chapter we will focus on the production planning part.

The following figure displays the standard **Design-to-Operate** business process. The process and its individual steps may vary significantly between different companies depending on the company procedures, the products or services that are sold and other factors. SAP provides all tools and customizing settings to tailor this process to the business needs.

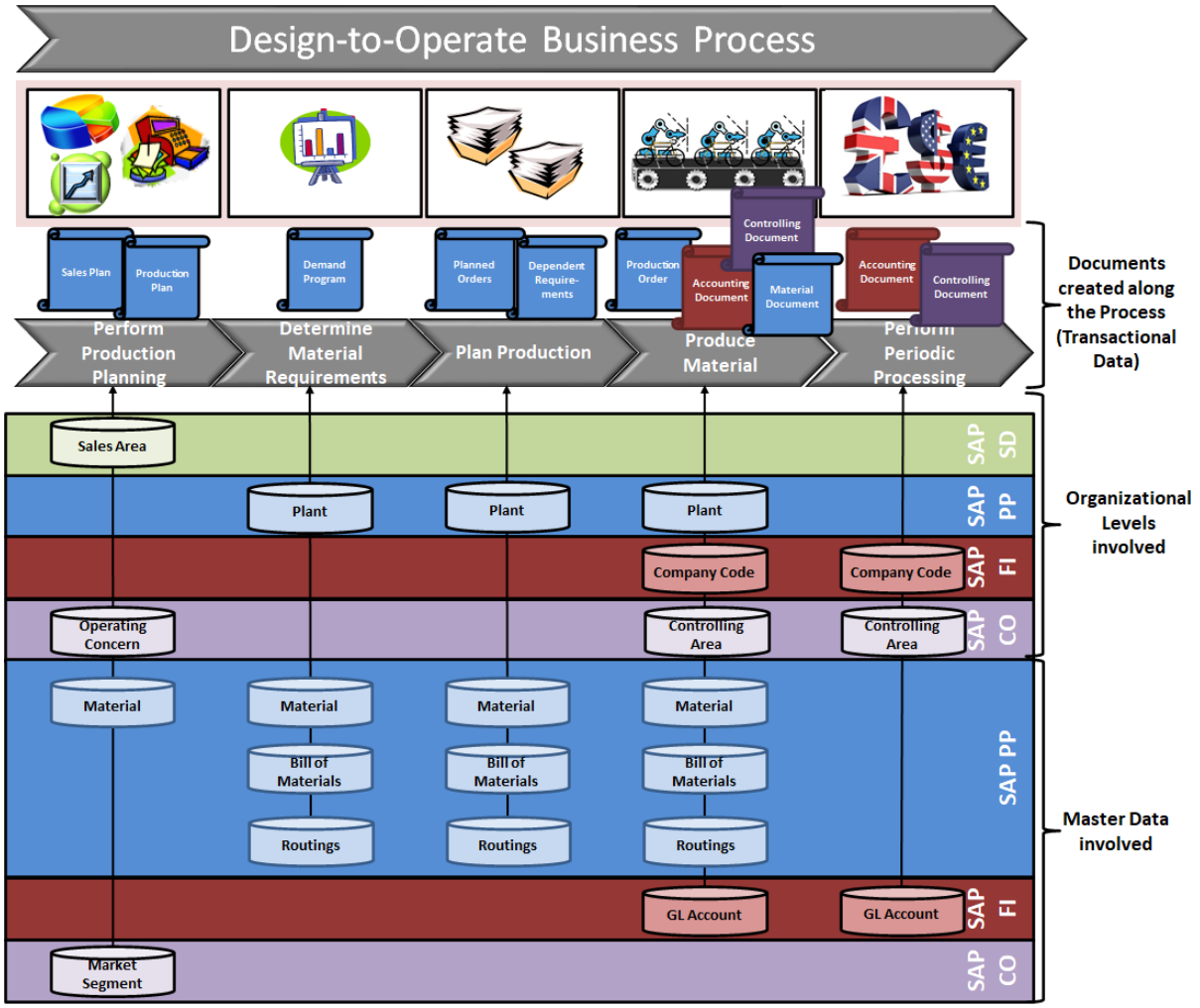


Figure 53: Design-to-Operate Business Process

Intelligent Enterprise: SAP S/4HANA and the Digital Supply Chain

The above-described business process encompasses all the process steps that take place in the digital core of the system landscape: the SAP S/4HANA system. This digital core is the system

of record, and handles all operational transactions for production planning, procurement, sales and distribution including Available-to-Promise (ATP) and connecting into the shop floor. However, SAP offers various solutions that extend the scope of the Design-to-Operate business process to the entire supply chain of the company and seamlessly integrate the process with suppliers, customers, procurement channels, and powerful analysis tools.

The following figure displays an example of the extended Design-to-Operate business process.

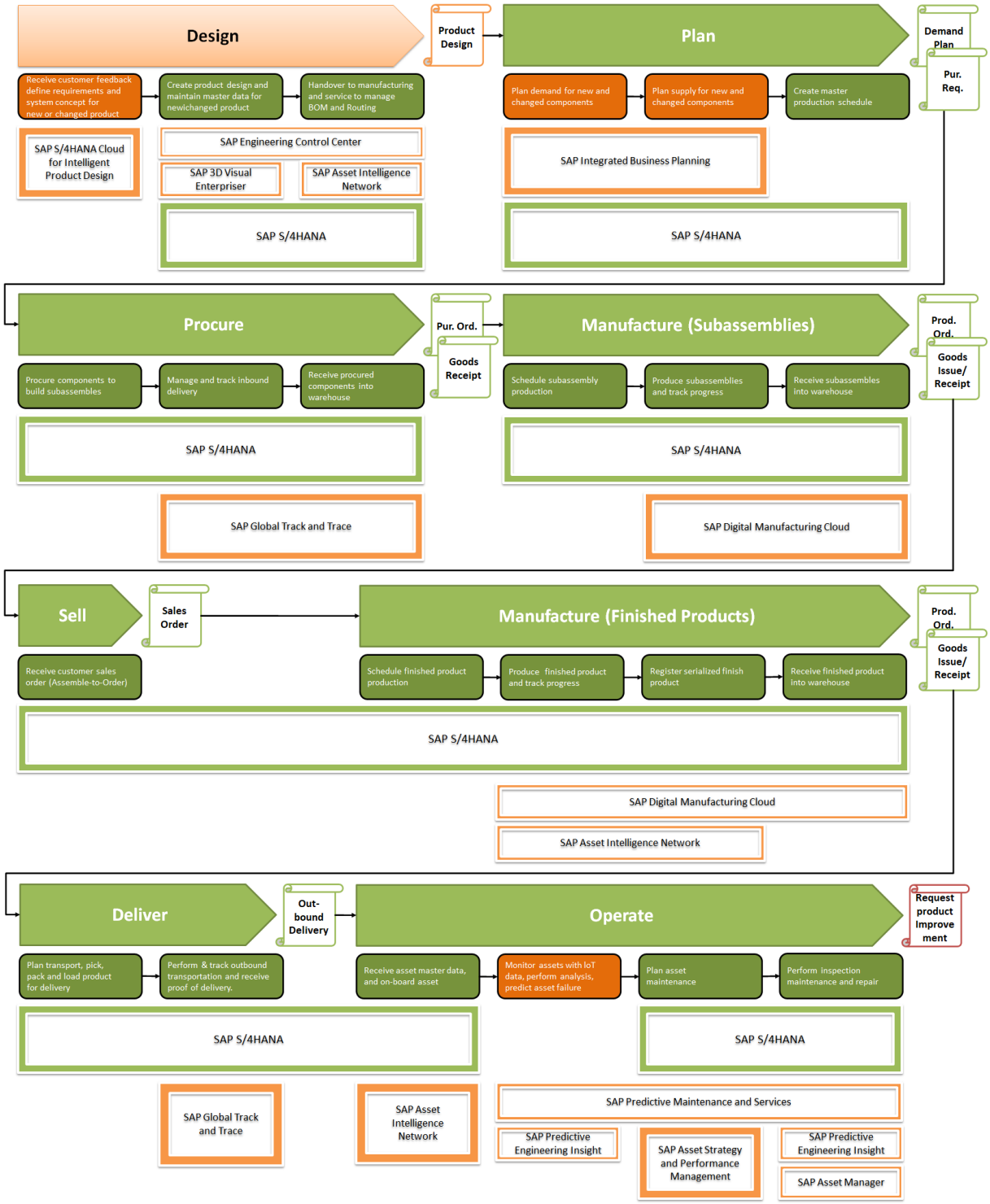


Figure 54: Extended Design-to-Operate Business Process (blogs.sap.com)

The Design-to-Operate business process is the digital Supply Chain & Manufacturing contribution to the Intelligent Enterprise Suite, primarily from a manufacturer and operator perspective, with a general focus on manufacturing industries in the standard delivery of the SAP S/4HANA system. SAP S/4HANA Design to Operate enables the end-to-end digital supply chain – from design and planning to manufacturing, logistics, and operations. The process seamlessly connects the entire supply chain, enriches it by intelligent technologies across all phases of the digital supply chain that includes Design, Plan, Manufacture, Deliver, and Operate solutions and creates a digital mirror of the entire value chain. The digital mirror provides consistent visibility and execution across all operational phases. Work and data flows span functional silos, leading to greater flexibility and consistency. Businesses can also simulate the impact of decisions at each step within the value chain and maximize their business innovation potential. These capabilities help reduce financial and operational risk through early detection and boost customer satisfaction through faster issue resolution.

3.1.1 Perform Production Planning

Before the production of materials can be carried out, this must first be planned. First of all, the production costs have to be determined in order to determine the production unit costs. Then a sales plan can be determined on the basis of different forecasting methods and transferred to the program planning in the form of independent requirements. Once the independent requirements have been determined, material requirements planning can be carried out to determine the material requirements at all levels of the BoM. The production planning is then completed with the capacity planning on the involved work centers.

3.1.1.1 Product Cost Controlling (SAP CO-PC)

In this chapter, we will focus on Product Cost Planning, which is an area of the Management Accounting sub-component Product Cost Controlling. First, we will provide an overview of the three general areas of Product Cost Controlling that all deal with product costs and prices.

3.1.1.1.1 Overview of the Components of CO-PC

The sub-component Product Cost Controlling (SAP CO-PC) of Management Accounting (SAP CO) deals with the planning of costs of production and services as well as tracking and analyzing actual costs. Therefore, it provides the following components:

- Product Cost Planning (SAP CO-PC-PCP)
- Cost Object Controlling (SAP CO-PC-OBJ)
- Actual Costing / Material Ledger (CO-PC-ACT/ML)

Product Cost Planning (SAP CO-PC-PCP)

The product cost planning component is used to calculate the manufacturing costs for production goods or services. It thus enables the planning of production costs for a material independently of a specific production order. The calculation can be based on quantity structures (bill of materials and routings) as well as value structures (material prices, performance prices, process prices, overhead costs) within the company.

The integration with Production Planning (SAP PP) allows to carry out the calculation automatically (**calculation with quantity structure**) by using the data of the quantity structure (BoM and routing) of a product. This means that the BoM components (materials that make up

the product) and the routing operations (work steps in work centers that are used to manufacture the material) are automatically included as costing items and valuated with the prices stored for them. By using the **batch input method**, quantity structures can be transferred from an external system (non-SAP system) to the SAP S/4HANA application.
Costing items can also be entered manually as part of **unit costing** or during ad-hoc-costing (**costing without quantity structure**).
The result of Product Cost Planning is a **Cost Estimate** that is updated into the material master as standard price. This standard price is then used in different processes that involve this material (e.g. production process for the material) to calculate the planned costs for the process. Product Cost Planning takes place before the production process.

Cost Object Controlling (CO-PC-OBJ)
The Cost Object Controlling area allows collecting costs (e.g., for materials and activity types) that incurred during the production of a product or a service and posting these costs on the particular cost objects that consume these resources. Cost objects that can collect costs during their processing are, e.g., sales orders, production orders, process orders, and production orders. The main tasks of CO-PC-OBJ are **simultaneous costing** and **period-end closing**:

- ***Simultaneous costing***: By assigning and valuating the logistical quantity flows this component provides real-time cost management functions that determine the cost of goods manufactured while they occur. For instance, actual production costs (performed activity types) are cumulated alongside material consumption (used raw materials) while the work is completed in a production order. The cost information collected during the production process allows comparing planned and actual costs at any stage of the production process.
- ***Period-end costing***: Once the production process has been accomplished, period-end closing calculates the value of goods in production (work in process), the production scrap, as well as variances between the product cost estimate (CO-PC-PCP) and the actual costs (CO-PC-OBJ) and carries out periodic-specific profit and variance calculations. The results of the period-end costing activities for cost collectors are settles Profitability Analysis (CO-PA) and Financial Accounting (FI). The cost settlements are also considered in the Actual Costing with Material Ledger component and influence the actual material costs in the Material Ledger.

Cost Object Controlling takes place during the production process.

Actual Costing/Material Ledger (CO-PC-ACT/ML)
The Material Ledger is the basis of actual costing. Actual costing using the Material Ledger is responsible for providing the actual cost of each material at the end of each period. It enables material inventories to be valuated in multiple currencies and allows the use of different valuation approaches. Each valuated goods movement for a material is, generally, valuated with the materials standard price during the period. A goods movement could, for instance, be a goods receipt from production process, once the production process has been accomplished. If variances of the material price compared to the standard price incur, e.g., due to variances in the production process, the variances can be collected in the material ledger when the production order is settled. During period-end closing, these variances are used to calculate an

actual price for the material in the closed period. Actual Costing with Material Ledger updates prices after the production process has been accomplished.

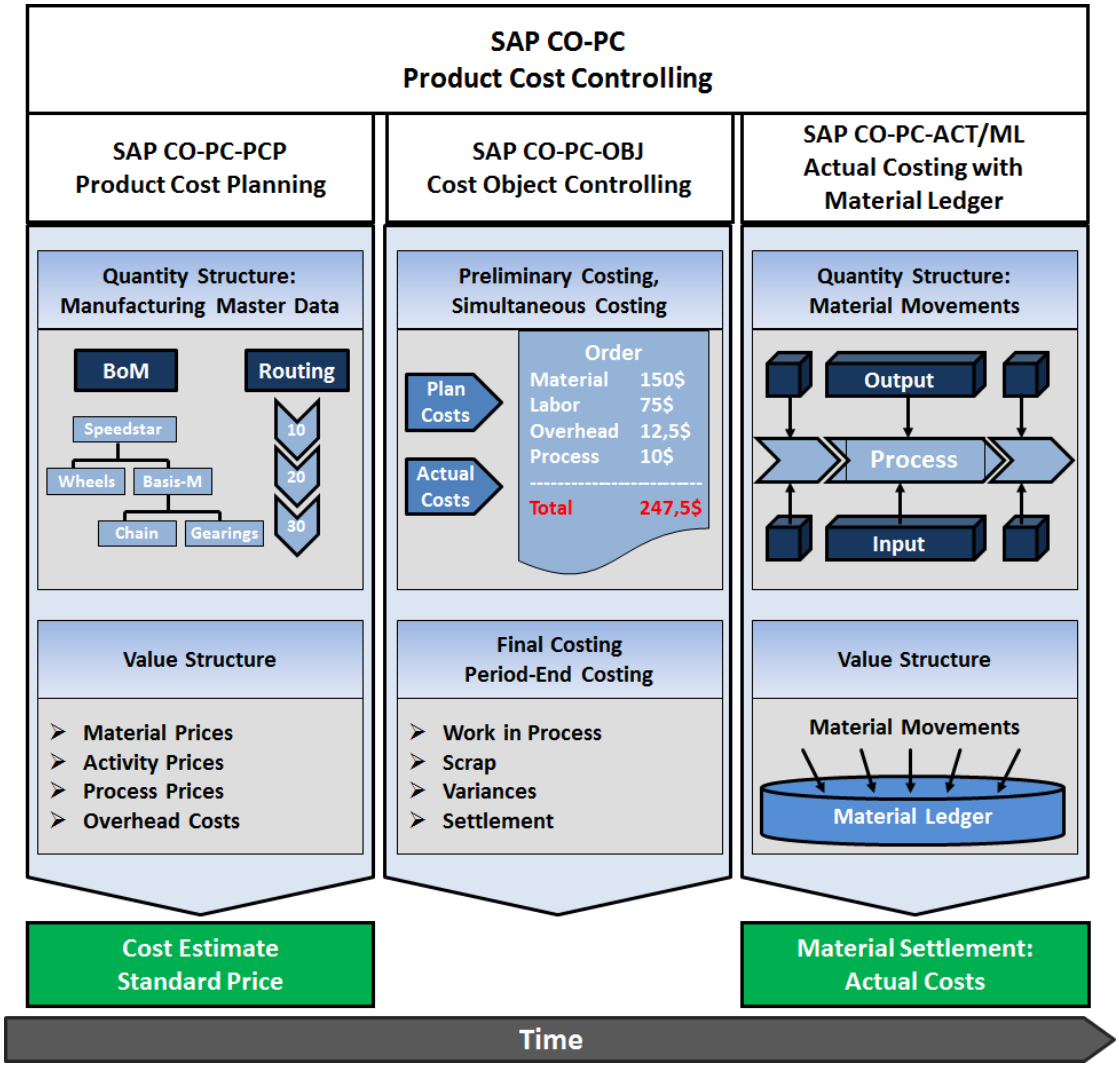


Figure 55: Overview of CO-PC (based on SAP Online Library)

3.1.1.1.2 Product Cost Planning (CO-PC-PCP)

Product Cost Planning is used to analyze the costs of products in a company such as:

- Manufactured materials
- Services
- Other intangible goods

CO-PC-PCP helps providing answers to questions such as:

- What is the value added of a particular step in the production process?
- What proportion of the value added can be attributed to a particular organizational unit?
- What is the cost breakdown including primary costs or transfer prices?
- How high are the material, production, and overhead costs?
- How can production efficiency be improved?
- Can the product be supplied at a competitive price?

Product Cost Planning (PCP) enables employees to make informed operational decisions for manufactured products by providing the following detailed information:

- Cost of goods manufactured, and the cost of goods sold
- Calculation of the break-even price for the product
- Comparison of production cost for large and small lot sizes
- Production cost breakdown and comparison, for example, material costs and wages
- Optimization of the production process
- Production cost by organizational unit
- Manufacturing cost by plant
- Effect of primary costs on production costs

Product Cost Planning encompasses the following components:

- Cost Estimate with Quantity Structure
- Cost Estimate without Quantity Structure
- Price Update
- Reference and Simulation Costing
- Easy Cost Planning and Execution Services

Of these components *Cost Estimate with Quantity Structure* and *Price Update* are of particular interest within the Design-to-Operate business process.

3.1.1.1.2.1 Cost Estimate with Quantity Structure

As mentioned afore, the CO-PC-PCP component automatically determines the quantity structure of a material from its manufacturing planning master data and calculates the product cost estimate based on this data.

When creating the product cost estimate with quantity structure using transaction CK11N or the Fiori UX App *Create Material Cost Estimate*, the user must enter the following information:

- **Material**: The material for which the cost estimate is to be performed
- **Plant**: The plant for which the product cost estimate should be valid.
- **Costing variant**: The costing variant is a control parameter and determines how the cost estimate is created. For instance, it defines if planned or actual prices are used, which dates are proposed, how the quantity structure is applied, etc.
- **Costing version**: Versions in Controlling allow creating multiple parallel plans. Costing versions for product cost estimates allow creating parallel product cost estimates for the same material.
- **Lot size**: The quantity of materials for which the cost estimate is calculated.
- **Dates** proposed from the costing variant:
  - The period of validity of the cost estimate (costing date from or to)
  - The selection date for the BOM and routing (quantity structure dates)
  - The pricing data for the material components and activities (valuation date)

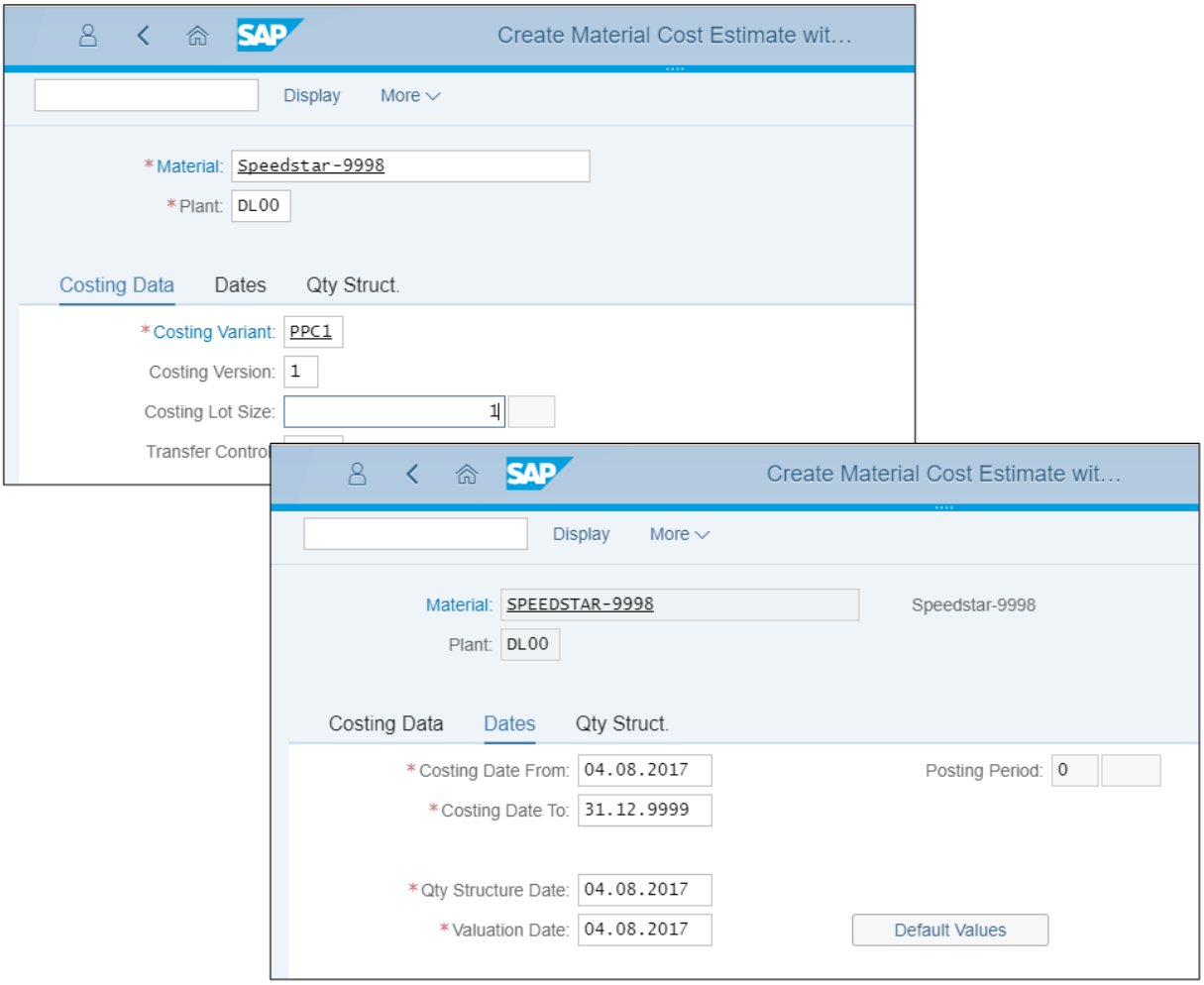


Figure 56: Cost Estimate with Quantity Structure (1): SAP-System-Screenshot

Once the product cost estimation run has been executed, the costing results can be displayed and saved as

- **Itemizations**: The itemization view displays detailed information about the origin of the costs. This includes the quantities and prices of the materials and internal activities that – according to the quantity and value structure – are used to produce the material.
- **Cost-element itemizations**: The cost-element itemization view displays the individual costing items as cost elements ordered in the sequence of their appearance. Cost elements are determined:
  - through account determination for materials
  - through activity type master record, or through activity type planning for activities
  - through the process master record for processes
- **Cost-component splits**: The cost-component split view displays the cost elements into cost components. When a multi-level structure is valued, the cost component split rolls up so that the original identity of the costs is retained for analysis.

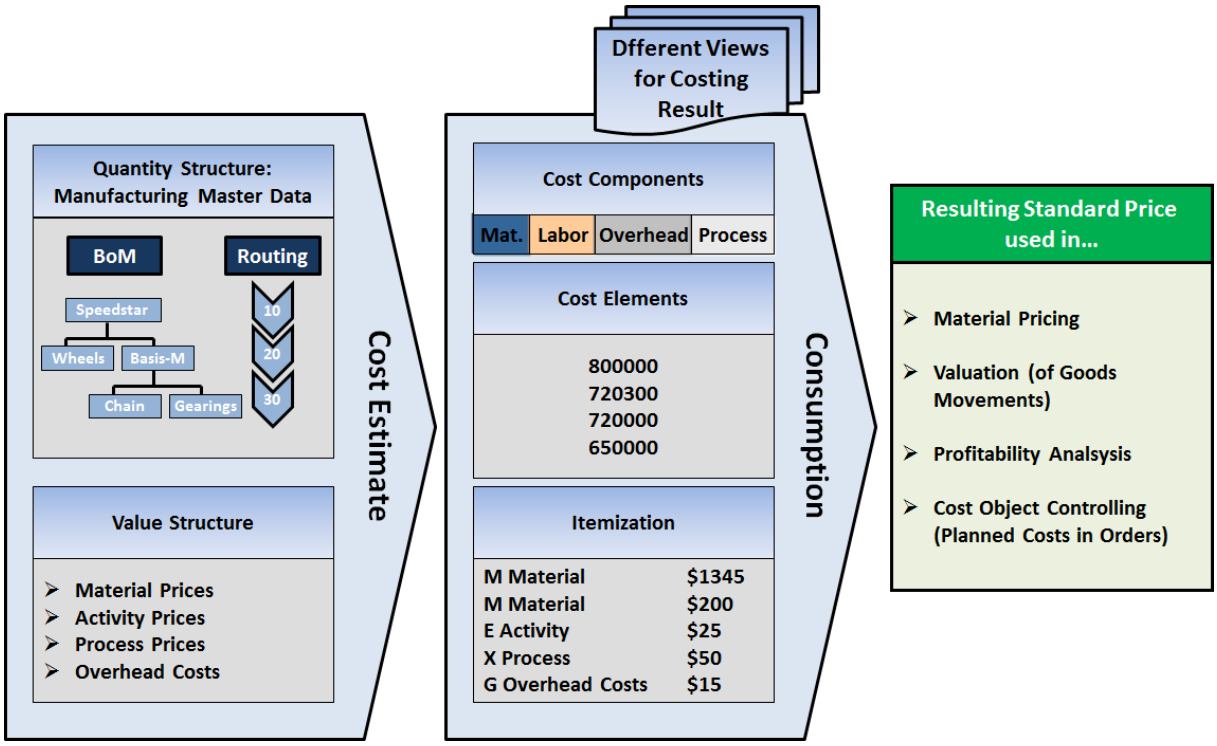


Figure 57: Elements of Product Cost Planning (based on SAP Online Library)

In the following figure, you can see the product cost estimate for material Speedstar. At the bottom of the screen the itemization view is displayed. It contains the individual materials (itemization category M) and activity types (itemization category E) that – according to the quantity and value structure – are used to produce the material. In addition to the quantities, the prices and assigned cost elements are displayed.

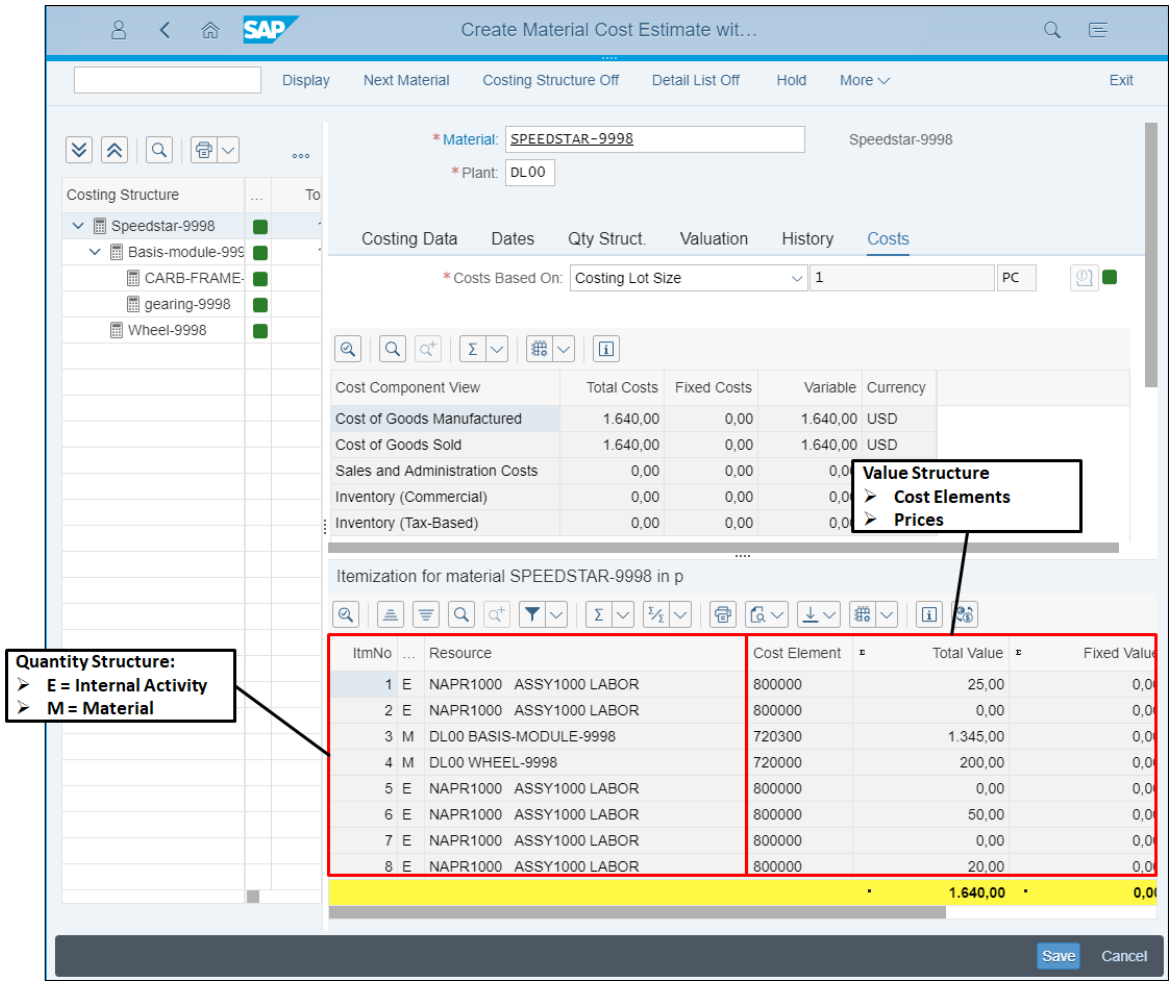


Figure 58: Cost Estimate with Quantity Structure (2): SAP-System-Screenshot

3.1.1.1.2.2 Price Update

The next step after calculating a product cost estimate in CK11N is to transfer the new standard price to the material master where the price fields are updated. This price update process is carried out in transaction CK24 or Fiori UX App *Release Material Cost Estimate* and always requires specifying the ***material, company code***, ***period*** and ***fiscal year*** as well as the ***costing version***. The price update process and consists of two steps:

- **Marking** the new Standard Price: In the first step, you mark the new cost estimate price for release. The system writes the new price into the ***Future Planned Price*** field in the ***Costing*** view of the material master. The new price can now be used to valuate a material component in the cost estimate. For instance, if you calculate an estimate for the Basis-module, which is a component of the Speedstar and mark the new price, then this new price is used, when the cost estimate for the Speedstar is calculated.
- **Releasing** the new Standard Price: In the second step, you release the new price. The system transfers the new price form the Future Planned Price field into the ***Current Planned Price*** and ***Current Standard Price*** fields. As of the period at which the new price is released, the new price is active for all valuation processes in SAP FI for this material. This includes all transactions involving products produced in-house that are valuated in the Logistics module using the standard price. Whether a material is valuated via ***standard price*** or ***moving average price*** is determined by the setting of the **price control indicator** in the material master.

For instance, if a material, for which is standard price control is set, is delivered to stock, inventories of this material are valuated with the standard price as determined by the standard cost estimate. This provisional valuation can be corrected at a later date following the settlement of the actual costs that occurred in the period.

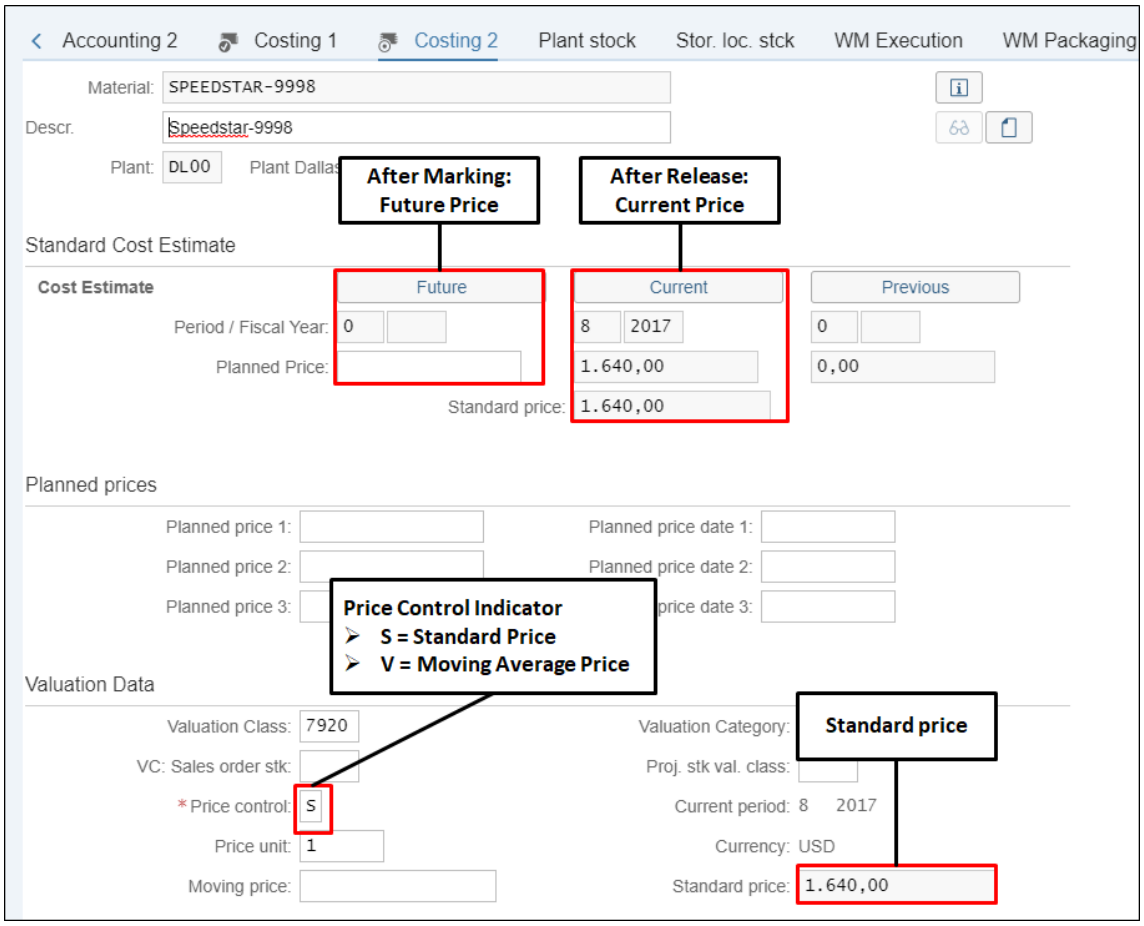


Figure 59: Price Update Process and Material Price: SAP-System-Screenshot

When performing product cost estimates, you should consider the following pre-requisites and restrictions for marking or releasing a standard cost estimate:

- A standard cost estimate can only be marked and released if it does not contain any **errors** (status KA, valued without errors).
- The **marking allowance** must have been set in CK24 for the period in which the marking and release of a new price is to take place. The employee that sets the marking allowance must have sufficient authorizations. The marking allowance is set for the combination of a company code, a costing variant, and a costing version.
- Only **one** standard cost estimate can be **released per period**. If an erroneous estimate is marked or released, it must be deleted first from the database (using a special transaction). Then a new standard estimate can be calculated and marked/released. Deleting released cost estimates should be handled with care as this could lead to major inconsistencies in the material valuation, e.g., if a process had already be run with the wrong standard price. Thus, it is strongly recommended to check any product cost estimate for correctness before it is released. Therefore, specialized reports are available in the information system of the SAP system.

3.1.1.1.2.3 Integration of Standard Price and Standard Cost Estimate

As mentioned before, **product cost estimation** and the **standard price** of materials have great impact on any processes that involve material valuations (e.g. goods receipts, goods issues, in-house production processes, etc.). We have also mentioned that the value set for the price control indicator (S or V) controls which price is used in the valuation of materials. Consequently, many integration points exist between SAP CO-PC-PCP and other components of the SAP system:

- **Cost Object Controlling**: After a standard price has been updated by a released product cost estimate for material, it is used in SAP CO-PC-OBJ when e.g. orders are created that include this material. The itemization of a standard cost estimate for a material is used to determine the target costs (planned costs) within a production order with which the material is manufactured. While the production order is processed all the actual costs being posted to the production order (which is a cost object), can be analyzed against these target costs. In this way variances between the target cost and actual cost are determined at the level of variance categories, such as quantity input and price variances. The saved itemization provides the basis for variance calculation.
- **Profitability Analysis**: In profitability analysis (CO-PA), product cost estimates (standard or any other product cost estimate) are used to compare the revenues generated from the billed quantities of the material with the cost component split of the product (costs of sales).
- **Material Valuation**: The price control indicator in the material master determines how material valuation takes place. When the price control indicator field is set to S, the inventory is valuated at the standard price. Goods movements are valuated directly in the system using a price selected in accordance with the price control indicator (S or V).
- **Material Ledger**: A standard price is also required in the material ledger to determine the actual price.

3.1.1.2 Planning Product Demand

In SAP ERP, product demand was forecasted and calculated using the Sales and Operations Planning application. In SAP S/4HANA, this application can still be used, but will be completely replaced in the medium term by the new heavily improved Integrated Business Planning application. In this chapter we will briefly introduce both planning functions.

3.1.1.2.1 Excursus: Sales and Operations Planning

SAP provides two different approaches to perform Demand Planning: *Flexible Planning* and *Standard Sales and Operations Planning*.

Flexible Planning provides more flexibility when creating the future sales plans. However, you can, and to a large extent, have to use the relevant information structures and planning types to create settings for flexible planning. This requires a detailed understanding of the structures of the Logistics Information System (LIS).

Standard Sales and Operations Planning (SOP) is a pre-configured forecasting and planning tool with which sales, production, and other supply chain targets can be set for products or product groups on the basis of historical, existing, and estimated future data. Rough-cut

planning can also be carried out using feasibility estimates (master plan, capacity estimates) to determine the amounts of the capacities and other resources required to meet these targets. SOP is generally used on the aggregated level of product groups and work center hierarchies and is particularly suitable for long- and medium-term planning.

The information used in SOP originates from several sources. These sources can be:

- *Sales*: historical and actual sales figures, sales figure forecasts
- *Marketing*: market research
- *Manufacturing*: historical and actual production plans and resource capacities
- *Accounting*: historical and actual revenue data
- *Human Resources*: personnel resource availability
- *Purchasing*: historical and actual purchasing requirements and orders
- *Intra-firm Collaboration*

In general, the SOP process consists of three steps:

- The forecasted sales data is entered in the **planning table** of SOP and build the future **sales plan**.
- A **production plan** can be developed based on a sales plan. In a production plan, you plan the quantities you need to produce in order to meet your sales plan taking -defined stock target or days' supply entries etc. into account user.
- In **rough-cut capacity plan** resource leveling for the production quantities of a product group or material is performed. Thereby, the following resources can be used: work center capacities, materials, production resources/tools, and costs.

The results of the SOP are sales plans, production plans, and resource requirements. These plans are planned on aggregate level in time buckets and are passed as **plan independent requirements** to **demand management** for further detailing of the production planning.

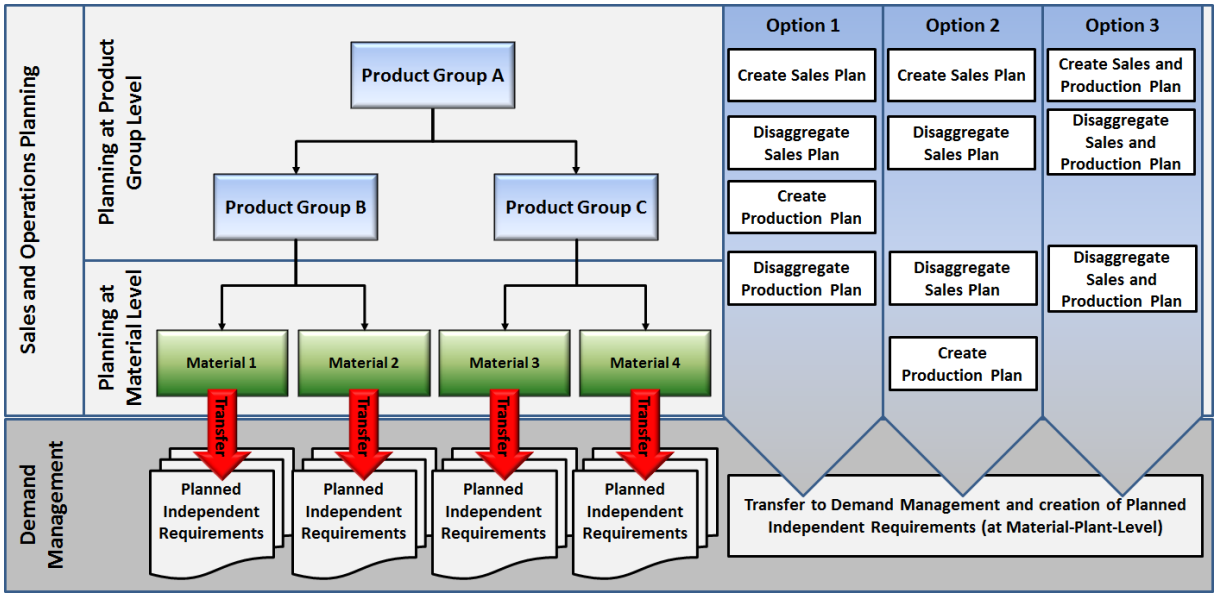


Figure 60: Disaggregation and Transfer to Demand Management

3.1.1.2.2 Integrated Business Planning

Sales & Operations Planning (SOP) is still available in SAP S/4HANA but considered as a bridge or interim solution. It will be replaced by Integrated Business Planning (IBP) which allows a stepwise system conversion from SAP ERP's SOP to IBP in SAP S/4HANA. Therefore, SAP recommends doing only reasonably investments in the classic PP-SOP.

Integrated Business Planning supports all SOP features plus advanced statistical forecasting, multi-level supply planning, an optimizer, collaboration tools, an Excel-based UI, and Web-based UIs. By using SAP IBP for Sales and Operations companies can achieve the following business values:

- State of the art business processes that enable new end-to-end business processes, models, and revenue streams.
- Synchronized planning processes that eliminate planning silos through connected and integrated planning processes.
- End-to- end visibility that provides visibility on strategic, tactical, and operational levels across internal ana external data.
- Faster planning cycles that react faster to changes in the business through complete integration across the supply chain.

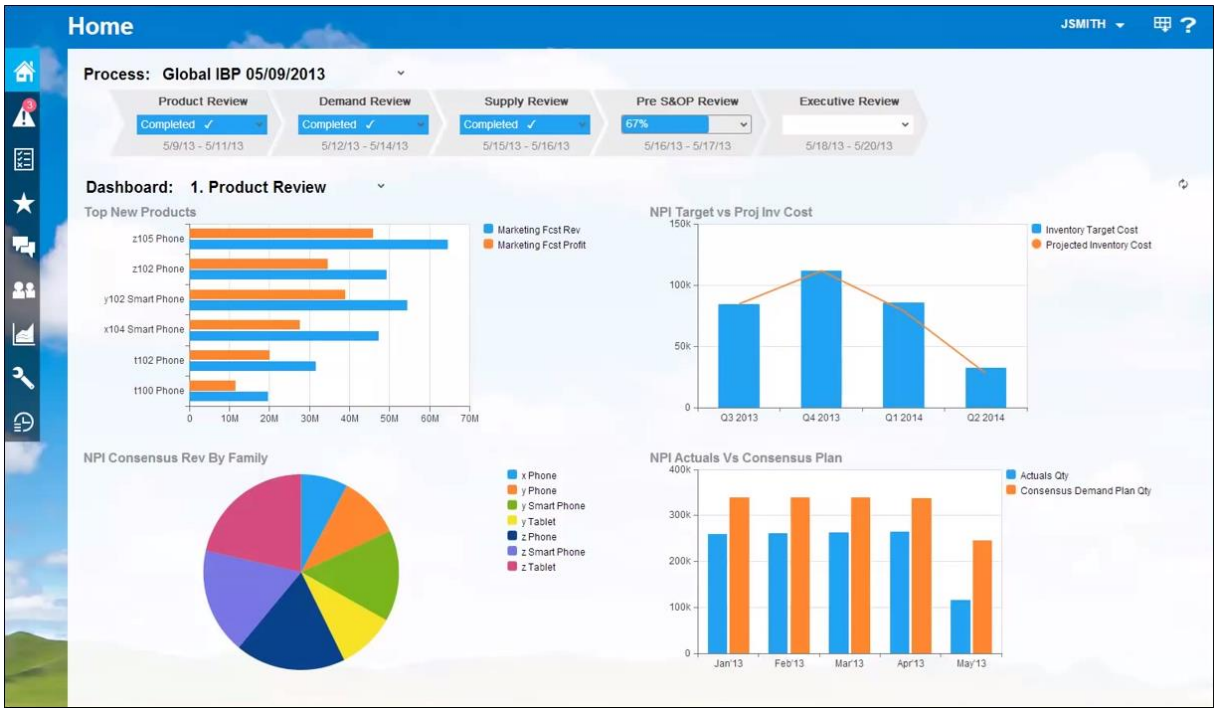


Figure 61: Integrated Business Planning for SOP – Preview (SAP.com)

Integrated Business Planning encompasses the following key capabilities:

- Creation of optimal business plans to drive revenue growth and increase market share
- Balancing demand and supply effectively while achieving financial goals
- Improvement of forecast accuracy and on-time delivery
- Increasing speed and flexibility of planning and increase profitability
- Modeling of multiple tiers of the supply chain network including customers distribution centers, plants, and suppliers

- Modeling multiple level BoMs as a constraint
- Generation of plans for distribution, production, and procurement

The shop floor information system used in SAP PP is a subset of the Logistics Information System LIS. LIS is used to compare planned vs. actual parameters like lead time, execution time, queue times, scrap, etc. The classic ERP utilization of the LIS has several drawbacks:

- LIS operates on redundant data since every business transaction in Logistics not only updates the business documents, but also pre-aggregated data in LIS. This leads to performance decrease, possible locking conflicts, and memory wastage.
- LIS operates on pre-aggregated data and, therefore, does not provide the possibility to drill down into the individual business documents. Multi-dimensional reporting (aka slicing & dicing) is only possible for dimensions provided in the pre-aggregated data.
- LIS uses an old UI technology making multi-dimensional reporting clumsy.
- LIS only supports material numbers with up to 30 characters.

Future production analytics in S/4HANA will be based on the HANA database. Transactional data generated in business processes will be aggregated when needed (on-the-fly) using SAP HANA CDS views. Powerful analytical UIs for multi-dimensional reporting will be provided as reports embedded into business processes. With this it will be possible to replace the current LIS.
However, the classic LIS and the future production analytics will still be used in parallel for some time as long as the update of the LIS tables are not switched off. Once future production analytics supports all analytics requirements, you can switch off the update of the LIS tables. Once you have switched off updating LIS tables, you will notice the following improvements:

- Improved performance of many transactions (fewer tables to update, fewer locking conflicts)
- Less memory required

3.1.1.3 Elucidation: Demand Management

For the sake of completeness, we will explain in this chapter, how the calculated (forecasted) production plan with its planned independent requirements are used in Demand Management to generate the demand program, which is then passed down to MRP to determine the dependent material requirements. Note that this is an elucidation chapter, and that elucidations are ***not relevant*** *for the* ***SAP exam****. They are only meant to give you a better understanding of the topic at hand.*

So far in the Design-to-Operate business process you have estimated future sales in Demand Planning (Standard SOP or IBP) as well as created the sales and production plans. The ***demand plan*** is then released to Demand Management as planned independent requirements. Demand Management deals with the administration of these planned independent requirements. It uses the ***planned independent requirements***, ***sales orders*** from the Sales and Distribution, and ***stock transfer postings*** from other plants to create the ***demand program***, which is later on utilized by Material Requirements Planning.

3.1.1.3.1 Requirement Types in Demand Management

As stated previously, **Demand Management** deals with the administration of the so-called **independent requirements**. Independent requirements are quantities of a ***finished product*** that are required in a plant due to

- **Planned Independent Requirements – Demand Plan**: The results of Demand Planning are *planned independent requirements* that depict the assumed (predicted) future requirements for finished goods due to forecasts and SOP. The demand plan thus, creates **planned** independent requirements with quantities of the product that the company will likely sell in the planning horizon.
- **Customer Independent Requirements – Sales Orders**: Customer requirements are created in sales order management and depict concrete requests by the customers for a specific product. Thus, customer requirements are not planned (predicted) sales figures but **real** independent requirements that need to be satisfied by the company's production at the specified date. Thus, they also create a requirement for a finished good and must be considered by Demand Management.
- **Stock Transfer Requirements – Stock Transfer/ Stock Transport Orders**: When another plant in the company requires a material, it can also consider internal procurement. Therefore, a stock transfer is used, which leads to the creation of a stock transfer requirement in the supplying plant. These requirements are also **real** independent requirements that must be considered by Demand Management and included in the demand program.

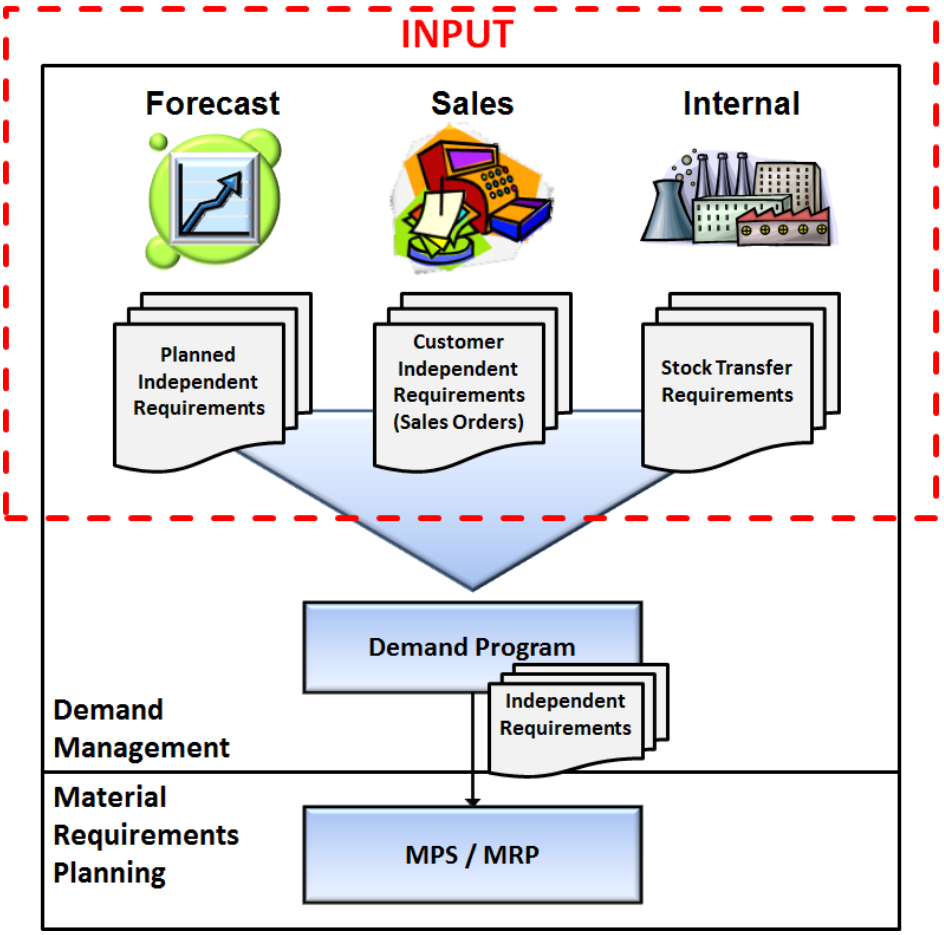


Figure 62: Input: Requirement Types in Demand Management

Consequently, we have planned independent requirements for a material on the one hand and "real" independent requirements on the other hand. The way in which these independent requirements behave and how they are considered in the **Demand Program** and in Material Requirements Planning (e.g., if real requirements affect or consume planned requirements) is determined by their **planning strategy** and the **consumption mode**.

3.1.1.3.2 Planning Strategies

With planning strategies, you determine the business procedures for the planning of production quantities and dates. SAP provides a wide range of production planning strategies, which offer a large number of different options ranging from pure make-to-order production to make-to-stock production. Depending on the strategy that is set for a particular finished or semi-finished product, you can:

- use sales orders and/or sales forecast values to create the demand program
- move the stocking level down to the assembly level so that final assembly is triggered by the incoming sales order
- carry out demand management specifically for the assembly

What planning strategy is used for a particular finished or semi-finished product in demand management is set in the material master data record of the material in the field *Planning Strategy (Planning Group)* of the MRP view.
Depending on a company's production requirements, multiple types of planning strategies can be used. SAP provides a magnitude of different pre-defined planning strategies. In this course, we will only discuss the following planning strategies:

- Make-to-Stock (MTS)
- Make-to-Order (MTO)

Planning Strategies for Make-to-Stock (MTS) Production

This planning strategy is designed for planning procurement (production or purchasing) of components by planning the final products. It is used, if:

- The materials are not segregated. In other words, they are not assigned to specific sales orders.
- Costs need to be tracked at material level, and not at sales order level.

Thus, this strategy is used for covering planned independent requirements from SOP and to cover future sales orders by previously produced stock inventory. That is, in your forecast (predicted future sales quantities) the potential future sales orders are already considered. You use this planning strategy if you produce materials that are manufactured for stock in greater quantities and then delivered to customers from the quantities available on stock. These materials are generally of rather low value.
To set a material for make-to-stock strategy one of the following entries must be made in the material master (MRP 3 view) of the product:

- 10 – Net Requirements Planning
- 11 – Gross Requirements Planning
- 30 – Production by Lot Size
- 40 – Planning with Final Assembly

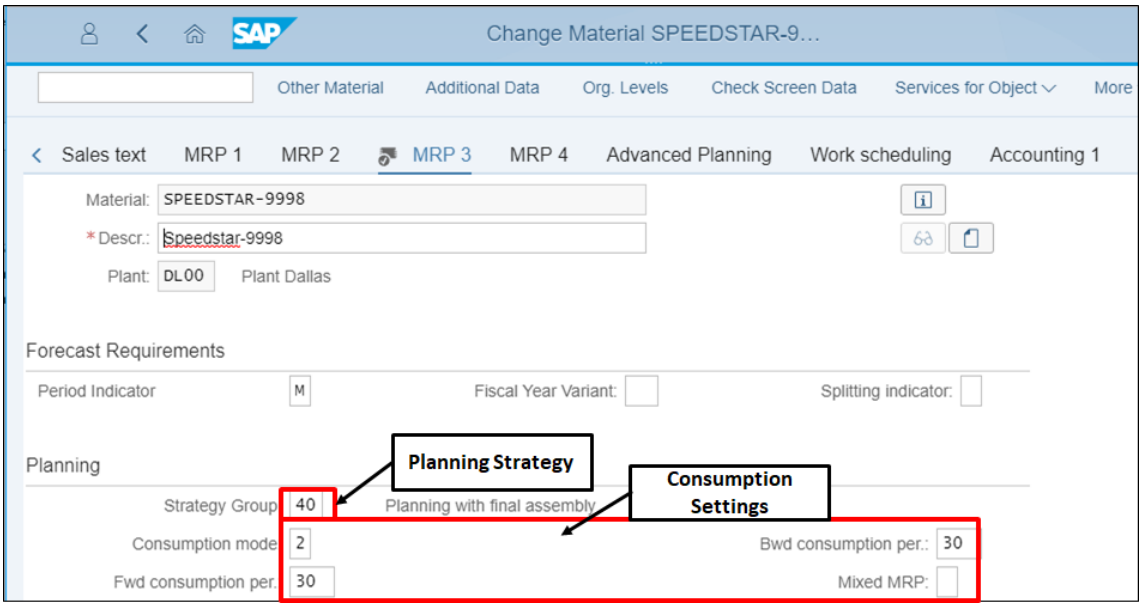


Figure 63: Planning Strategy in Material Master: SAP-System-Screenshot

Planning Strategies for Make-to-Order (MTO) Production

This planning strategy is designed for the production of a material for a specific individual sales order. That is, you do not produce the finished products until concrete sales orders are received from customers. This means that make-to-order strategies always support a very close customer-vendor relationship, since sales orders are closely linked to production. This strategy should be selected, if:

- The materials are segregated. That is, they are uniquely assigned to specific sales orders.
- Costs must be tracked at a sales order level and not on a material level.

Thus, in make-to-order strategy, planning takes place using customer orders and the production process starts with the receipt of a concrete sales order. You use this strategy, when you have products that are of very high value and you will start producing them, only after the contract with the customer has been signed. In this case, no planned independent requirements are necessary, and the sales order (created in SAP SD) creates the concrete customer requirement that is transferred into a production order

To set a material for make-to-order strategy one of the following entries must be made in the material master (MRP 3 view) of the product:

- 20 – Make to Order Production
- 50 – Planning without Final Assembly
- 60 – Planning with Planning Material

3.1.1.3.3 Consumption Mode and Consumption Period

The parameters **consumption mode** and **consumption period** together determine, how *actual requirements* (sales orders, stock transfer orders) consume *planned independent requirements*. Both characteristics are set in the MRP 3 view of the material master.

The parameter **consumption mode** determines in which direction of the time axis consumption of the incoming sales orders with the planned independent requirements is carried out:

- **Consumption mode 1** (**Backward Consumption**): Actual requirements consume planned independent requirements that are scheduled **before** the actual requirements.

- **Consumption mode 3** (**Forward Consumption)**: Actual requirements (sales orders, stock transfer orders) consume planned independent requirements that are scheduled **after** the actual requirements.
- **Consumption mode 2 (Backward/Forward Consumption)**: Actual requirements (sales orders, stock transfer orders) consume planned independent requirements that are scheduled **before** the actual requirements, first. If no planned independent requirements are scheduled before the actual requirements, the planned independent requirements that are scheduled **after** the actual requirements are consumed.
- **Consumption mode 4 (Forward/Backward Consumption)**: Actual requirements (sales orders, stock transfer orders) consume planned independent requirements that are scheduled **after** the actual requirements, first. If no planned independent requirements are scheduled before the actual requirements, the planned independent requirements that are scheduled **before** the actual requirements are consumed.

The **consumption periods (before/ after)** determine the time period before and after the actual requirement that is checked for planned independent requirements that could be consumed. If you do not enter a value for the two characteristics, the default setting, (i.e. backward consumption for 999 days) is applicable. Also consider that if you enter a consumption mode but no consumption period, only requirements of the same day are consumed.

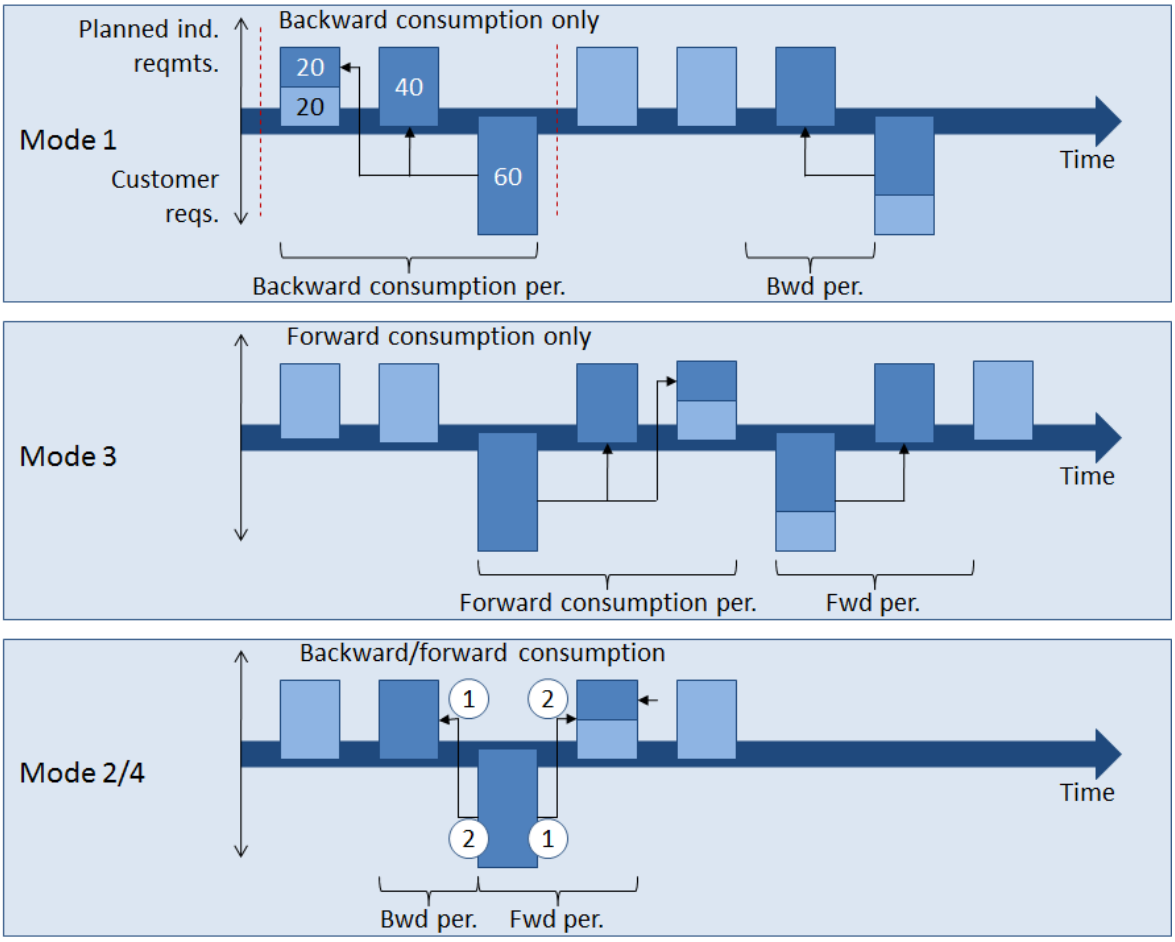


Figure 64: Consumption

Example 1:

- You have planned independent requirement for the 15th of August and 15th of July.
- You have set forward consumption (consumption mode 3).
- You have a consumption period of 1 month.
- Now you receive a sales order with the date of 16th of July. This sales order then consumes the planned independent requirement from **August**.

Example 2:

- You have planned independent requirement for the 15th of August and 15th of July.
- You have set a combined consumption (consumption mode 2 or 4).
- You have a consumption period of 1 month.
- Now you receive a sales order with the date of 29th of July. This sales order then consumes the planned independent requirement from **July**, since the July requirement is closer to the sales order date.

3.1.1.3.4 Demand Program

The purpose of **Demand Management** is to determine requirement quantities and delivery dates for finished products assemblies. Demand management is the link between SOP and detailed planning (MPS and MRP). Therefore, Demand Management uses planned independent requirements and customer requirements as well as potential stock transfer requirements to create a **demand program**.

The independent requirements are the foundation for building the demand program. That is, from all the independent requirement types, which are input to the Demand Management, the SAP system calculates the independent requirements that are included in the demand program based on the specific planning strategy of the given material.

Thus, to create the demand program, the ***planning strategy*** for a product (finished good) must have been defined beforehand. By using these planning strategies, you can determine if production is triggered by sales orders (make-to-order production), or if it is not triggered by sales orders (make-to-stock production) but rather manufactured for stock. For the later, future sales orders are supplied by the products from stock.

In reality, you often have strategies that range somewhere in between these two planning strategies. Thereby, in many cases, production figures are planned ahead in order to prevent long waiting times for the customers, being able to immediately react to customer requests, as well as set up a smooth production flow. Thus, you have planned independent requirements that arise from prediction of what quantities of the product the company will sell in future. When actual requirements occur in form of sales orders or stock transfers, they are offset against the planned independent requirements. This means that actual requirements reduce the quantities of planned independent requirement.

Example
A sales order (customer independent requirement) with a quantity of 50 Speedstars is created in the SAP SD application. This creates a requirement for Speedstars with quantity 50 in

Demand Management. There are three options for how the MRP program deals with a sales order based on the planning strategy of the material:

- Sales orders are the exclusive requirement source for which specific procurement or production is initiated (make-to-order production). No consumption occurs as there are no planned independent requirements. The customer requirement is added to the demand program.
- Sales orders create the total demand together with the planned independent requirements from the forecast planning. If you have 75 Speedstars planned to be produced for the current period based on the forecasts and now you receive a sales order over 50 Speedstars, this will result in 125 Speedstars to be produced.
- Sales orders consume planned independent requirements. If you have 75 Speedstars planned to be produced for the current period based on the forecasts and now you receive a sales order over 50 Speedstars, this will result in 50 Speedstars to be produced and the reduction of the planned independent requirement to 25.

In case the sales order quantity exceeds the planned independent requirements quantity, a planned order is automatically created in the next MRP run for the quantity exceeding the planned independent requirement (unplanned quantity).
The output of demand management is the **demand program**, which is transferred to and used by MRP to create *planned orders*.

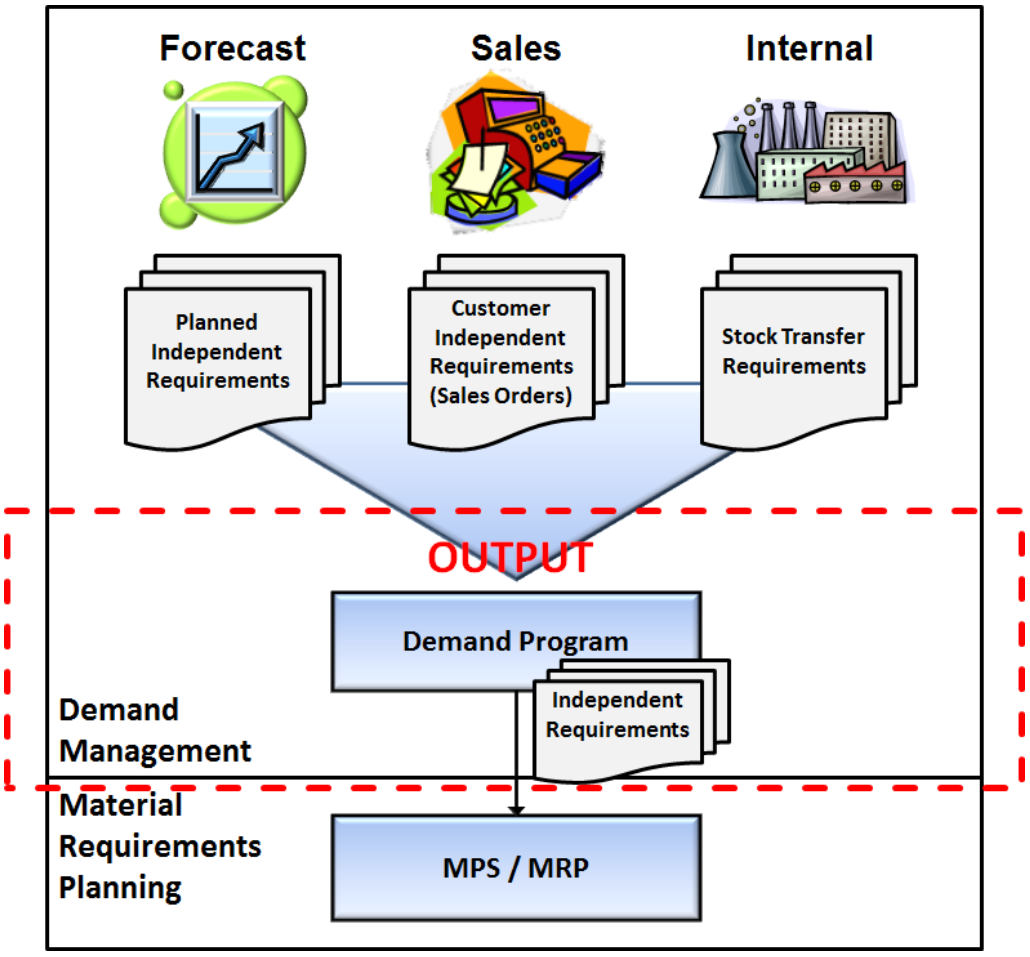


Figure 65: Output: Demand Program in Demand Management

3.1.2 Determine Material Requirements

Material Requirements Planning (or MRP) is a supply chain planning process. It is used along with other planning processes such as, Demand Planning, Supply Planning, Sales & Operations Planning, Production Planning, and Transportation Planning, to manage the supply chain activity of the enterprise. The central role of MRP is to match enterprise-wide supply with actual and forecasted customer demand to identify potential material shortage situations and to recommend potential solutions. Examples for the supply-side are materials in inventory, planned stock transfers, purchase orders, and good receipts from manufacturing. Examples for the demand-side are customer sales orders and forecasts of future customer demand.
Supply and demand requirements are location specific and MRP matching is performed to ensure that the materials are in the right location at the right time to fulfill customer demand.

MRP takes place on a very detailed planning level. Its purposes are:

- *Monitor inventory stocks*: Are the products that we sell and the materials that are required for production of these products available on stock in a sufficient quantity?
- *Determine material requirements*: What materials are required at what quantity and at what time?
- *Generate purchase or production orders*: If finished products and materials are not available on stock, purchase orders and production orders must be created to procure these materials.

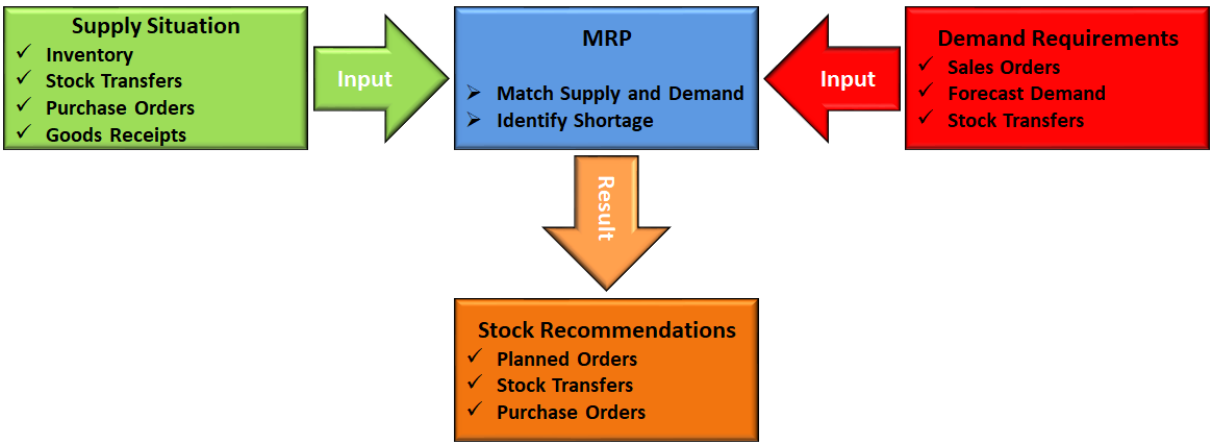


Figure 66: Material Requirements Planning (MRP)

3.1.2.1 Defining the MRP Process

The main function of material requirements planning is to ensure material availability, i.e. to procure or produce the required quantities punctually for internal purposes as well as for distribution. This process includes inventory control and, in particular, the automatic generation of procurement proposals for purchasing and production.

3.1.2.1.1 Net Requirements Calculation

Material Requirements Planning takes current and future sales as its reference point. The planned requirement quantities trigger the MRP calculation. In MRP, the requirements elements include sales orders, planned independent requirements, material reservations, the dependent requirements created by exploding the BOM, etc.

To do so, a **net requirements calculation** is carried out in the planning run to determine whether there is a shortage for any material, which is required as part for the production of the respective finished product (***independent requirement***).

Thereby, the system checks whether it is possible to cover these requirements (demand) with the stock available in a plant and fixed goods receipts already planned to be received (supply). The system also considers all fixed goods issues (e.g., customer requirements/sales orders, planned independent requirements, or reservations) and receipts (e.g., production orders, purchase orders, fixed purchase requisitions) for a material. The result of this comparison is the **quantity available for planning**.

In case the calculated *quantity available for planning* is below zero, a material shortage situation is at hand. MRP reacts to this with the creation of new *procurement proposals*. Procurement proposals are either generated as planned orders or purchase requisitions, depending on the **procurement type** and a specific parameter of the MRP run. The proposed procurement quantity results from the **lot-sizing procedure** (e.g., EX), which is set in the material master.

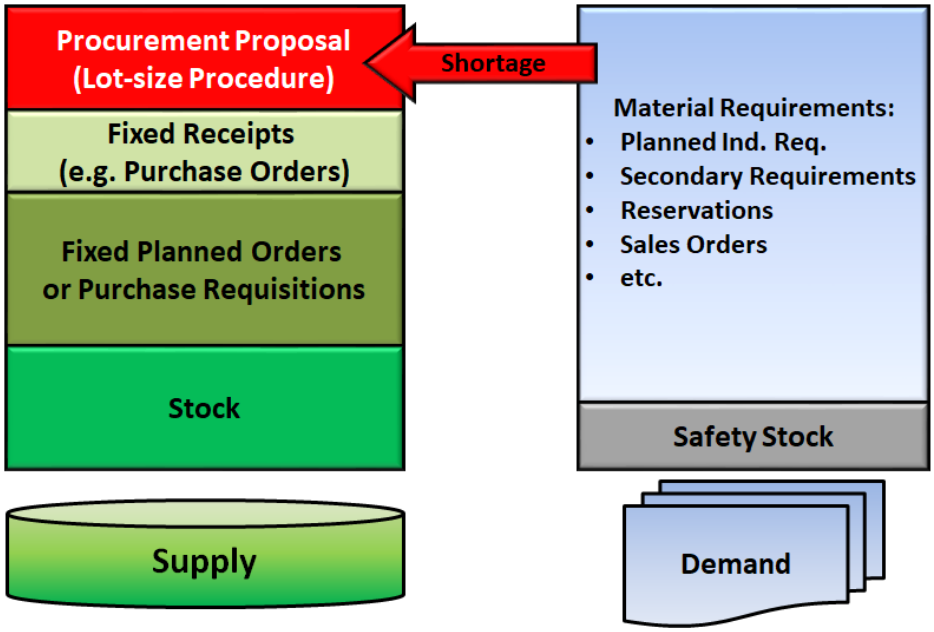


Figure 67: Net Requirements Calculation (based on UA 2012)

Procurement Type

When determining the materials that need to be procured the system first checks whether procurement should take place via in-house production or external procurement. This information is defined in the material master by setting the procurement type field in the MRP view to ***in-house production (E)***, ***external procurement (F)***, or ***both (X)***.

Depending on this setting, the system processes procurement elements differently and also creates different outputs in the MRP run:

- Results of MRP for external procurement materials are planned orders, purchase requisitions, and schedule lines.
- Results of MRP for internal procurement materials are planned orders.

Procurement Quantity Calculation (Lot Size Calculation)

In the net requirements calculation, the system has determined material shortages for each requirement date. These shortage quantities must be covered by receipt elements. The system therefore calculates the receipt quantity in the lot-size calculation. Lot-sizing procedures serve to calculate the procurement quantities, that is, the purchase order and production order quantities. SAP provides three groups of lot-sizing procedures:

- In **static** lot-sizing procedures, the procurement quantity is calculated exclusively according to the quantity specifications entered in the material master.
- In **period** lot-sizing procedures, the system groups several requirements within a time interval together to form a lot.
- **Optimum** lot-sizing procedures account for the costs resulting from stock keeping, from the setup procedures, or from purchasing. Therefore, it groups shortages together in such a way that these costs are minimized. The costs include lot size independent costs (setup or order costs) and storage costs.

(Multi-Level) Scheduling

Scheduling is another step executed during an MRP run.

- During the net requirements calculation, the system has determined the shortage quantities and material shortage dates.
- During the procurement quantity calculation (lot-sizing), the system has calculated the procurement quantities necessary for covering requirements.
- During scheduling, the system now determines start and finish dates for the procurement elements of materials that are produced in-house and for materials that are procured externally.

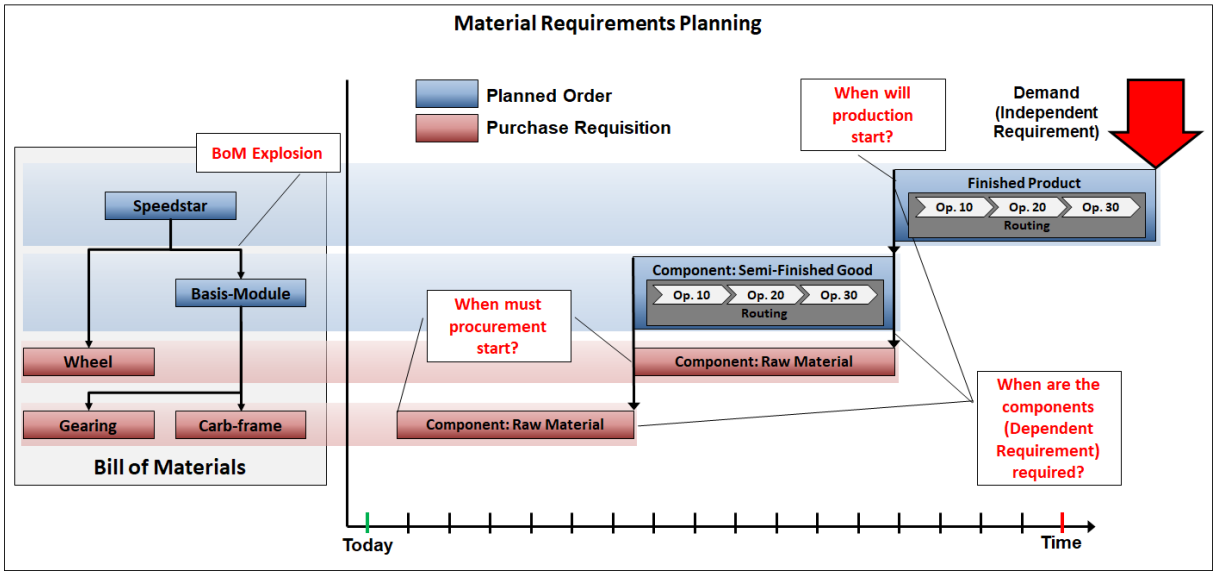


Figure 68: Main Functions of MRP

3.1.2.1.2 Results of Material Requirements Planning

If the MRP run determines shortage quantities, the system creates procurement proposals. The type of procurement proposals generated depends on the procurement type of the material.

For **externally procured materials**, the MRP run creates either planned orders, purchase requisitions, or schedule lines:

- A **planned order** (planning) is a request created in the planning run for a material at a determined time. It specifies when the inward material movement should be made and the quantity of material that is expected. A planned order for externally procured materials can be converted into a ***purchase requisition***.
- A **purchase requisition** is an instruction to the purchasing department to procure a certain quantity of materials or services on or by a certain date. A purchase requisition can be converted into a ***purchase order*** by the purchasing department. A purchase order is a request or instruction from a purchasing organization to a vendor (external supplier) or a plant (internal procurement) to deliver a quantity of material or to perform services at a certain point in time.
- **Schedule lines** are created for materials that are procured externally and for which a source list entry and a scheduling agreement already exist.

For **internally procured materials** the MRP run creates planned orders.

- A **planned order** (planning) is a request created in the planning run for a material at a determined time. It specifies when the inward material movement should be made and the quantity of material that is expected. A planned order for internally procured (produced) materials can be converted into a ***production order*** *(or process order)*. Only in Repetitive Manufacturing (REM) production is carried out directly on the basis of the planned orders.
  A production order (execution) is a request or instruction to internally produce a specific product at a specific time. If a planned order is converted into a production order, the dependent requirements are transferred to order reservations.

Purchase requisitions, planned orders and delivery schedule lines are internal planning elements that can be deleted, changed, or rescheduled at any time.
After the conversion of planned orders or purchase requisitions, production orders, process orders and purchase orders are fixed for planning.

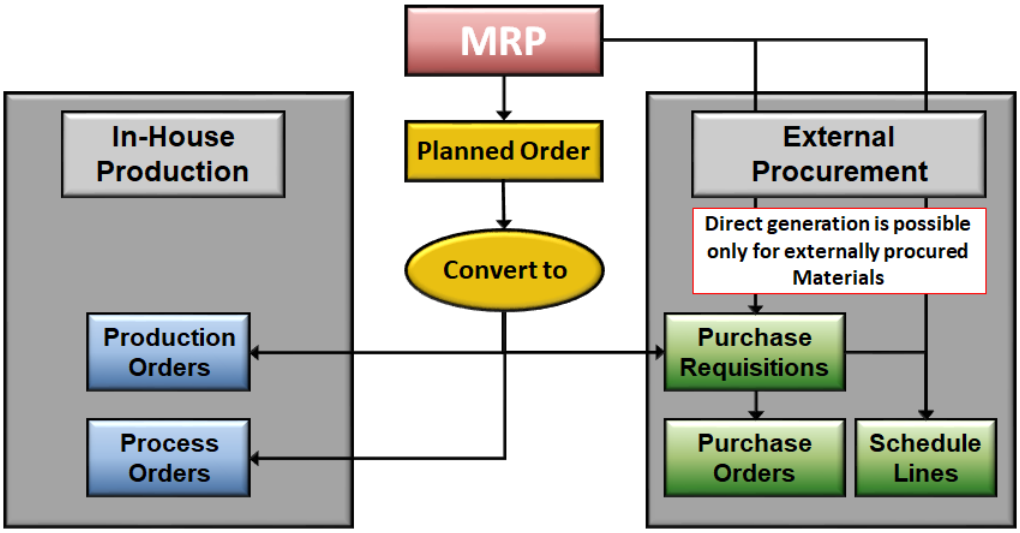


Figure 69: Output of MRP (UA 2012)

3.1.2.2 Material Requirements Planning in SAP S/4HANA

With SAP S/4HANA, SAP has introduced a new application – namely MRP Live – which is the successor of the classic MRP used in SAP ERP and several new processing modes for the MRP planning run. In this chapter, we will introduce the functional scope of MRP Live and discuss the differences and innovations in comparison to the classic MRP.

Processing Modes for MRP

SAP S/4HANA provides the following modes for executing Materials Requirements Planning (MRP):

- **Classical MRP**: This is the classic MRP mode that was already available in SAP ERP. It can still be used without any restrictions and can also be co-deployed with the new MRP Live. The classic MRP is not optimized for running on the SAP HANA database and, accordingly, is significantly slower than MRP Live.
  The classic MRP reads data from the underlying database and calculates all the necessary operations on application layer. This requires reading huge amounts of data from the database, transferring this data for the calculations to the application server and then writing the results back to the database. Of course, this leads to tremendous resource occupation on both database and application layer of the SAP system.
- **MRP Live**: MRP Live is an MRP run optimized for the SAP HANA database. In opposite to the classic MRP, MRP Live in SAP S/4HANA shifts the main part of the calculations directly to the SAP HANA database. This leads to less data being transferred between the MRP application (S/4HANA) and the database server (SAP HANA) as most calculations are done where the data actually resides (in the database). Therefore, ABAP code is "pushed down" to the SAP HANA database and processed there using stored procedures (with the help of SQL Script). This minimizes the volume of data that must be copied from the database server to the application server and back, which considerably improves performance. Consequently, MRP Live allows reading material receipts and requirements, calculations of shortages, and creation of planned orders and purchase requisitions can be processed all in one database procedure.
- **Predictive MRP (pMRP)**: This mode is a new mid- and long-term solution for capacity planning through MRP prediction. The pMRP mode is a simulation-based planning tool used to drive long term, in depth plans for plants. It includes options to simulate and resolve capacity and material gaps in a plant before they occur.
- **Demand Driven MRP (DDMRP)**: This mode allows prioritizing actual sales data over forecast and creating strategic forward looking inventory buffers. The system analyzes the material flow to propose a dynamically optimized stock situation to lower the risk for strategic replenishment gaps.

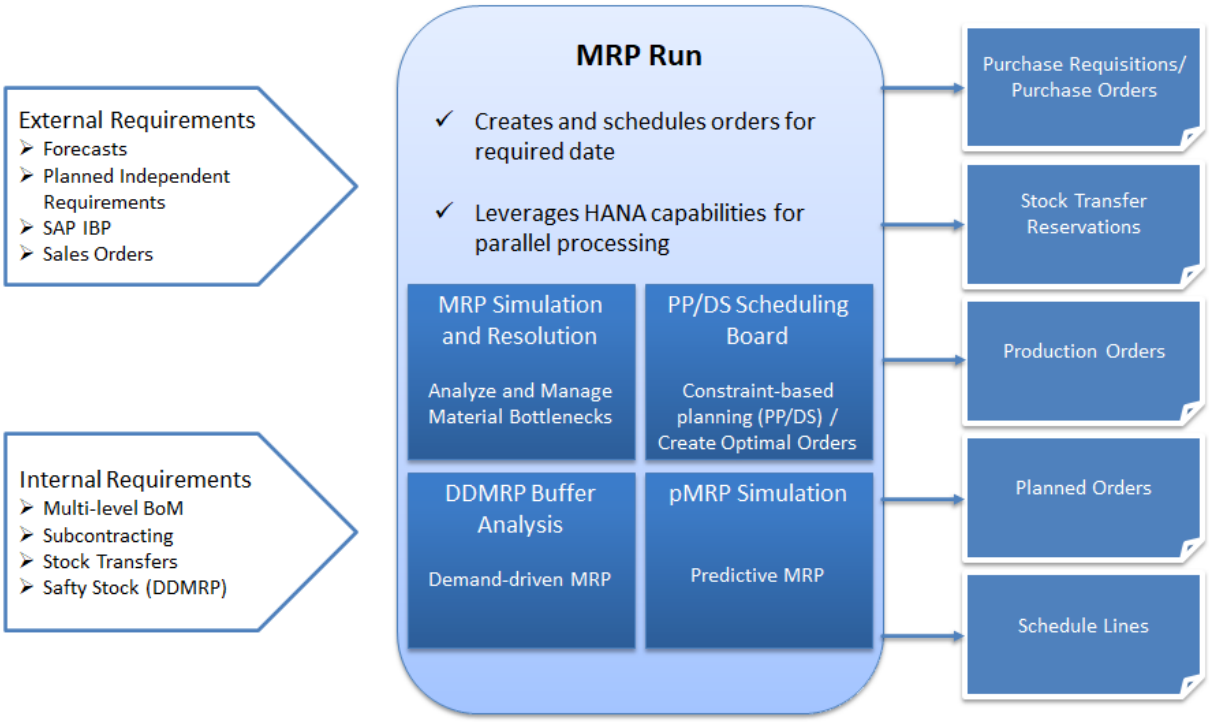


Figure 70: Material Requirements Planning in SAP S/4HANA

For the new modes, SAP has developed corresponding native SAP Fiori Apps that replace the classical MRP transactions and screens. However, the classic transaction codes MD01, MD02, etc. can still be used for running the Classic MRP processes.

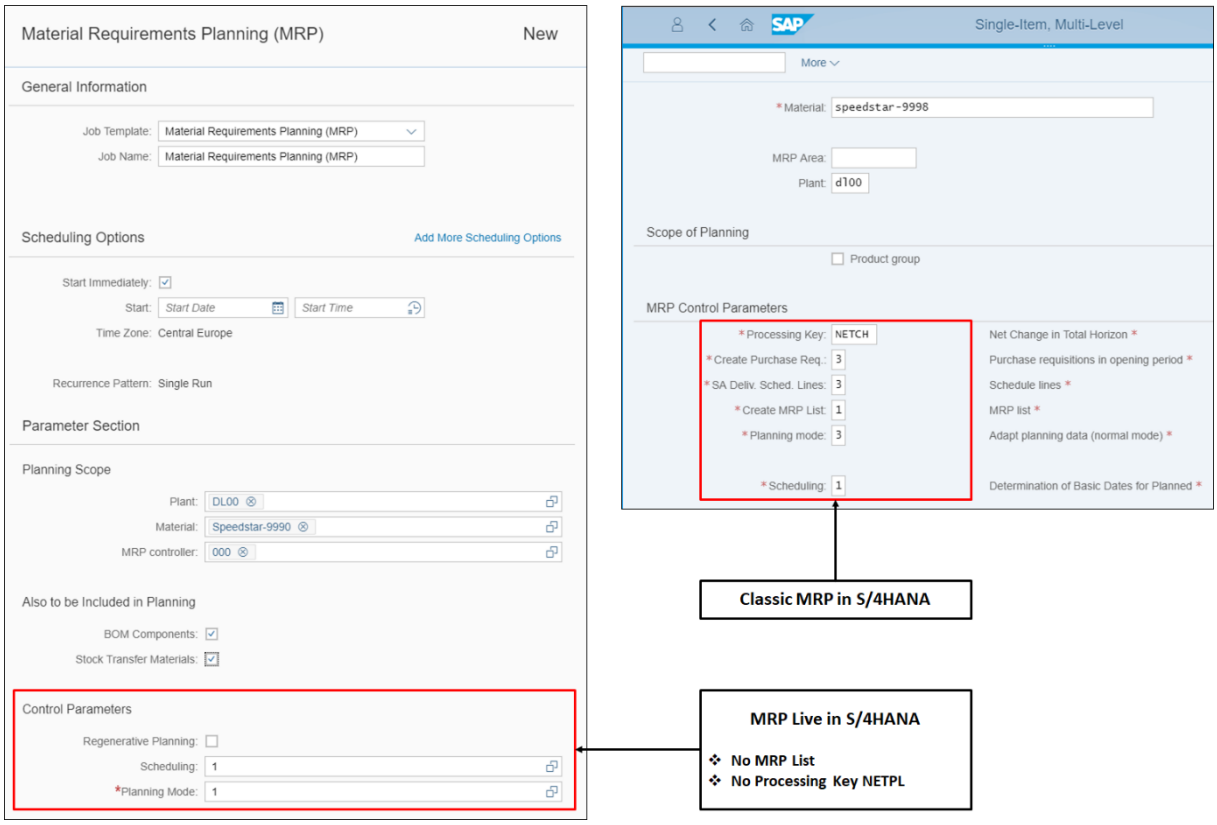


Figure 71: MRP Live and Classic MRP in S/4HANA: SAP-System-Screenshot

The following figure illustrates the differences between the calculation procedures for the classic MRP run and the optimized implementation used by MRP Live in S/4HANA. You can see that read and write activities are optimized in MRP Live and take full advantage of aggregation and parallelization capabilities of the HANA database. In opposite to the classic MRP run, where each table is read individually for each material that is planned, MRP Live reads the database tables that contain stock, demand and supply information for **all** planned materials in parallel, calculates and – if possible – aggregates the data directly in the database and returns the results to the application (consumer).

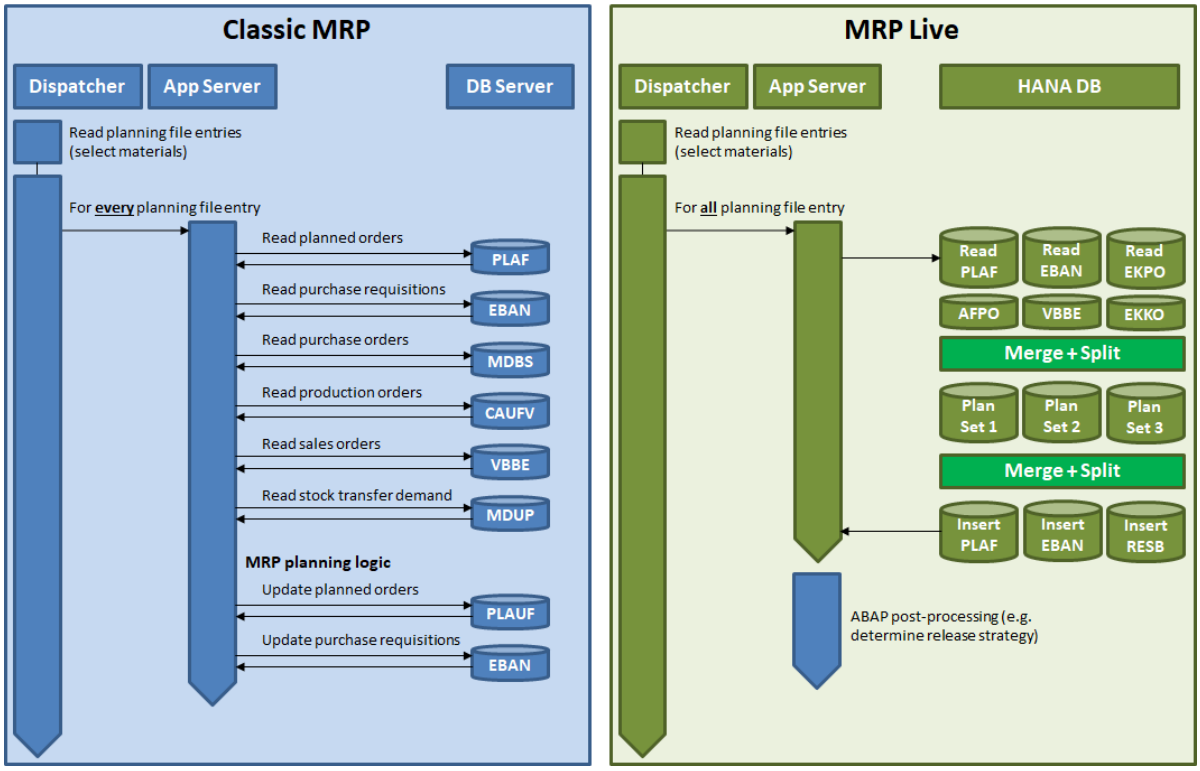


Figure 72: Optimized MRP Live Run vs. Classic MRP (Chikkappaiah 2017)

Key Features and Advantages of MRP Live

MRP Live on SAP S/4HANA is a true business enabler. With the key features and benefits it provides, in comparison to the traditional MRP on SAP ERP, great improvements in identifying and solving material shortage issues. MRP Live provides the following capabilities:

- **Speed**: Due to the processing mode for calculations directly in the database and the general speed advantages of the SAP HANA database in comparison to traditional relational databases, the MRP run is performed with a factor of up to ***10 times faster*** than the classic MRP run of SAP ERP and reduces the memory footprint in the database by a factor of 5. The new process is, thereby, not only faster, but also streamlined and requires less manual interaction from the material planners. This allows MRP being executed ***more frequently*** and, thus, provide material planners with up-to-date information.
- **Analyze and Manage Material Bottlenecks**: With the help of the MRP cockpits disruptions in material availability can be easily detected via Exceptions and KPIs. The user can simulate the impact of disruptions, resolve issues and use change requests to track resolution flow.

- **Holistic view on inventory situation**: The definition of the planning scope in MRP Live is more flexible. Material shortages can be detected and evaluated using flexible rules across multiple plants. Hence, with MRP Live planning a set of materials with all components, materials for which a certain production planner is responsible, or one material across all plants is possible. If, e.g. a material is transferred from one plant to another then – in the classic MRP – the stock-transfer requirement is not known in the supplying plant until after the material has been planned in the receiving plant. MRP Live determines the sequence in which materials must be planned across several plants.
- **Real-time planning data**: MRP Live calculates and highlights the material requirements issues that need to be addressed across thousands of material stock situations. It finds critical demands (uncovered sales order items or missing parts in production) and critical supplies (late or overdue purchase orders or production orders) and evaluates consequences (which sales orders are endangered by a late supply) more quickly and finds better solutions to material shortage situations. Thus, it provides real-time visibility to a broader set of supply and demand data from across the company, including sales orders, inventory, and procurement information into a single view.
- **Sustainability**: MRP Live is a prerequisite for the production planning and detailed scheduling (PP/DS) solution in SAP S/4HANA, which allows constraint-based planning and the creation of optimal orders. PP/DS allows to
    - analyze resource impact of schedules
    - use the Planning Board and heuristics for reschedules and pegging optimization and/or the creation of collective MRP purchase orders for individual suppliers.

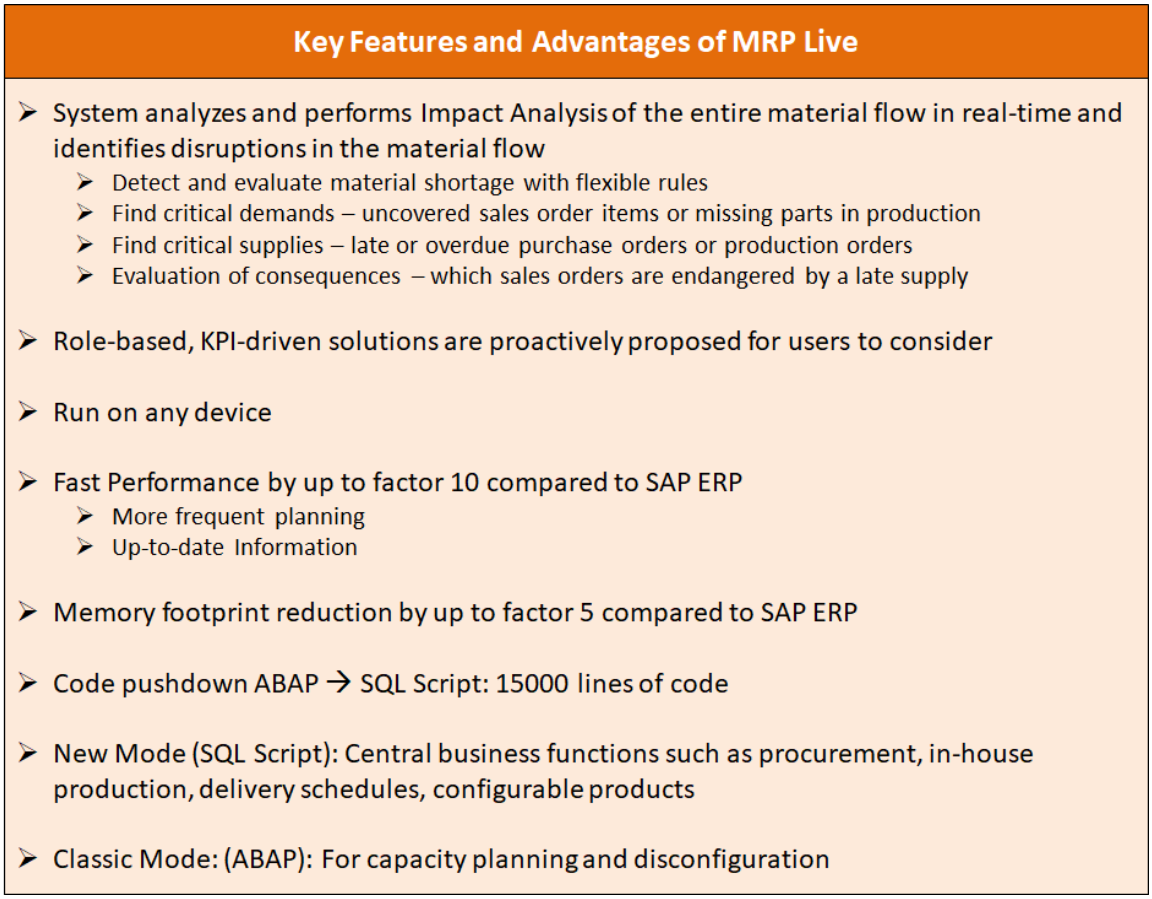


Figure 73: Key Features and Advantages of MRP Live (SAP Online Library)

3.1.2.3 Running Material Requirements Planning

Material Requirements Planning can be run on different levels with different scopes and with different parameters in the SAP system. In the following we will discuss the central settings for MRP runs in the SAP system.

3.1.2.3.1 Material Requirements Planning Levels

In the SAP system, MRP can be executed on two different levels:

- **Total planning**
- **Individual planning (single-item planning)**

Total Planning

Total planning is used in MRP to plan **all** materials of a **planning scope** and explode **all BoM levels** of those materials.

The **planning scope** can include *one* or *multiple plants* and/or *MRP areas*. An **MRP area** represents an organizational unit within one plant for which you can perform material requirements planning separately. An MRP area can include one or several storage locations of a plant or a subcontractor. This allows planning and providing the right quantity of materials on time for each distinct area, such as a production line, a storage location for spare parts, or subcontractor stock. The planning scope can also be set to limit the total planning run, specifically to those materials that fulfill freely definable criteria using a customer-defined **user exit**. You can use this, for example, to select all the materials belonging to a particular MRP controller. User exits allow defining more flexible planning scopes. But consider that they are not pre-configured in the SAP standard delivery and must be defined by the SAP users themselves.

The MRP procedure for total planning is a **multi-level planning** and accounts for independent and dependent demands (requirements) through **BOM explosion**:

- An **independent demand** is depicted by the original source of the demand. For instance, a sales order for a Speedstar is an independent demand as it is not a component within a BOM.
- For **dependent demands** the source of demand resides at another level of the material BOM. For instance, all components of the Speedstar are dependent demands in an MRP run, as the material requirements for those components depend on the product that is to be produced.

Thus, the BOM of a product that is planned in an MRP run is exploded and the dependent requirements are determined, after the system has performed the procurement quantity calculation (lot-size calculation) and scheduling. The bill of material is exploded for every new procurement proposal for an assembly during the planning run. Dependent requirements, which mean the required quantities, are determined for all the assemblies and components needed to produce the product.

Total planning can be executed either as a **background job** in transaction MDBT or in a **dialog process** (online) in transaction MD01, or the corresponding Fiori App. To execute the total planning run as a background job, you select a report variant limiting it to the corresponding scope of planning and plan the job. Using background jobs is recommended when running total

planning, since total planning, generally, encompasses a magnitude of materials, BoMs, dependent items, etc. and, thus, may require a lot of time and resources.

Individual Planning

Individual planning (**single-item** planning) plans one material or finished product separately. That is, you enter a specific material that is to be planned. Individual planning is always executed in a dialog process. The following individual planning options are available in the SAP system (that are relevant in this course):

- single-item, **single-level planning** (transaction MD03, or the corresponding Fiori App): Only the header material of the BoM is planned.
- single item, **multi-level planning** (transaction MD02, or the corresponding Fiori App): Planning is carried out across all BoM levels of a particular material.
- single item, **single-level interactive planning** (transaction MD43, or the corresponding Fiori App): Single-level simulative planning, with checking and altering the planning results before saving.

In **single level** planning only the ***header material*** is actually planned. For instance, you plan only the Speedstar. The components of the Speedstar are not planned.

In multi-level planning, planning is carried out across all BoM levels of a particular material. Accordingly, **multi-level** planning also covers ***dependent requirements***. Requirements depending on the header material arise from the explosion of the BoM of the finished product (header material). They are referred to as dependent requirements (or secondary requirements).

Interactive planning is a ***single-level simulative planning***. Here, the planning results are first displayed on the screen and can be checked and adjusted before the user saves them. When executing the interactive planning, the system first displays the stock/ requirements list. At this moment, the planning is a simulation, and the planning results are not saved to the database. From this stock-/requirements-list you can trigger the planning and simulation functions manually. Thereby, you have the following options:

- Entering procurement proposals for materials procured in-house or externally
- Changing or rescheduling procurement proposals entered in the planning run
- After each change, you can carry out a rescheduling check and the planning (net and lot-size calculation).

This planning type is suitable for materials for which a thorough check is necessary, e.g., high value materials like an aircraft engine, which costs millions of Euros.

The new **MRP Live** function in SAP S/4HANA is more flexible than the classic MRP as it provides all processing modes in one app. With MRP Live, you can plan material requirements

- for one or multiple materials,
- for one or several plants,
- for all BoM-Levels (multi-level),
- in a batch job or online interactively.

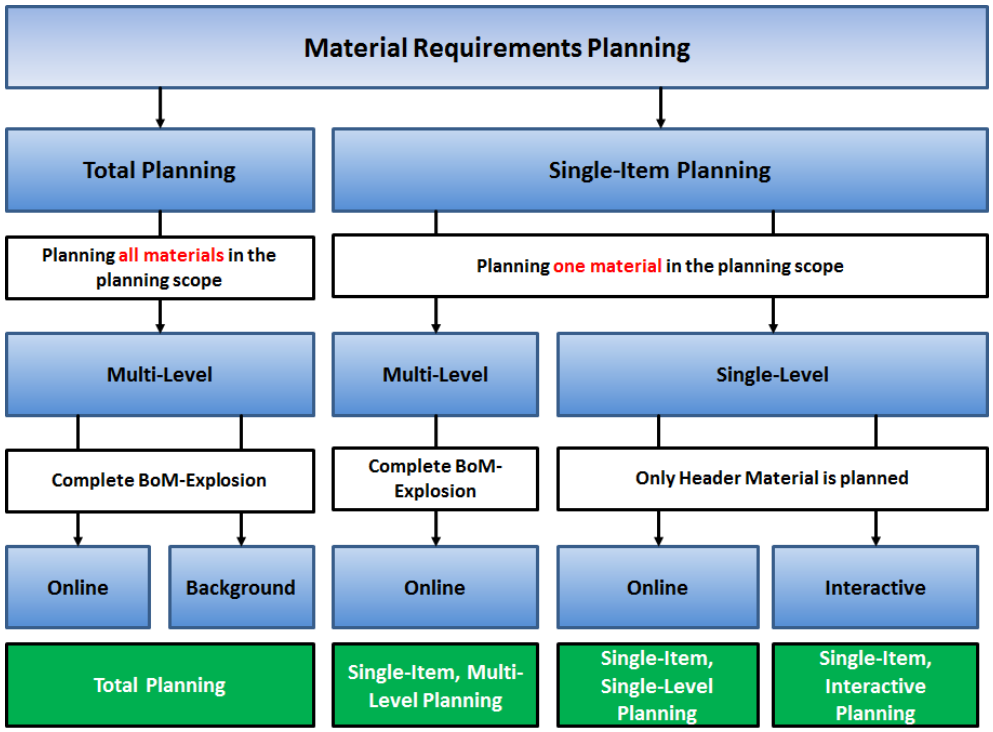


Figure 74: Running MRP

3.1.2.3.2 MRP Control Parameters

Depending on the type of planning that is executed, different parameters can be set to control different aspects of the planning run. The following figure illustrates the central parameters for MRP runs executed in transaction MD02 (or the corresponding Fiori App) in comparison to the MRP Live App:

- **Processing Key**: The processing key is the main parameter of a planning run. With the processing key you define the planning type to be executed. The options here are (see also next chapter):
  - (NEUPL) Regenerative Planning
  - (NETCH) Net Change Planning in Total Horizon
  - (NETPL) Net Change Planning in Planning Horizon.
- **Create Purchase Requisition**: This field is only relevant for *externally procured materials* (procurement type F or X in material master). As you already know, MRP can result in planned orders, purchase requisitions, or schedule lines for externally procured materials. With the setting in this field, you can determine, if the MRP run should create
  - (1) Purchase requisitions
  - (2) Purchase requisitions in the planning horizon
  - (3) Planned orders

  For *internally produced materials* (procurement type E) always planned orders are created.
- **Scheduling Agreements Delivery Schedule Lines**: This field is also only relevant for externally procured materials. With the setting in this field, you can determine, if the MRP run should create
  - (1) No schedule lines
  - (2) Schedule lines in the planning horizon
  - (3) Schedule lines

- **Create MRP List**: With the entry in this field you determine whether an MRP List should be generated in the planning run. The options here are:
  - (1) An MRP list should be created for all planned materials.
  - (2) An MRP list should be created for certain materials depending on the exception message. Exception messages that are to trigger the generation of an MRP list are defined in the *Define and Group Exception Messages* activity in Customizing.
  - (3) No MRP list should be created for the planned materials.
- **Planning mode**: With the entry in this field, you determine whether already existent planning data (planned orders, purchase requisitions, etc.) should be adjusted or planning should be performed completely anew. The options here are:
  - (1) Adapt planning data: Only MRP-relevant changes to the master data are considered in the new planning run.
  - (2) Re-explode BoM and routings: All BoMs and routings of the involved materials are re-exploded and the planned data is adjusted, accordingly.
  - (3) Delete and recreate planning: The current plan is deleted and planned anew.

The creation indicator for purchase requisitions, schedule lines, and MRP lists can also be set in the ***MRP group***. Materials assigned to this MRP group are planned accordingly in the overall planning run.

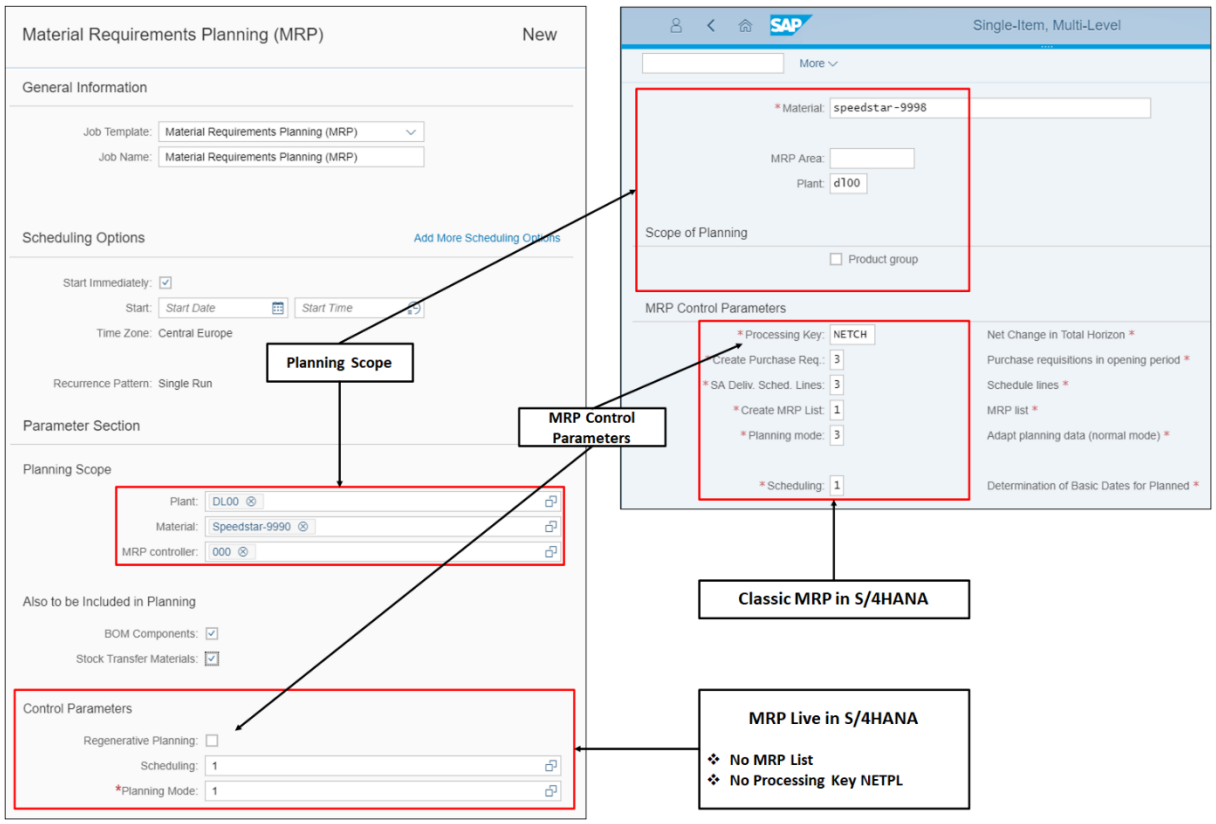


Figure 75: MRP Live and Classic MRP in S/4HANA: SAP-System-Screenshot

3.1.2.3.3 Scope of the Planning Run: Processing Key

When running the Materials Requirement Planning, you have several options for the **processing key** selection. In the initial screen for planning (MD01, MDBT, MD02, MD03, MD43), you can determine the type of planning run to be executed. The options are:

Regenerative Planning (NEUPL)

With the processing key **NEUPL**, you specify the planning run as total planning, and perform is for **all** materials of the planning file (planning scope). Consider that NEUPL processing key is not possible in the single-item planning transactions (MD02, MD03, MD43).
Regenerative planning is expedient when the planning run is carried out for the first time. Moreover, it is useful in occasions where (e.g., due to technical errors) data consistency cannot be guaranteed, and a total planning should be carried out to have all materials planned from scratch. However, this type of planning should only be carried out, if necessary, as it requires a lot of computational resources and has a long run-time.

For single-item planning, you can differentiate in the processing key field, whether *Net Change Planning in Total Horizon* (**NETCH**) or *Net Change Planning in Planning Horizon* (**NETPL**) is to be executed.

Net Change Planning in Total Horizon (NETCH):

Particularly when dealing with many materials, it usually makes sense to carry out MRP only for those materials that have undergone a MRP-relevant change (e.g., due to goods issues, new sales orders, changes to the BoM structure) in current operations. To plan only materials with changes relevant to MRP, you can use **Net Change Planning (NETCH)** procedure. This procedure allows for carrying out the planning run in relatively brief periods, due to its short run-time.

Net Change Planning in Planning Horizon (NETPL):

Instead of NETCH you can also use **Net Change Planning in Planning Horizon (NETPL)**. Here, the system only accounts for changes in the planning horizon. Accordingly, only materials are planned that have undergone an MRP-relevant change during the planning horizon (e.g., one month). The planning horizon is defined in the system's Customizing for MRP as plant or MRP group parameter. The length of the planning horizon should be at least a time span in which sales orders are usually received (e.g., 30 days). Moreover, delivery times and total lead times for the materials should be considered.
Note, that the processing type NETPL is only supported if you use the classic MRP, since the new MRP run determines material shortages for **all** known material requirements and not only for a limited planning horizon.
Note, that the processing type Net Change Planning in the Planning Horizon (NETPL) is not supported anymore in MRP Live, since the new MRP run determines material shortages for **all** known material requirements and not only for a limited planning horizon.

3.1.2.4 Evaluation of Material Requirements Planning

The results of the MRP run can be viewed in the **Stock/Requirements List** using transaction MD04. This is a dynamic list contains the current status of stock, requirements, and planned

receipts for a material. Any changes that occur to the stock level of a material (e.g. goods receipts, goods issues) and new requirements that are created for a material (e.g. sales orders, purchase requisitions, purchase orders, stock transfer orders, etc.) are immediately displayed in this list as soon as the current list is called up, or information is updated from the database by pressing the *Refresh* ( ) function.

A second list that is used to display the results of Material Requirements Planning is the **MRP List**. Contrastingly to the *Stock/Requirements List*, this list is static and always displays the results that were generated by the latest MRP run (MRP). If any MRP-relevant change is carried out after the planning run, for instance, if a sales order or purchase order is created, then these changes are not reflected in the MRP List. Only after a new planning run is executed, changes are displayed in the MRP List and, for example, new requirements are updated. Also in opposite to the Stock/Requirements List, the MRP List is not automatically generated by the MRP run (e.g. MD02). You can set the indicator *Create MRP List* in the MRP transactions if you want the MRP List to be generated.
The basic structure of both lists is the same. The following figure illustrates the Stock/Requirements List in the SAP system:

- On the left-hand side, there is the work list for the MRP controller in the form of a material tree.
- Above the list there is the header with the material number. Moreover, you can display further information using the different tabs on the header details.
- The list itself contains the individual MRP items and the available quantities of the material on different dates. The list considers all input and outputs for the given date.

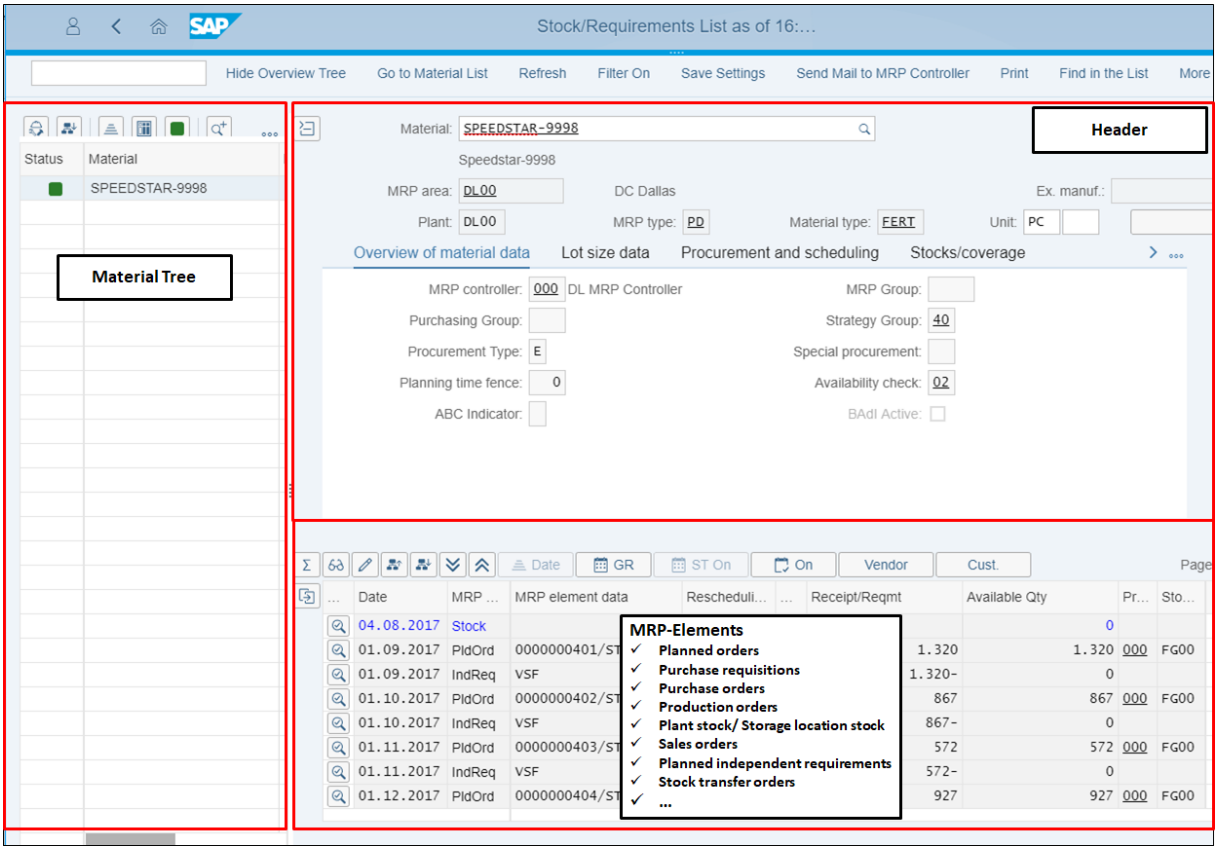


Figure 76: Structure of the Stock/Requirements List: SAP-System-Screenshot

Using the **Stock/Requirements List**, you can analyze the capacity situation for a material by selecting *Goto/Capacity Situation* from the menu in MD04. The system displays the available capacity, the total capacity requirements and the capacity requirements of the current material for each work center and capacity category. Overload situations are highlighted in different colors. Note that planned orders that have not been scheduled using detailed scheduling do not generate capacity requirements.

Both, MRP list and the Stock/Requirements list offer several **display options**. Examples are:

- You can display various dates (the availability date or the goods receipt date, with/without safety time).
- You can use display filters and selection rules
- You can use the ***period totals*** display function in the MRP List and Stock/ Requirements to group the planning results into periodic buckets (e.g., weekly or monthly buckets). In the *Define Period Display for Period Totals* activity in the system's Customizing, you define the periods to be shown in this display.
- Several display options can be set as default in the user's personal settings.

Further examples of functions of the **Stock/Requirements List** and the **MRP List** are:

- Convert planned orders to purchase requisitions
- Convert purchase requisitions to purchase orders
- Convert planned orders to production orders
- Adjust or delete MRP elements
- Display stock statistics and sales statistics

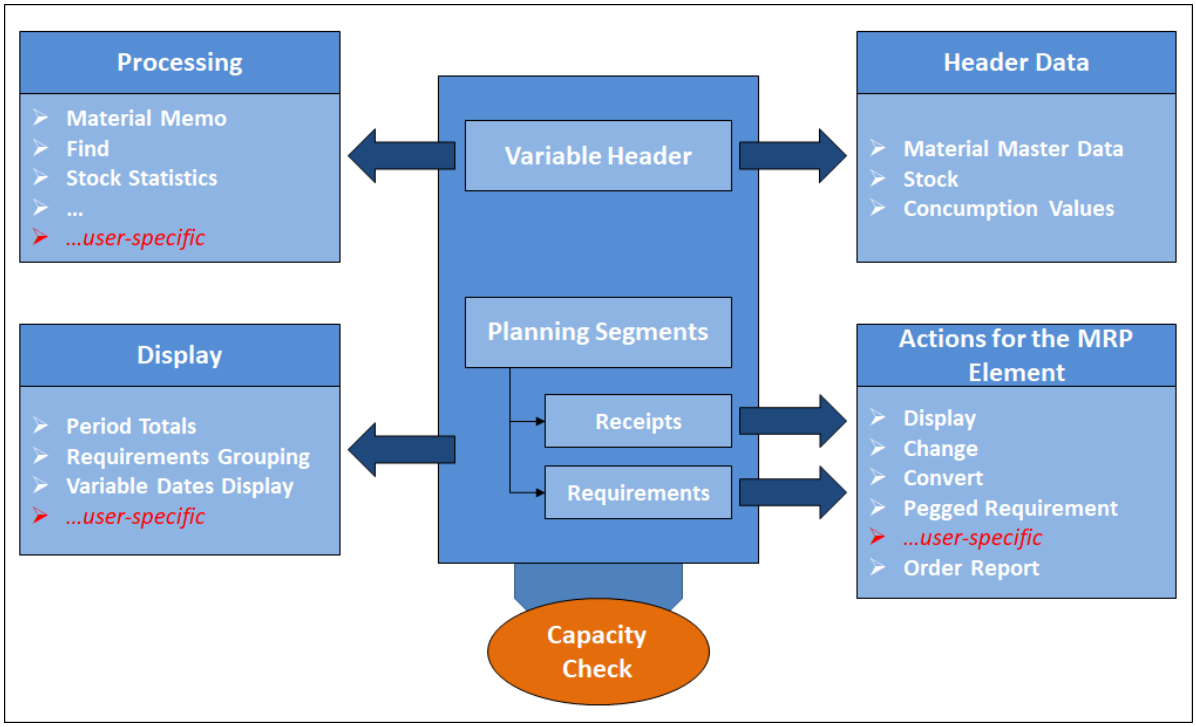


Figure 77: Functions of the Stock/Requirements List

The following figure shows the comparison of the Stock/Requirements List and the MRP List.

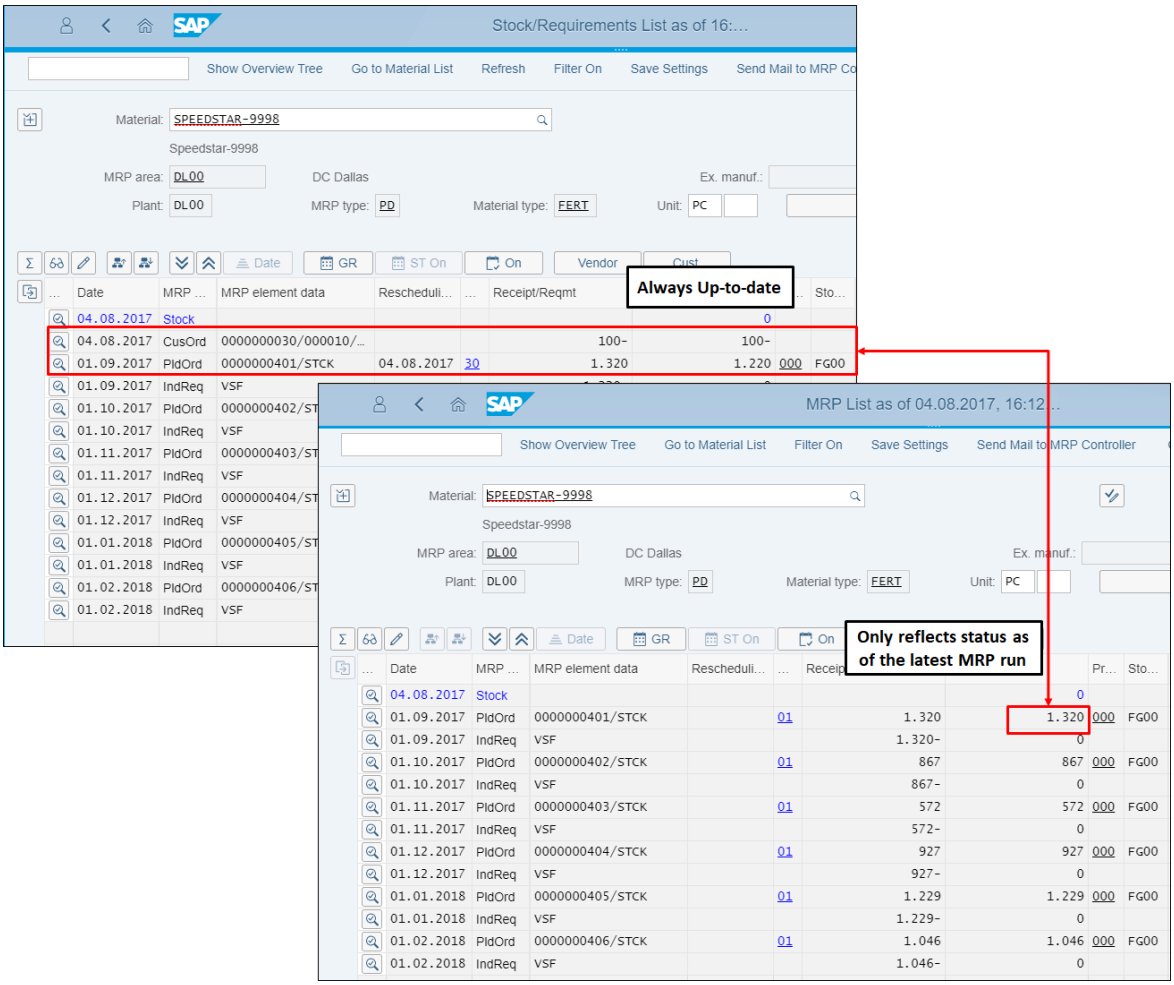


Figure 78: Stock/Requirements List and MRP List: SAP-System-Screenshot

3.1.3 Plan Production – Advanced Planning

In addition to regular Material Requirements Planning (MRP) and Capacity Requirement Planning (CRP), SAP S/4HANA offers another far more powerful planning application for complex planning situations in production and procurement along the entire value chain (supply chain): **Production Planning and Detailed Scheduling** (PP/DS – Production Planning and Detailed Scheduling)

3.1.3.1 Overview of Production Planning and Detailed Scheduling (PP/DS)

Production Planning and Detailed Scheduling (PP/DS) is an advanced SAP application used for the following purposes in Supply Chain Management:

- It generates procurement proposals for in-house production (planned orders/production orders) or external procurement (planned orders/purchase requisitions) to cover previously determined product requirements.
- It plans and optimizes the resource allocation (work centers/machines) and the order dates at the most granular level of detail
- Resource and component availability can be considered during planning.

PP/DS is used primarily for planning important or critical products, e.g., used for products with long procurement times or products that are manufactured on bottleneck resources. PP/DS makes it possible to create feasible production plans and

- Reduce lead and processing times
- Increase delivery reliability
- Increase product throughput and reduce inventory costs by better coordinating resources, production, and procurement

PP/DS can be used for interactively planning important products that you wish to plan manually or if any planning problems that have arisen during automatic planning need to be resolved. The application provides several tools for interactive planning, e.g., the detailed scheduling planning board or the product planning table.
Detailed Scheduling schedules orders automatically on the resources, taking various planning conditions into account (e.g., availability of components or resources).
The optimization tool allows optimizing the resource schedule according to certain criteria, e.g., setup times and setup costs, to improve the planning situation and solve detailed scheduling problems.

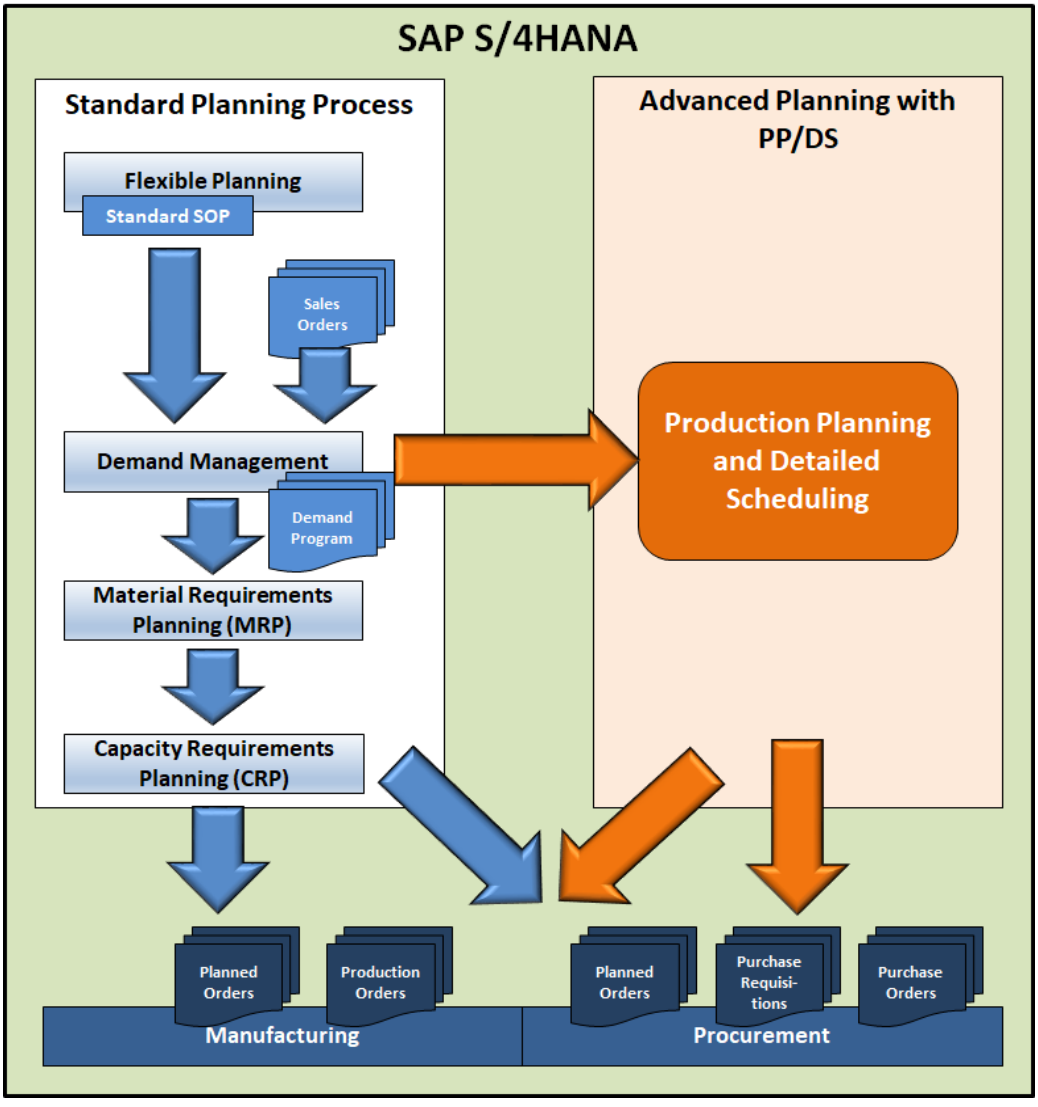


Figure 79: PP/DS vs. MRP and CRP

The functionality and level of detail of planning with PP DS goes far beyond the capabilities of the MRP and CRP applications in SAP ERP or S/4HANA. Accordingly, in previous releases, this component was part of the special solution *Supply Chain Management – Advanced Planning and Optimization (SCM APO)*. With the development of SAP S/4HANA and its function as a new application platform, the component has been integrated into SAP S/4HANA.

3.1.3.1.1 Objectives of Production Planning and Detailed Scheduling

The main purpose of the PP/DS application is to carry out a (finite) planning with exact times in the production plant both for in-house production and for external procurement. PP/DS covers the procurement requirements by creating planned orders for the planning of in-house production as well as purchase requisitions or schedule lines for the planning of external procurement.

The advanced planning capabilities provided by PP/DS may not be required for all materials and should typically only be used for critical products that are typically manufactured with bottleneck resources. Less critical materials (such as consumption-based purchasing materials) should be planned with MRP Live.

Accordingly, the selection of materials to be planned in PP/DS should be carefully defined. For example, all products manufactured on the same resources should be scheduled in PP/DS to achieve practical capacity planning.

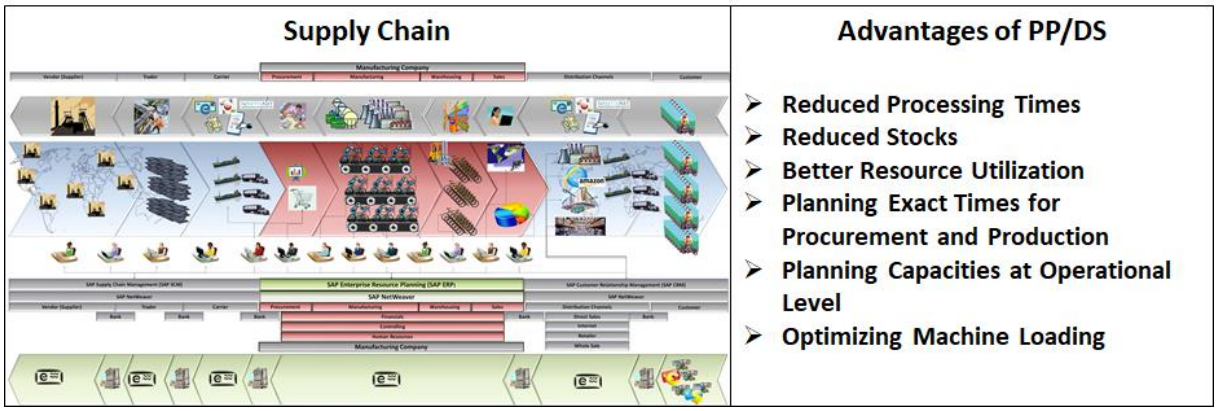


Figure 80: Objectives and Advantages of Production Planning and Detailed Scheduling

3.1.3.1.2 Advantages of Planning with PP/DS

Planning with PP/DS offers far-reaching benefits:

- **Minute-exact planning**: PP/DS plans can be created with exact times in hours and minutes, even for dependent requirements and orders. Accurate planning makes it possible to reduce inventory while achieving improved delivery reliability.
- **Bidirectional planning**: Planning processes can be flexibly designed using a large number of standard heuristics. This includes a bottom-up heuristic for bidirectional planning.

  In SAP ERP and in earlier releases of the ERP software, when a planned order for a component of a finished product was started, planning switched to forward scheduling. However, the planned order for the finished product is not rescheduled. A bottom-up heuristic can be used in PP/DS to ensure that the planned order for the finished product does not start until the component has been completed.

- **Pegging**: It is possible to obtain a multi-level view of material availability and capacity availability (pegging).
- **Capacity Planning**: PP/DS provides advanced options for capacity planning. For example, resources can be defined as finite resources in the resource master data. Ordering processes are then created for these resources only if there is enough capacity to fulfill the order quantity by the specified due date. If the available capacity is insufficient, the system searches for a new date taking into account the capacity situation.
- **Optimization of machine planning**: Within the framework of detailed scheduling (DS), optimization procedures for minimizing set-up times, set-up costs, schedule delays, alternative resource selections, etc. are carried out.
  For example, if orders have been generated over time in a not-optimal sequence, this sequence and the assigned resource of existing orders can be changed in the optimization run.
  By optimizing order sequences, lead times can be reduced.
- **Alerts**: Dynamic alerts are created to quickly identify critical situations.

3.1.3.2 Master Data in PP/DS

The master data used in PP/DS differs from its counterparts in the logistics applications (PP and MM) of SAP S/4HANA. Accordingly, a **master data transfer** must be carried out when the PP/DS application is used.

During master data transfer, the master data objects relevant to SAP PP are assigned to the corresponding **planning master data objects** in PP/DS. For PP/DS master data that has no equivalent in SAP S/4HANA, the master data is created directly in PP/DS. The following figure shows an overview of these assignments.

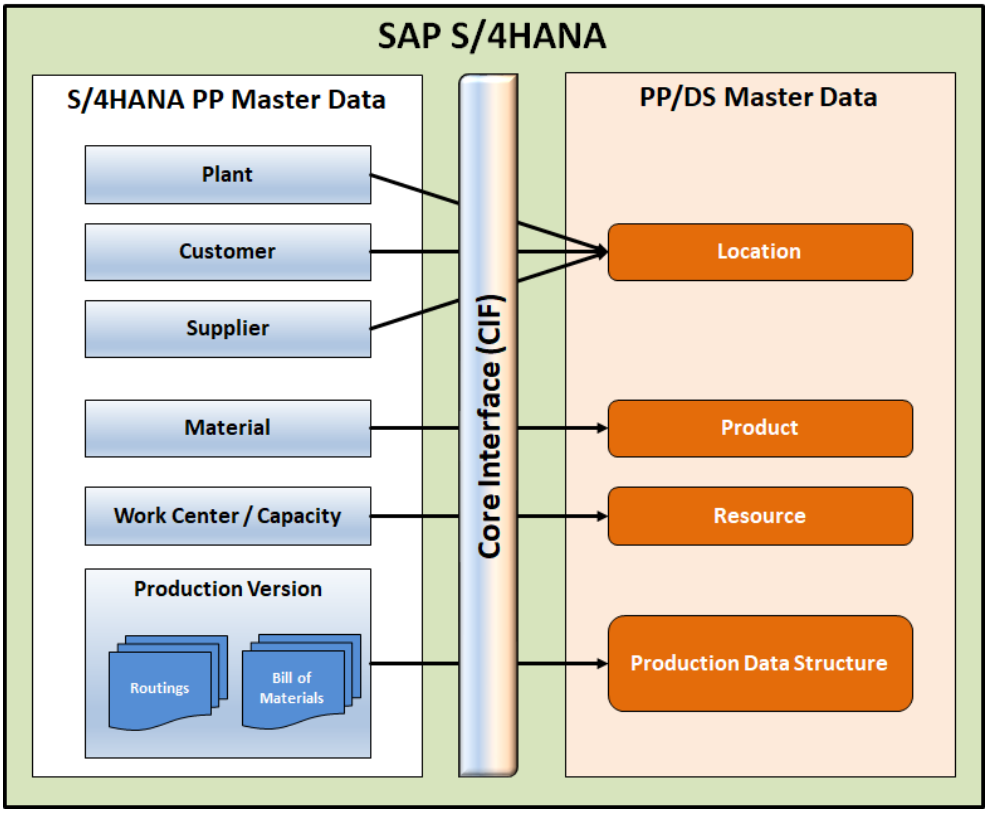


Figure 81: Master Data in PP/DS

3.1.3.2.1 PP/DS Integration Model

The integration between the classic ERP systems (SAP ERP, SAP ERP Enterprise, SAP ECC) and a connected SCM for this data exchange takes place via **Core Interface (CIF)**. On the side of the SCM system, CIF is part of SCM Basis and can be used by all systems that contain SCM Basis. Core Interface (CIF) is also used for the integration of master data between an ***S/4HANA*** system and ***PP/DS***, whereby the configuration has been simplified significantly.

A CIF integration model is only required for plants and is needed for a few master data. Examples are location master data (plant, customer, vendor, etc.) and external procurement relationships such as purchasing info records, contracts, and scheduling agreements.

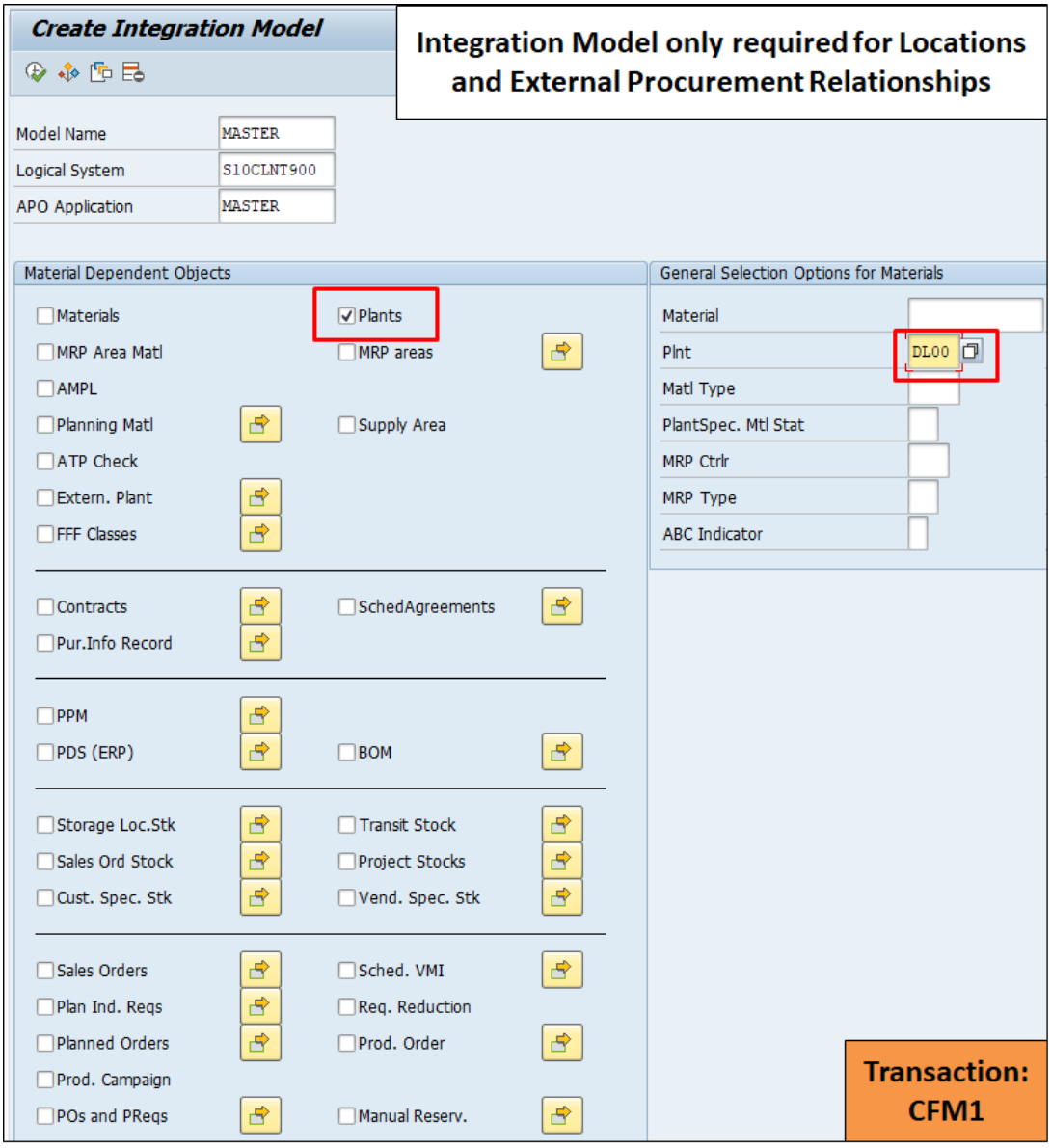


Figure 82: PP/DS Integration Model: SAP-System-Screenshot

A corresponding transportation lane must exist to transport products between two locations in the supply chain (e.g., from a manufacturing plant to a distribution center). For this purpose, **transport lanes** are created from CIF in PP/DS.

- You can view the material-specific information, e.g., define the special procurement keys for stock transfers in the material master.

- You can copy special procurement keys and purchasing info records for the stock transfer between plants to the transportation lane in PP/DS as a product-specific entry.
- You can also transfer purchasing info records or outline agreements that are used to form price agreements and supply contracts with specific suppliers as external procurement relationships. At the same time, a product-specific entry is created in the corresponding transportation lane.

3.1.3.2.2 Create Products and Resources

To integrate S/4HANA materials with PP/DS products and S/4HANA work centers with PP/DS resources, the corresponding settings must be made in the **Advanced Planning** tab in the material and work center master data in S/4HANA.

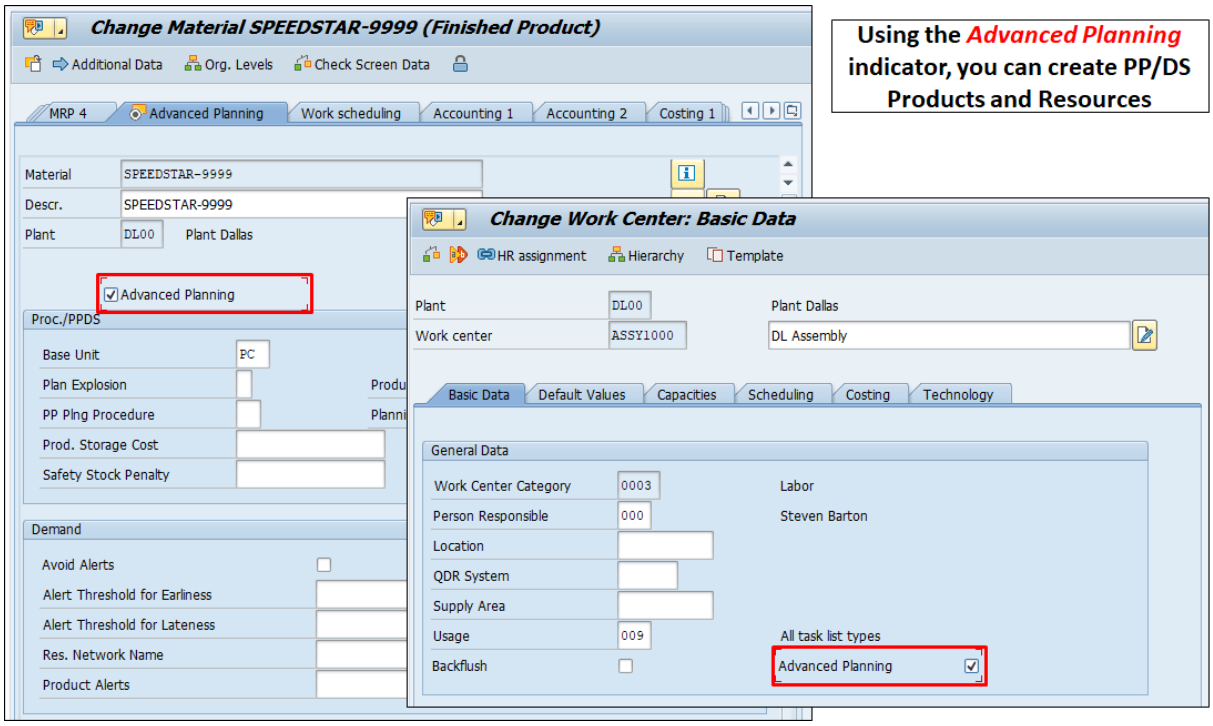


Figure 83: Create Products and Resources: SAP-System-Screenshot

3.1.3.2.3 Work Center and Resource

When transferring an S/4HANA work center to the PP/DS component, each capacity type is mapped to the corresponding resources. The following naming convention is used during the transfer:

- A **W** is added to the work center number
- The **number of the plant** from which the work center originates, and the **capacity type** are appended

Work center capacities from SAP S/4HANA are transferred in the category *Production* as single-activity resource or multi-activity resource.

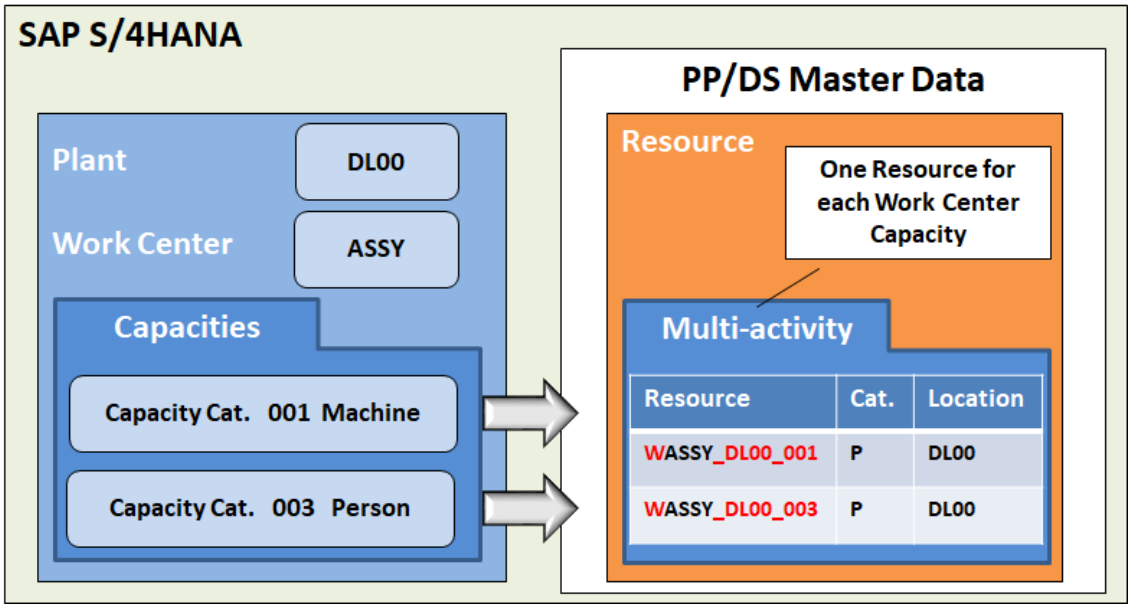


Figure 84: Work Center and Resource

3.1.3.2.4 Production Data Structure

In S/4HANA, the production of a material is described by a **routing** and a **bill of material** (BoM). BoM components can be assigned to a specific operation within a routing. BoM components that are not explicitly assigned to an operation in the routing are automatically assigned to the first operation. Consequently, the procurement of BoM components could be scheduled to be available (just-in-time) at the beginning of the operation, where it is required.
In addition to the BoM components, you can also assign **production resources or tools (PRTs)** to the routing. PRTs are means of production that are not localized but are necessary for production (e.g., a meter).

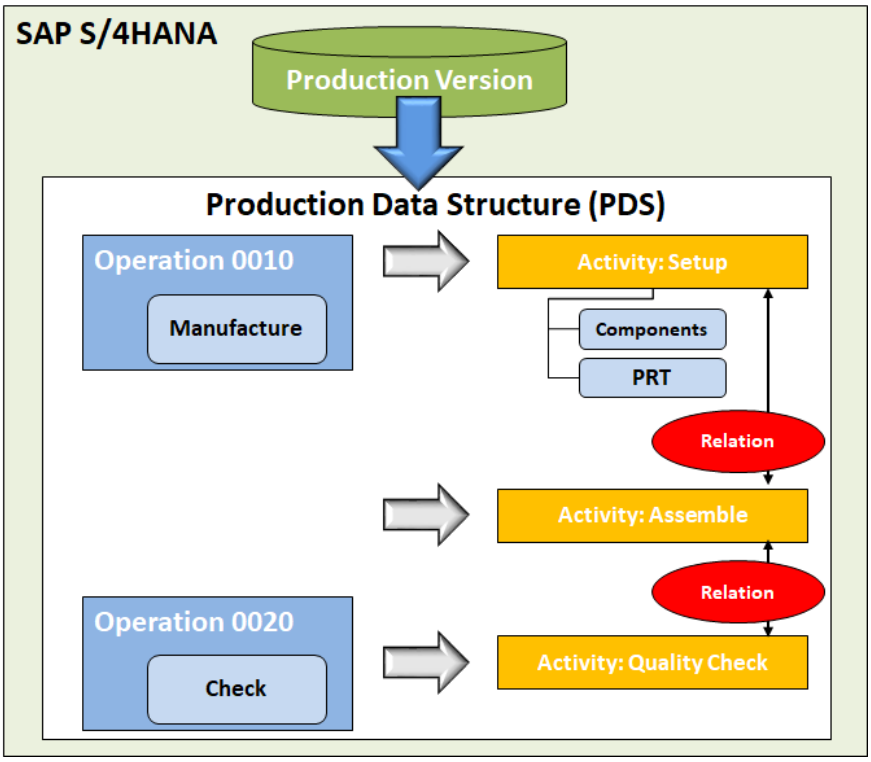


Figure 85: Production Data Structure

From the production version created for a material in SAP S/4HANA, a **production data structure (PDS)** can be created in PP/DS, which specifies the detailed information for the production of a product. Each PDS has one or more operations, each operation containing one or more activities. The components and resources consumed by an activity are used in sequence within the operation.

3.1.3.2.5 Models and Versions in PP/DS

The PP/DS component uses a supply chain model, which represents the master data for the supply chain from the supplier to the customer via the production and the distribution locations. The model includes

- Locations
- Transport lanes
- Products
- Resources
- Production Data Structure (PDS)

The master data maintained in SAP S/4HANA is automatically assigned to the **active model (model 000)** when transferred to the PP/DS component. This model represents supply chains used by the company and automatically provides all the transferred master data for operational planning model 000. Master data created manually in PP/DS must be explicitly assigned to a model.

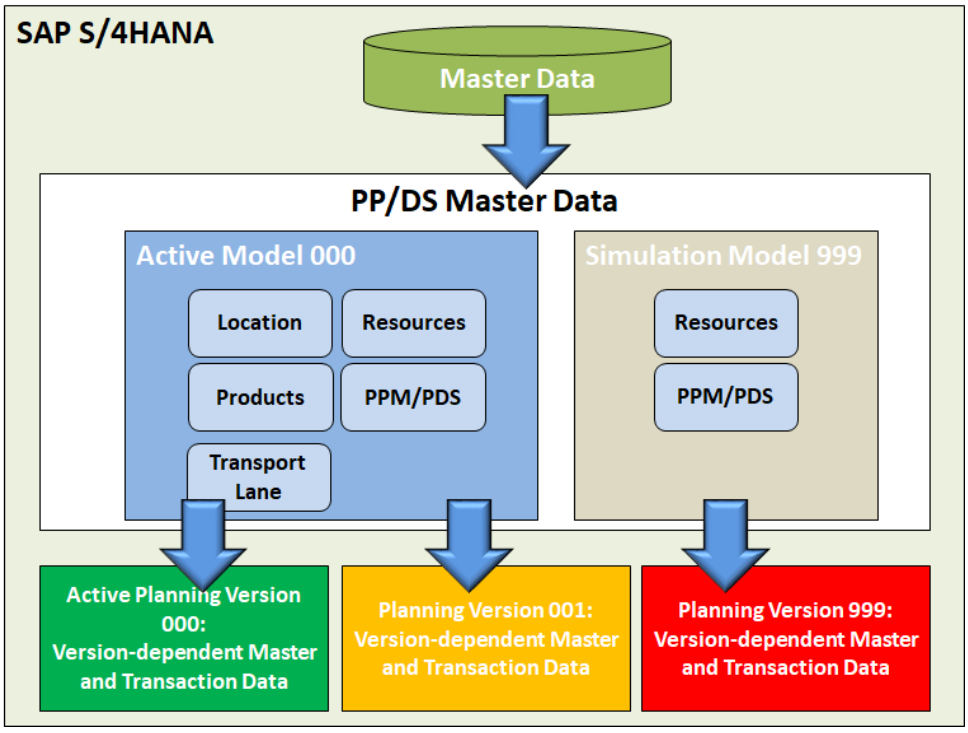


Figure 86: Models and Versions in PP/DS

A model is uniquely assigned a version and controls all transaction data for the master data of the model. However, only the **version 000** for the **active model 000** can exchange transaction data with the execution system. Additional versions for a model are created for simulation purposes, such as changing specific master data and the entire transaction data. For example,

planned independent requirements (PIRs) can be increased and plan the production based on increased demand.
Models and scheduling versions can be copied or manually created using version management. However, these must be clearly marked so that two planning variants of indifferent models do not have the same name (for example, active plan version 000 only exists for model 000).

3.1.3.3 Planning Methods

If the **Advanced Planning indicator** is set in the material master, the MRP Live planning run executes the maintained product heuristic in PP/DS.

3.1.3.3.1 Planning Horizon in Production Planning

Within the planning horizon of PP/DS, production planning (PP) focuses on lot-size-oriented planning in the sense of quantity-oriented demand planning. A decision on the feasibility or viability of planning will not be made until the capacities are transferred by Detailed Scheduling (DS) within a short-term timeframe, in which production generally also takes place. In general, this is typically significantly higher than the planning horizon.
The planning horizon delimits the area of responsibility of the quality inspection (functionality of Material Requirements Planning MRP) from the actual area of Detailed Scheduling (DS). This is because internal elements cannot be changed by a requirements planning run, while detailed scheduling regarding deadlines is still possible.

The PP component uses background planning runs (batch) and interactive tools (dialog), such as the product view with PP heuristics, which perform a net requirement calculation and replicate the lot-sizing procedure. This form of planning is infinite and does not take into account any overloading of resources that might occur.

The DS component can then perform capacity planning using background planning runs or interactively using the DS planning board. The system provides DS heuristics and the PP/DS optimizer as automated help. If the DS component generates feasible plans, where production planning was fixed in advance, it may be necessary to

- redo the planning
- repeat the production planning (PP) with other restrictions
- repeat the detailed scheduling (DS), for example.

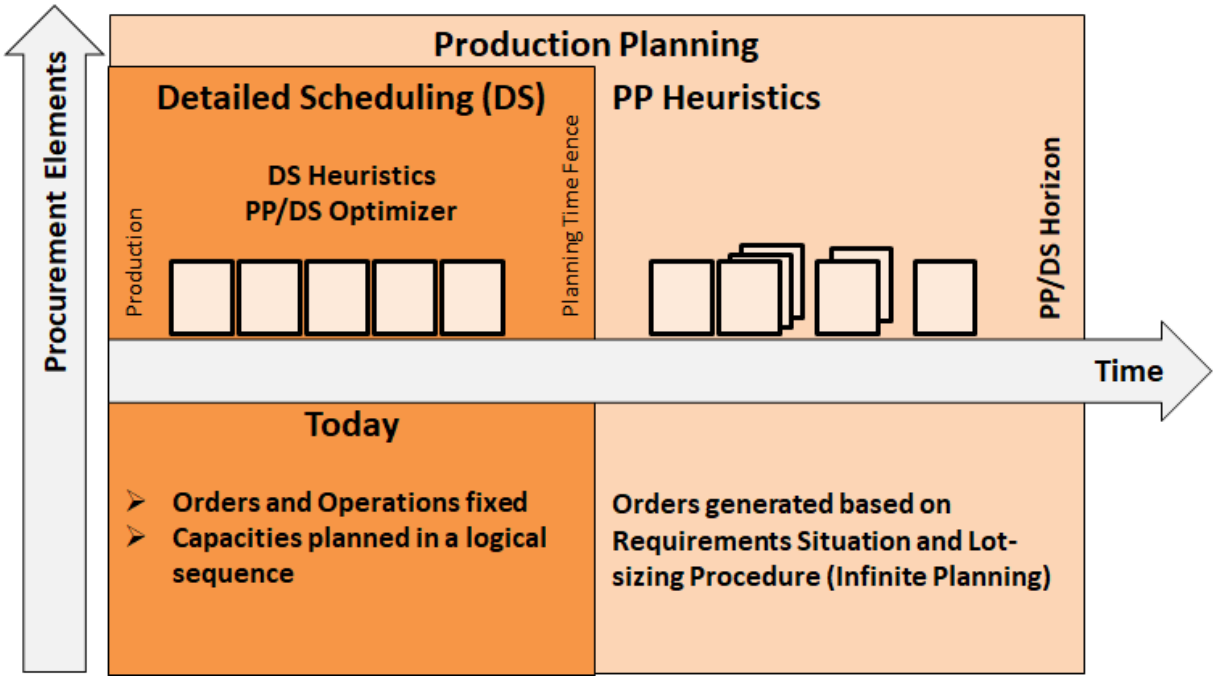


Figure 87: Planning Horizon in Production Planning

3.1.3.3.2 Main Processes in PP/DS

PP/DS supports the following main processes:

- **Make-to-Stock (MTS)**: Various planning strategies are available for the production of a product for make-to-stock production. In MTS, the demand program is determined using planned independent requirements and, if necessary, applied to existing sales orders. Requirements can be covered with finite or infinite planning. In capacity planning, various optimization procedures are available.
  Make-to-stock production allows also to plan sales orders as part of a CTP check (Capable-to-Promise). When a sales order is created, an Available-to-Promise (ATP) check is performed to determine whether the necessary procurement elements exist, and, if required, a new procurement element is created and scheduled according to capacity. If capacity overloads will lead to possible delays for the sales order, these overloads will be reported to the sales order directly. In make-to-stock production, a CTP check is only possible within the PP/DS horizon.
- **Make-to-Order (MTO)**: In MTO, every incoming sales order is planned in a separate segment. Since the PP/DS horizon is not relevant in the Make-to-Order (MTO) production, the CTP check can be performed without any time restrictions. Here, any warehouse orders would issue the materials to the production order for manufacturing.
- **External Procurement**: In addition to in-house production, the external procurement of materials can also be planned in PP/DS. Automatic source determination (suppliers) can also be carried out cost-based. In addition, the processing of scheduling agreements and the subcontracting can be modeled.

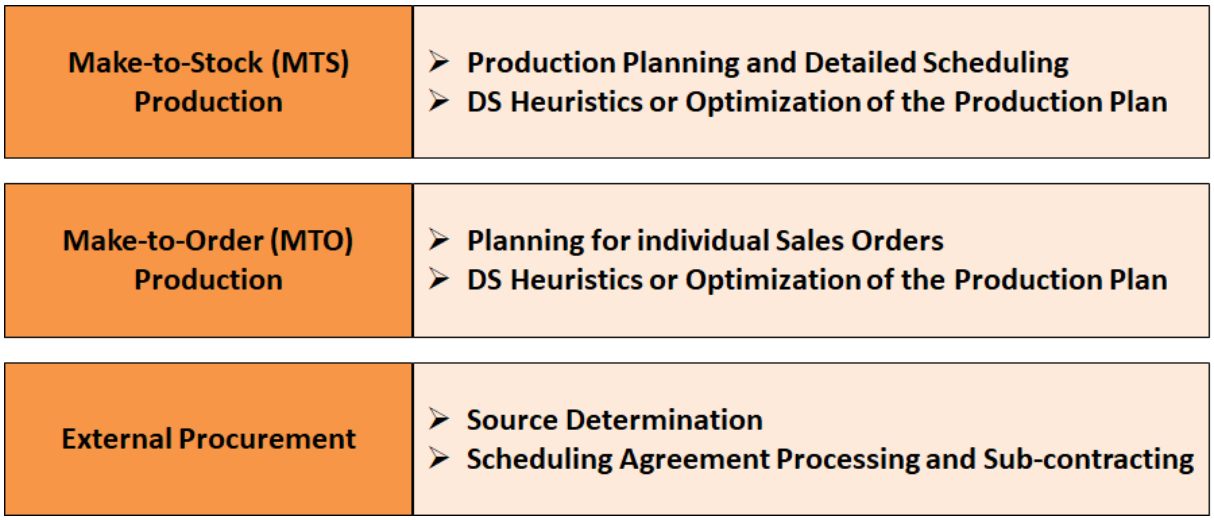


Figure 88: Main Processes in PP/DS

Consumption forecasting is a central function in PP/DS and ERP systems and is an integral part of the PP/DS planning process.

In general, consumption represents the comparison of two order types. One or more order types that represent actual requirements can consume another order type. In PP/DS, for example, the order type Planned Independent Requirement (PIR) is consumed by other order types, such as sales orders, dependent requirements, or stock transfer requirements.

The purpose of consumption is to ensure that requirements are not duplicated in the system and that the most detailed requirements are always used. For example, forecasts and sales orders are two different types of requirements. Since a forecast is less specific than a sales order, it is reduced if there are other more specific requirements, such as sales orders for the same product. In this way, when using forecasts and sales orders to generate receipt elements, e.g. planned orders, always the right quantity is generated.

3.1.3.4 Simultaneous Quantity and Capacity Planning

Before we introduce Simultaneous Quantity and Capacity Planning in PP/DS, the concept of infinite and finite planning should be briefly explained.

The characteristics of **infinite** planning are:

- When you create a planned order, the resources are not checked so that a planned order is created even if the resource is overloaded.
- Then DS-Heuristic (capacity planning) generates a feasible production plan, whereby a final optimization of the plan is still possible.

The characteristics of **finite** planning (Capable-to-Promise) are:

- In simultaneous quantity and capacity planning, all finite resources are checked when a planned order is created.
- The planned order is created only when capacities are available.
- Downstream optimization of the plan is possible.

If a resource planned with **finite planning** is already busy on the requested date, the system will search for a new date on which the planned order can be created. In a **strategy profile** you determine how the system should schedule orders (find slot, perform infinite planning, etc.).
You define a resource with finite planning using the finite resource indicator in the work center master data. Ordering processes for these resources are only created if there is enough capacity for the order quantity on the order date.
The strategy profile mentioned above is maintained in Customizing by setting heuristics, planning methods or global PP/DS settings for the profile to be used for planning planned orders.

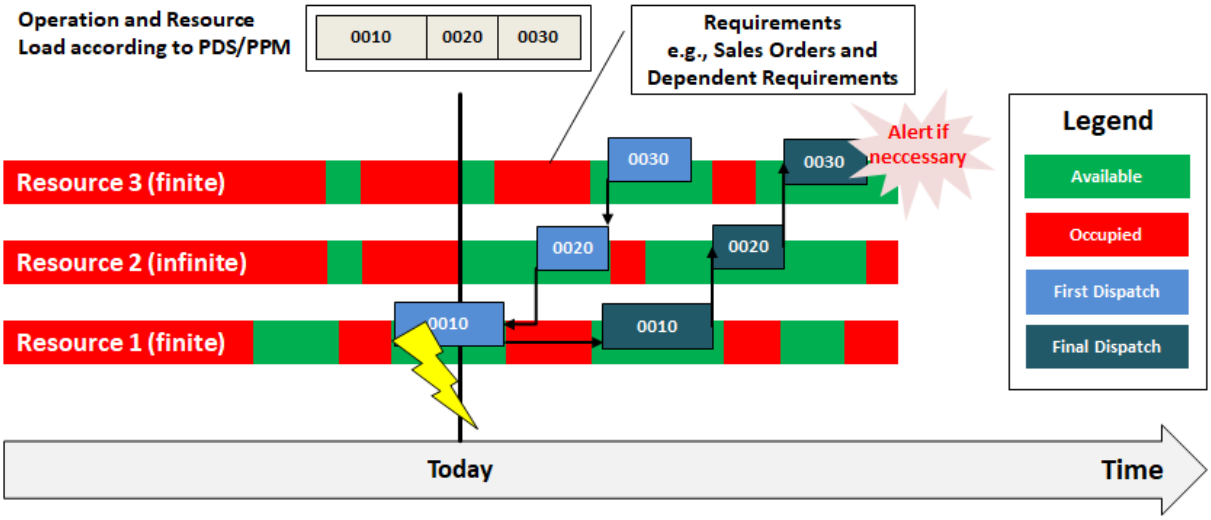


Figure 89: Simultaneous Quantity and Capacity Planning

3.1.3.4.1 Multilevel Backward Scheduling in PP/DS

If insufficient stock or receipt quantities exist to cover a requirement, the PP run generates a planned order. In this case (as with MRP), the PDS is exploded to generate dependent requirements for the assemblies. The planning on the next-lower BOM level takes place analogously. Planned orders are also created here if there are not sufficient stock or receipt quantities for the dependent requirement. This BOM level could also have assemblies with dependent requirements, which are then also scheduled, and so on.

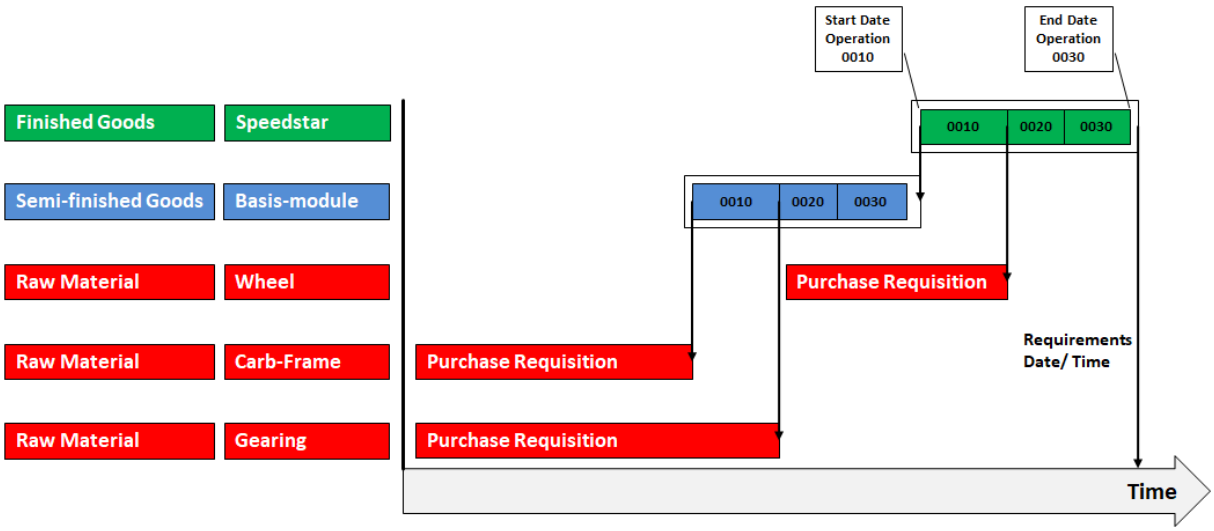


Figure 90: Multi-level Backward Scheduling in PP/DS

After the lot size of the planned order has been determined and the PDS has been exploded, the dates for the individual planned orders are calculated in PP runs. Possible processing times in the PDS and possible goods receipt processing times from the product master data are taken into account.
The requirement dates for the dependent requirements are moved to the dates of the operations of the PDS, which enables plant-specific and just-in-time material supply.
The system adopts the material supply based on the assignment of components to operations in the PDS. The date for the dependent requirements of the BoM components is set to the production start date of the operations to which they are assigned.

3.1.3.4.2 Excursus: Methods of Advanced Planning

In the following, we will briefly introduce the central methods used in Advanced Planning.

3.1.3.4.2.1 Pegging in PP/DS

Pegging is a feature that associates product demand with appropriate existing product receipts and product stocks that can meet the demand. Pegging organizes the material flow across all BOM levels. This means that all material requirements are taken into account, from the procurement of components and raw materials to the delivery of, for example, a sales order. The linked orders and their pegging relationships form a pegging structure. The following figure shows an example of a pegging structure wherein the arrows indicate the pegging relationships, i.e. represent the material flow.

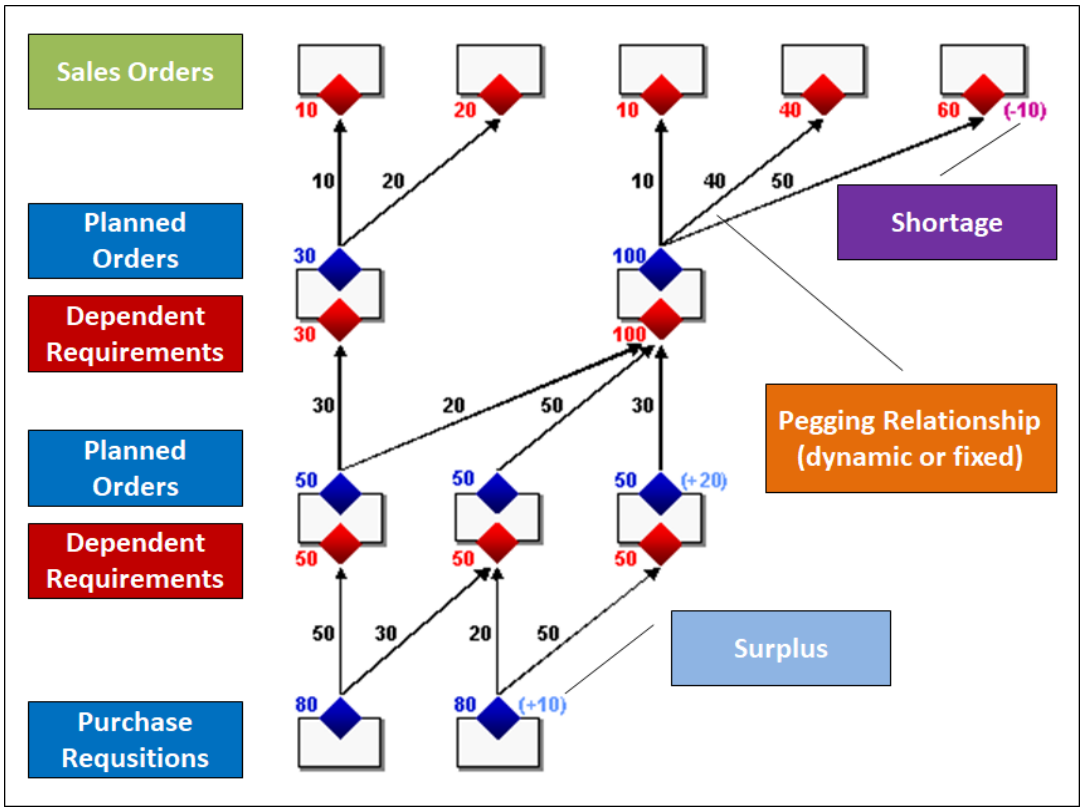


Figure 91: Pegging (SAP Online Library)

In PP/DS there are two types of Pegging: Dynamic Pegging and Fixed Pegging.
With **dynamic pegging**, the system automatically links the requirements for a location product with suitable stocks or receipts for the location product. If the planning for the location product changes, for example, new requirements or receipts are created or dates are changed, the system can use dynamic pegging to create new dynamic pegging relationships that are adapted to the changed planning. As a rule, dynamic pegging relationships are only kept for a short time.
Dynamic pegging relationships are evaluated by various PP/DS applications. For example, this is done to analyze the planning situation, to identify planning problems or to perform certain planning tasks. For this reason, these applications automatically perform dynamic pegging when needed.
Different PP/DS heuristics process pegging relationships depending on their planning task and therefore carry out dynamic pegging in the heuristic run. For example, the heuristics of sales order-oriented planning SAP_PP_014, SAP_PP_015, and SAP_PP_016 can determine open planned independent requirements based on pegging relationships that have no sales orders and reduce these planned independent requirements and the corresponding planned orders at the lower BoM-levels accordingly.

If **fixed pegging** is used, the assignment of a sales order item to a receipt element remains stable. In addition, the component assignments can be kept stable over several levels. In other words, components assigned to an order through fixed pegging cannot be consumed by other competing orders. This means that it is easier to uphold the confirmation date communicated to the customer as the delivery date.

Pegging over the entire BOM Structure
A requirement element of an order can be linked with a receipt element or an element of another order via a fixed or dynamic pegging relationship.

- A planned order requiring a particular component may e.g. associated with a purchase requisition for the component in external procurement.
- It can also be linked to a planned order for the component in in-house production.

Pegging relationships should be taken into account when scheduling or rescheduling a job or an activity from an order. That is, the system must schedule or reschedule so that no demand dates are violated. This can lead to the system having to schedule or reschedule objects with pegging relationships. Therefore, date values or date changes must be passed to the dependent objects.

3.1.3.4.2.2 Production Planning Run in PP/DS

PP planning operations determine which planning action the system performs for each product as soon as a planning-relevant event occurs for a product. For example, the system can automatically schedule the product affected by a requirements change or write a planning file entry for the product.

The procurement planning of products – especially for products with planning entries (net change planning) – is carried out by executing a **production planning run**. ***Heuristics***, ***detailed scheduling functions*** or ***optimization*** for a large number of objects can be performed either

online / interactively (in dialog) or as a ***background job*** (batch). As part of a production planning run, several heuristics or functions can be executed one after the other, as required.

The **interactive planning** is usually used for important products, if the planer needs to plan them manually in the dialog process, or to solve any planning problems that have occurred during the automatic planning. For interactive planning, various tools are available, e.g. the DS planning board or the product planning board.

Detailed scheduling automatically takes place on the resources and takes into account different planning conditions (for example, the availability of components or resources).

The **optimization tool** allows optimizing the resource plan according to certain criteria, such as setup times and setup costs, with the aim of improving the planning situation and solving certain detailed scheduling problems.

As mentioned earlier, PP/DS uses **pegging** to create relationships between the stock, receipt, and demand elements of a product within a location. Based on these relationships, the system can identify quantity and date or time issues and forward date or time changes to other BOM levels.

Within the scope of the PP run, several successive processing steps can be defined for which the system executes different **heuristics** for the defined objects. You can specify which objects are to be processed with which heuristics. The objects must be compatible with the selected heuristic. For example, PP heuristics can only be used to plan products.

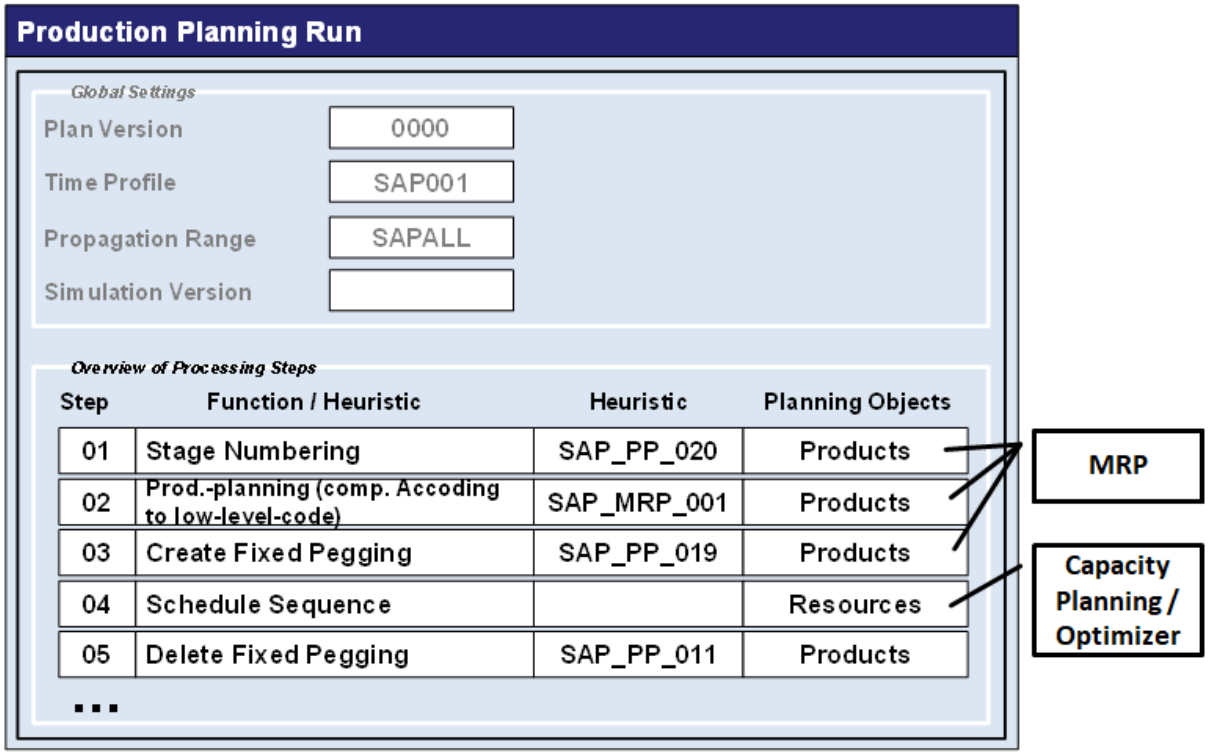


Figure 92: Production Planning Run

3.1.3.4.2.3 Execution of Heuristics in Production Planning (PP)

Heuristics are used for production planning (PP heuristics),

- to create procurement proposals in **interactive planning** or in the **production planning run** for uncovered product requirements
- to carry out **other planning tasks** for products or orders

PP/DS includes a variety of standard heuristics for procurement planning, scheduling and other planning tasks. The different heuristics make it possible to carry out procurement planning with different lot-sizing and MRP procedures. In a planning run, several heuristics can be executed in sequence as required.

The normal requirements planning (Infinite Planning) is carried out with the heuristic **SAP_MRP_001 (Product Planning (Comp. After service level))**. This MRP heuristic is used if, for example, procurement planning is to be carried out according to low-level codes for many products (MRP planning run). The MRP heuristic processes the products in the order of their low-level codes. From the component level (bottom up) you can then reschedule to resolve backlogs due to scheduling durations and pass delays on to the final product.

Infinite planning with heuristic SAP_MRP_001 creates new planned orders in PP/DS. The relevant basic settings for this planning are made in the strategy profile in PP/DS Customizing. Capacities are not checked in the infinite planning. Planned orders are created with the defined lot-sizing procedure, regardless of the capacity utilization.
Capacity planning takes place in a second step using special DS heuristics or optimizations. In a PP run, you can automatically perform all steps in the background.

The heuristic **SAP_PP_020 (Stage Numbering Algorithm)** from the *other planning tasks* area must be used regularly to ensure consistent planning. This heuristic determines the low-level-codes of products. It can be scheduled at the beginning of planning or separately (for example once a week).

3.1.3.4.2.4 Finite Capacity Planning (DS)

If a planned order is created during finite planning, the system checks whether the capacities and components required for production are available. A planned order can only be created if sufficient capacity is available on the resources involved. If there is no capacity available at the desired time, the planned order can be created later if the required capacity is available and this delay is indicated by a corresponding alarm.

The existing production plan can be improved in a subsequent step using DS heuristics or DS optimization.

DS Heuristics

Detailed scheduling heuristics are used to plan operation sequences on resources. Examples of such heuristics are *reduce processing time* and *dissolve backlog*. For example, the finite capacity planning step can be performed using the DS heuristic plan sequence **SAP001**. It is typically used for bottleneck resources for which an accurate planning sequence can be

specified. The user can freeze orders for resources and date shifts and pass them on to the bill of material structure using bottom-up planning (for the finished product) or top-down planning (for components). This optimization can be used, for example, to reduce setup time, lead time, and delays resulting from the original schedule.

DS Optimization

As an alternative to planning with DS heuristics, capacity planning in the production plan can be optimized using **DS optimization**. Optimization in PP/DS is used after an infinite MRP run has been executed. During optimization, the system carries out finite scheduling to achieve a feasible production plan.

DS optimization optimizes the production deadlines and resource allocation of operations according to the following criteria that are set in the optimization profile:

- Production Range
- Assembly
- Set-up costs
- Delay costs
- Mode Returns

The optimization determines a schedule for scheduling in the optimization range in which a result as close as possible to the desired result, for example, the minimum setup time, is achieved. To do this, the system varies the start dates and the resource allocation for the operations.

Example: Optimization with set-up times

For example, the planning of individual resources can be optimized based on the total setup time and the total setup cost. The system uses the setup matrix (which can only be maintained for single resources) to determine sequence-dependent setup times and setup costs. The objective function can then be used to determine the goal of the optimization. Various objective functions such as minimization of costs and delays are available.

The following figure shows an example in which the objective function consists of the sum of the setup times. The setup times or setup costs result from the setup matrix for the objective functions. The setup time in the setup matrix can be any time unit, e.g. hours or minutes. The system uses seconds for the setup time in the target function. For example, if a setup time of 10 minutes is entered, the system uses the value 600 (seconds) in the objective function.

Setup costs can also be entered in the setup matrix. Setup costs have no units. In the objective function, the system uses the value entered in the setup matrix.

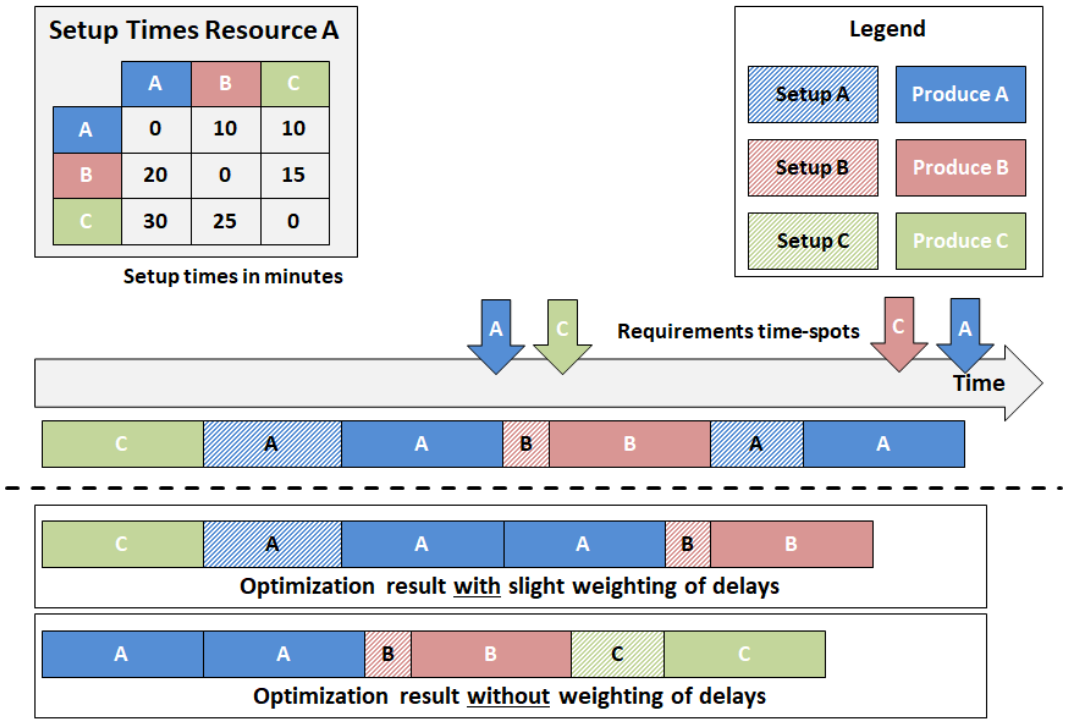


Figure 93: Optimization with Setup Times

3.1.3.5 Tools in PP/DS

PP/DS offers a number of tools that facilitate and graphically support the central and interactive execution of procurement planning in Interactive Planning. In the following, we briefly introduce the **product view** and the **detailed scheduling planning board**.

3.1.3.5.1 Product View

The **product view** is a user interface in PP/DS that displays information on requirements, receipts and stocks for a selected location product and makes it possible to evaluate the planning situation for the product in the location.

The product view is a versatile and flexible tool, and offers various functions for processing receipts and demands, including:

- Display and change individual MRP elements
- plan interactively
- access the alert monitor

The structure of the product list is shown in the following figure:

- The upper part of the product view screens contains a header with the considered product number.
- On the left side there is an (optional) overview tree that can be shown and hidden. This navigation tree represents the scope of the product view.
- In the main area of the screen is the actual work area. This area is divided into several tabs, each providing different information about the planning situation. Available tabs are: Elements, Periods, Quantities, Stock, Product Master and Pegging Overview.
  In the Elements tab, for example, the list with the individual MRP elements and the corresponding available elements that can be displayed and edited is shown.
- User-specific settings allow users to customize the display to their own needs.

The product view is a dynamic list. If the interactive planning is performed by a planer and the results are saved, the new planning situation is displayed in the product view. It is also possible to update the list if the current planning status should be displayed after some time.

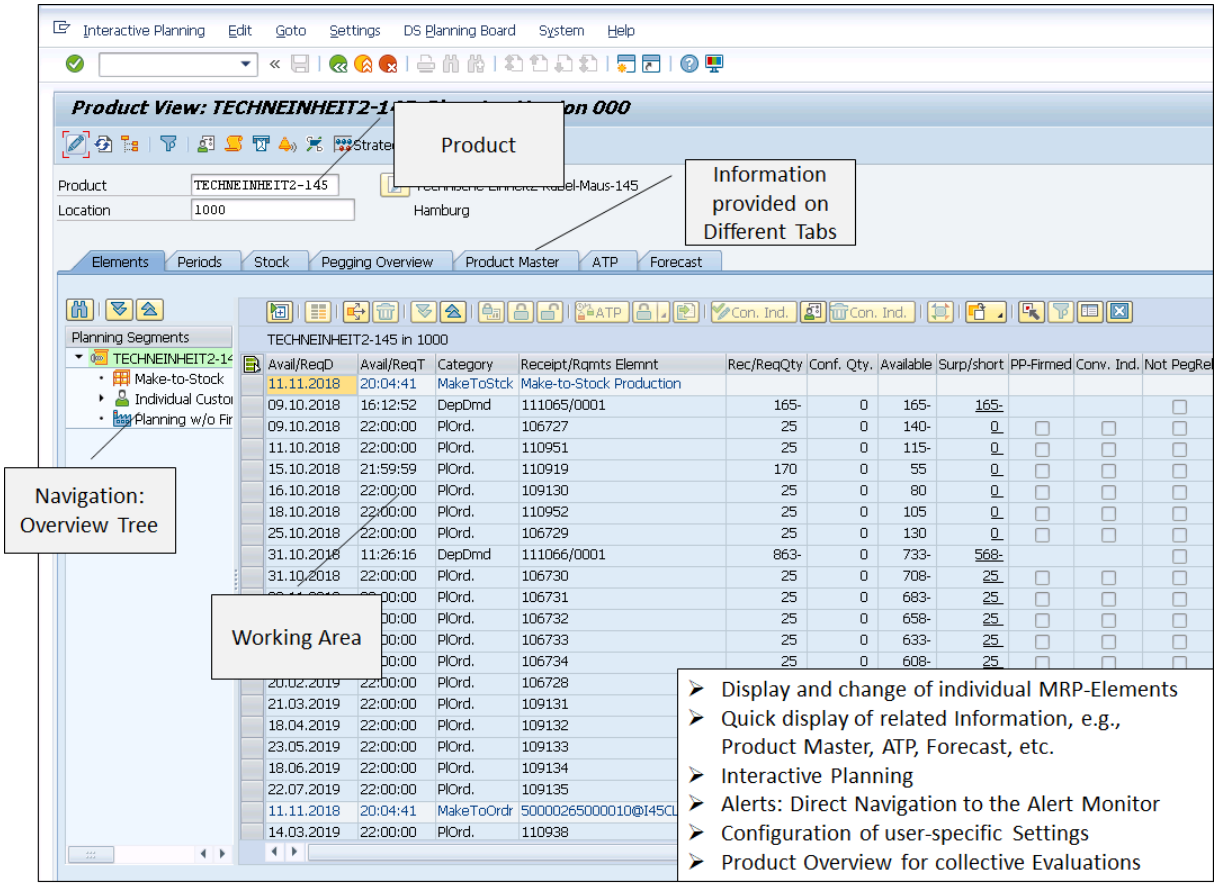


Figure 94: Product View: SAP-System-Screenshot

3.1.3.5.2 Detailed Scheduling Planning Board

Using the DS planning board, planers can perform interactive planning to help solving planning issues, such as scheduling problems and sequencing problems on resources, or to deal with alarms. You can call the planning board directly from the PP/DS menu or from the order processing.

The DS planning board is used to

- *Graphically depict the planning situation*: In the individual screens of the detailed scheduling planning board, you can graphically represent different aspects of scheduling in the charts of the detailed scheduling planning board. For example, you can show the situation of operations on resources over time and the development of the resource utilization or pegging relationships between orders over time.
- *Interactively resolve planning problems*: You can perform interactive scheduling on the detailed scheduling planning board to solve scheduling problems such as sequence or date/time problems on resources. Various scheduling functions and heuristics are available in addition to manual scheduling with Drag & Drop.

The user can select a layout for the planning board, for example, to specify that different diagrams (e.g., the resources and order tables) are displayed, and which field selections and layout to display for the columns in the table section of the diagrams.

Furthermore, the objects that are displayed in the diagram area, can be assigned, e.g.

- Operations and orders (graphical objects)
- Histograms (curves for stock and resource loads)
- Network views of transactions and orders
- Time and pegging relationships between operations and orders

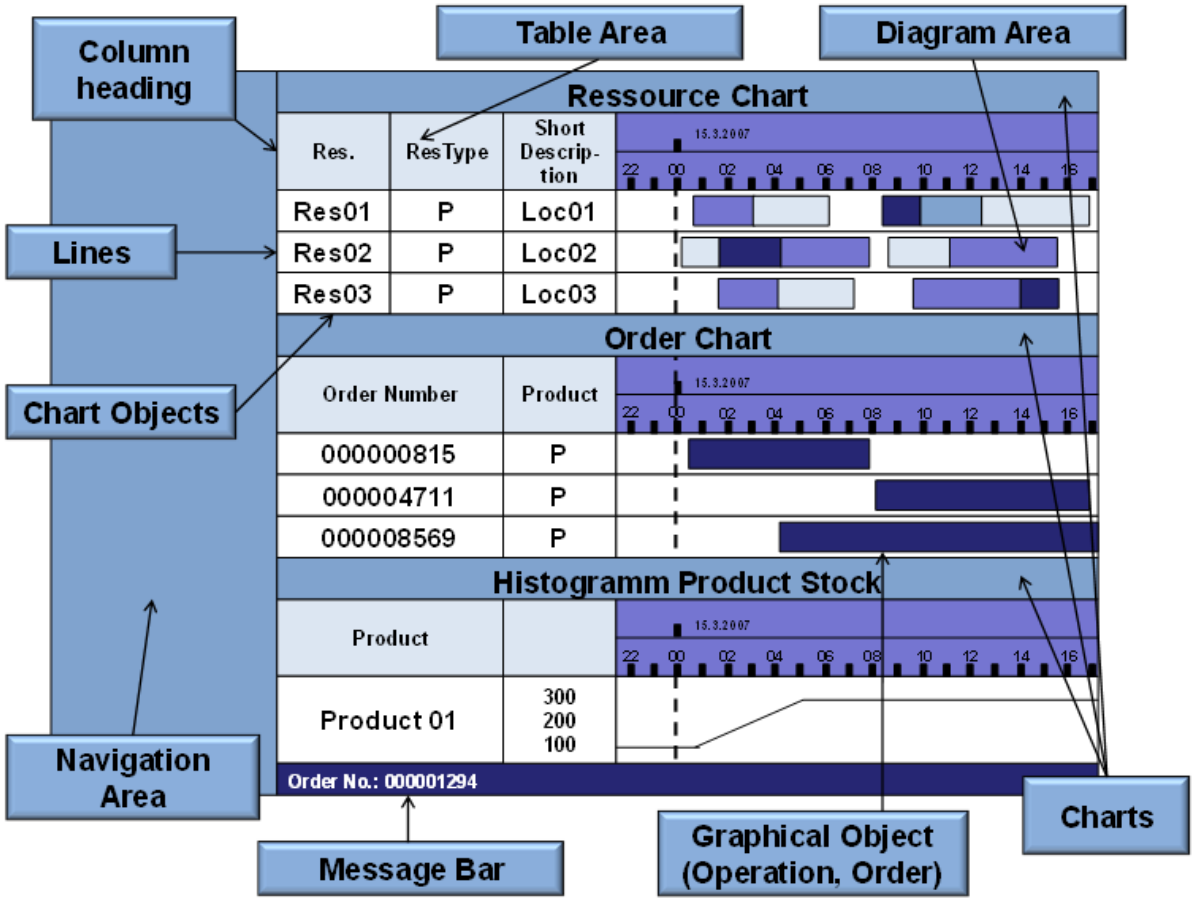


Figure 95: Detailed Scheduling Planning Board

3.1.3.6 PP/DS Planned Orders

With the execution of detailed scheduling (DS), PP/DS planned orders are scheduled. This means that a planned order then contains all the operational dates. Procurement of the required components is also planned specifically for each operation.

If a strategy was used for the planning of a planned order that provides **finite planning**, simultaneous quantity and capacity planning takes place at the level of the planned order. The availability of the capacities required for production is thus automatically guaranteed.
If an **infinite planning strategy** has been used, capacity planning must take place in a separate step at a later date.

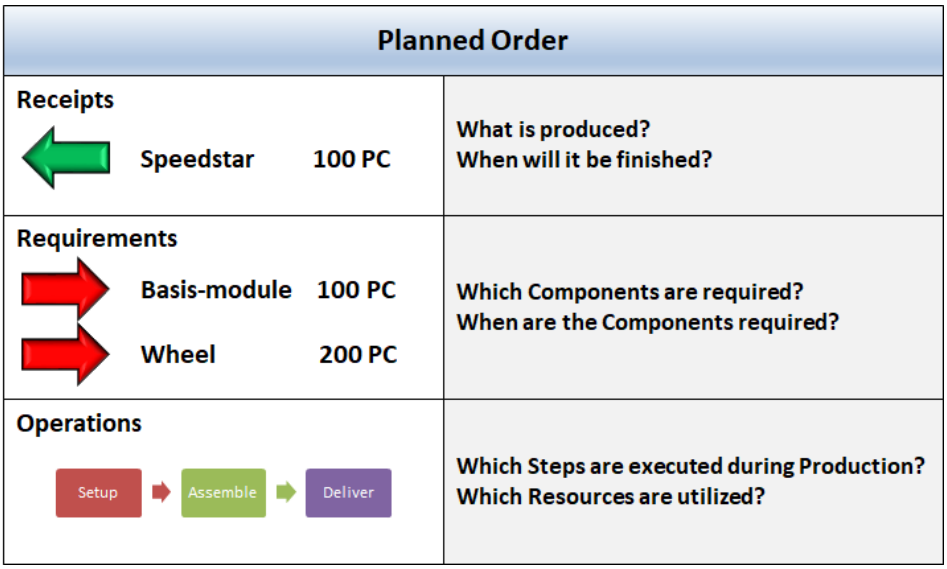


Figure 96: Planned Orders in PP/DS

Planned orders created in PP/DS can be transferred to the SAP S/4HANA application PP. However, the corresponding SAP S/4HANA PP planned orders do not contain any operation dates. Instead, they contain the basic dates between which production is to take place. In addition, they contain the dependent requirements for PP/DS and non-PP/DS components. The planner can plan the procurement of the components in SAP S/4HANA based on the dependent requirements.

If production planning and control is to take place in PP/DS, the planned orders in PP/DS must be converted into production orders. The only difference between a PP/DS production order and an SAP S/4HANA PP planned order is the **conversion indicator**. If this indicator is set in PP/DS, a corresponding SAP S/4HANA production order is created. This order contains the production dates that were determined in PP/DS. Like every SAP S/4HANA PP production order, it also contains all the functions required to execute production in SAP ECC (e.g., printing order documents, confirmations, and so on).

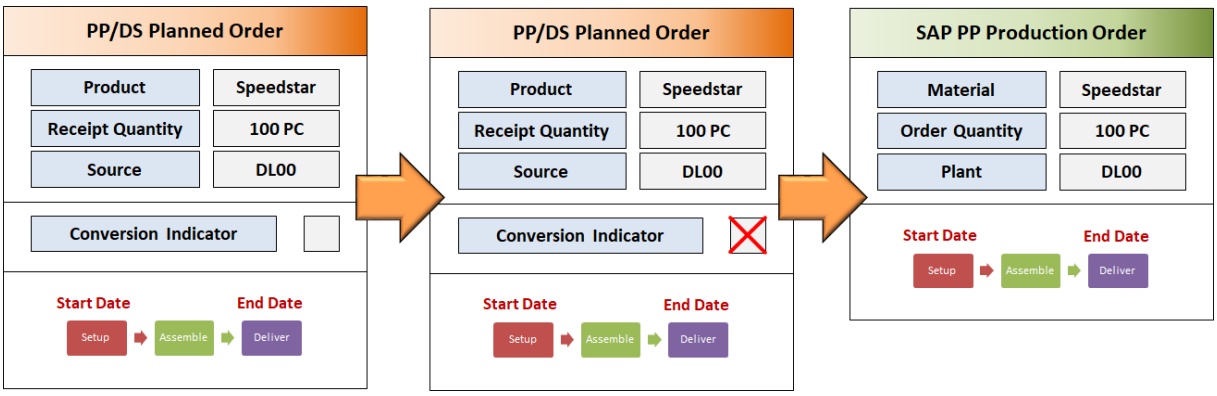


Figure 97: Planned Orders in PP/DS

3.1.3.7 Alert Monitor

The Alert Monitor is a component that can monitor the smooth operation of the PP/DS application. It provides a central point of access for possible problems in PP/DS and informs planners in the event of exceptional situations with corresponding information, warnings or error messages. It is also possible to send notifications by e-mail to the planner.

The occurrence of warnings depends on the context and is defined in the **alert profiles**. The display of alerts also depends on the planning version of the model.

Alerts are automatically available in the Alert Monitor and are displayed in a standard presentation component. The planer can access the PP/DS Alert object by drilling down in the appropriate application. **Alerts** have different **priority levels** and are issued as one of the following **standard alert types**:

- Information (lowest priority)
- Warning
- Error (highest priority)

You can also define your own alert types in Customizing.
Alert types are automatically assigned to a specific priority level but can be changed in Customizing to level 2 or 1. The **threshold values** can be defined either in the alarm profiles or in the definition of alert types.
A planner can name (time-dependent) substitutes for all of her favorites. This substitute can access the alert monitor and choose between her own favorites or the favorite of the substitute colleague (by replacing the substitute in the alert monitor).
If the basis application **Alert Notification Engine** is used, the planer can use the workflow to automatically send alerts. The Alert Notification Engine uses the functions of SAP NetWeaver Application Server 6.20 for this purpose. The type of notification is defined to use the notification profile and the alert notification profile (settings for the alert notification engine).

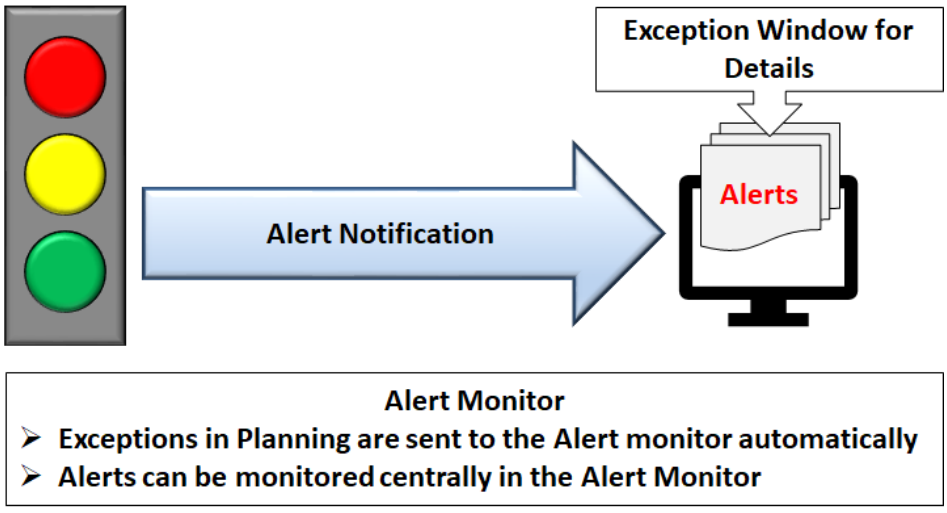


Figure 98: Alert Monitor

3.2 Practice: Product Cost Accounting

In the previous units you created all required master data (material master records, BOMs, routings) for the production of the two products. Thus, the entire structure of the Speedstar and Speedstarlett is available in the system. Now, as a **Controller** in the functional area **CO**, you need to calculate the costs of the goods manufactured and the costs of the goods sold for each product unit of the Speedstar and Speedstarlett. Thereby, you will use information from other departments. Therefore, you will carry out a **product cost calculation.**

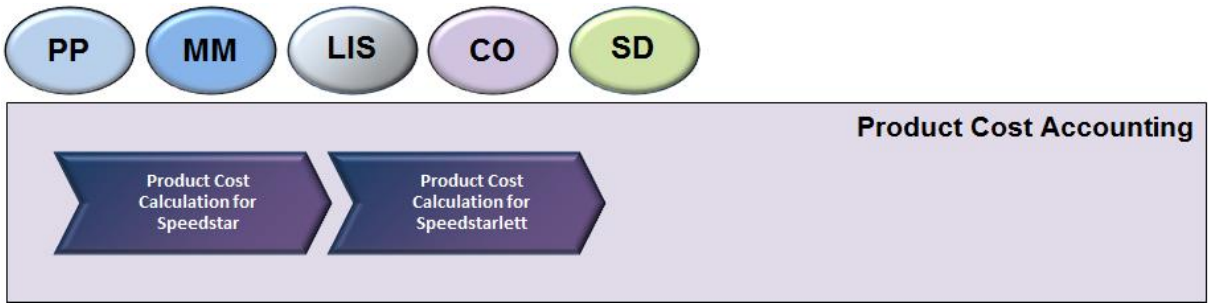


Figure 99: Process Overview: Product Cost Accounting

3.2.1 Product Cost Calculation for Speedstar

Currently, the value of your manufactured items (Speedstar, Speedstarlett, Basis-Module, and Basis-Module 2) is calculated according to the standard prices specified in the material master. These standard prices are, however, not the actual costs for the manufacturing process of your products. Therefore, you have to conduct a product cost calculation.

The calculated price (planned price), the standard price, and the moving price are figures to value a material in terms of Accounting. They are usually not the sales price for a material since the sales price is negotiated using conditions with the customer. The planned price is a figure for the costs incurred during the manufacturing process. Correspondingly, the term "prices" used in the SAP jargon should not be confused with market prices that were negotiated with customers. They serve merely for the valuation of a material in terms of accounting.

The **product cost calculation** is a procedure to determine manufacturing costs and costs of goods sold regarding a cost object. Thereby, the system uses the quantity structures of ***BOM*** (material input quantity) and ***routing*** (standard times). The valuation approaches on the one hand originate from the material master of components, and on the other hand from the tariffs for each activity output of the GBI, determined in cost-center accounting. The calculation is the basis for determining

- standard costs
- variances of produced materials regarding the respective standard price
- contribution margin of materials sold

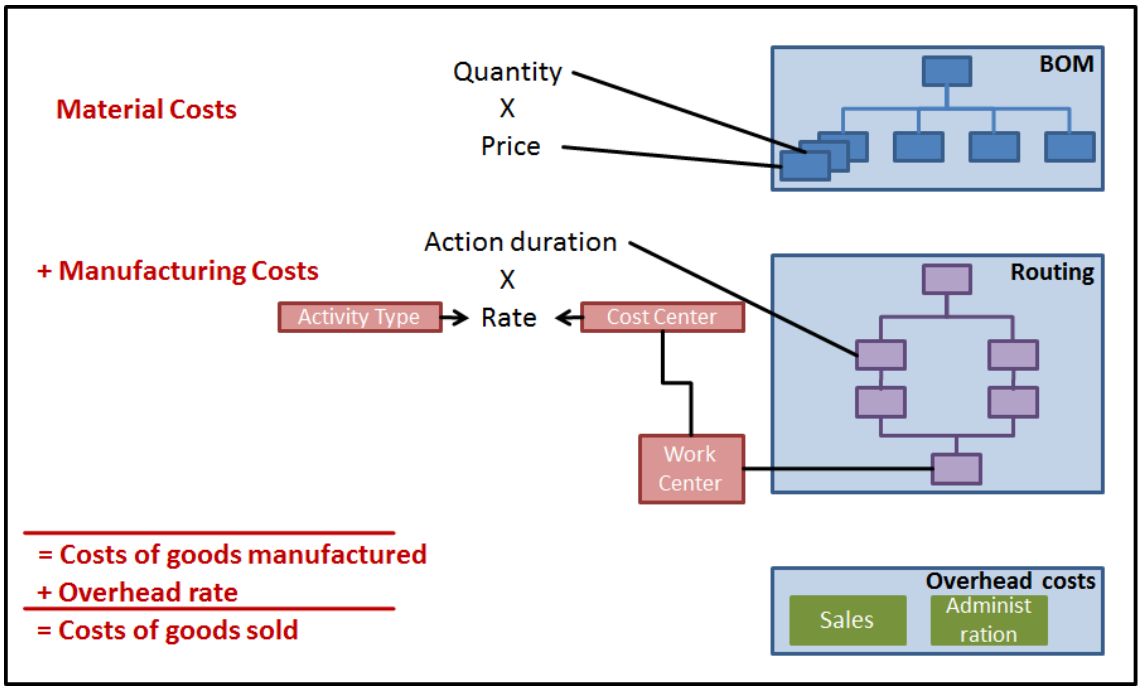


Figure 100: Product Costing

3.2.1.1 Product Cost Calculation: Basis-Module

First, carry out a product cost calculation for the semi-finished product ***Basis-Module-xyyy***, since this is required for the product cost calculation of the Speedstar. Therefore, within the tile group **Script 2 – Design-to-Operate** select the app ***Create Material Cost Estimate***.

1. In the **Create Material Cost Estimate** dialog, enter the following data:
   - **Material** ***Basis-Module-xyyy***
   - **Plant** ***DL00***
   - **Costing Variant** ***PPC1 (Standard Cost Est.)***
   - **Costing Version** ***01 (Calculation Version 01)***
   - **Costing Lot Size** ***1***
   - Confirm with *Enter*.
2. The system automatically goes to the next tab. Set the following date:
   - **Costing Date From** ***current date***
   - Confirm with *Enter*.

The system now calculates the material costs. This is carried out with reference to the routing and the BOM.

For comparison:
Costs with reference to the costing lot size 1 were displayed. Costs should be approximately consistent with the following figure (small variances of approx. 1 USD are usual).

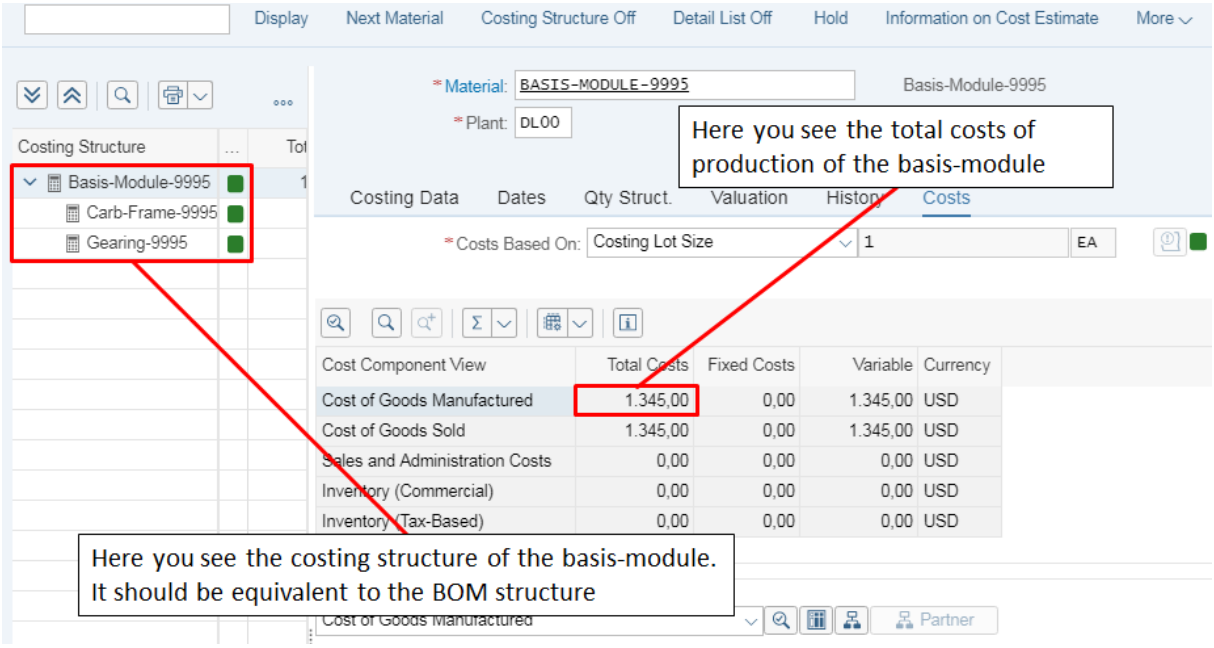
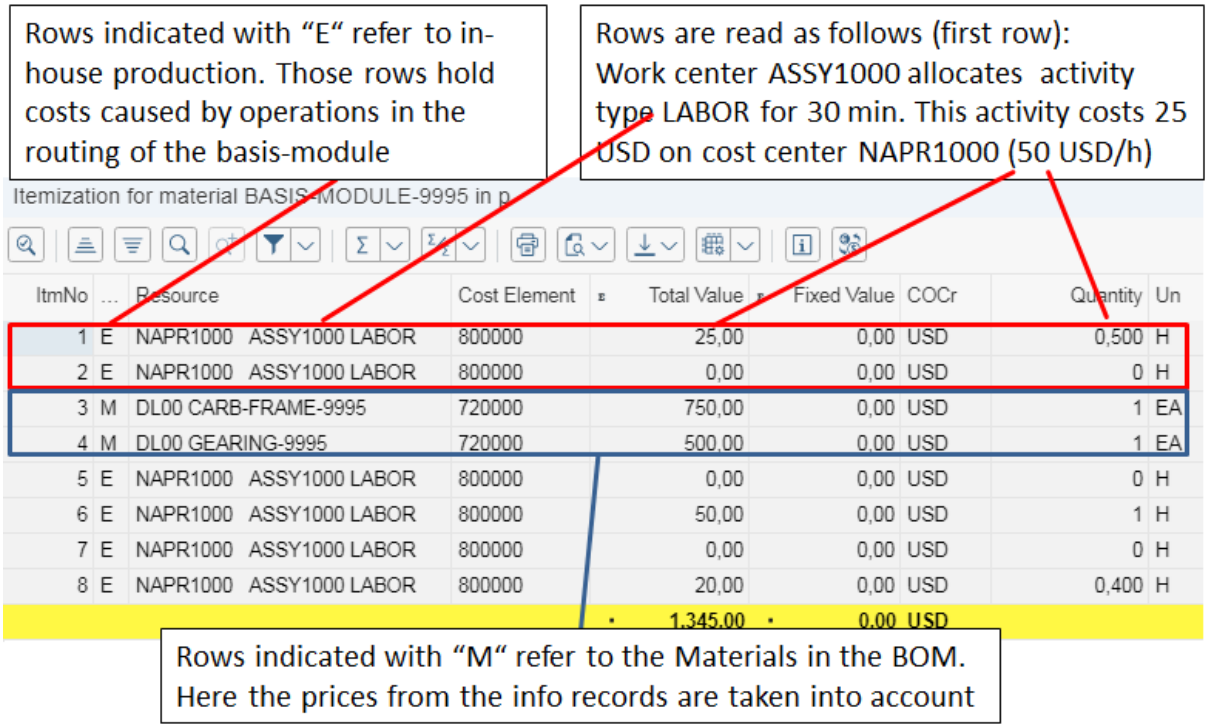


Figure 101: Product Cost Calculation Basis-Module: SAP-System-Screenshot

In the lower part of the screen, you can see the itemization (if not, go to the menu and select **More → Costs → Itemization** or press **F6**, respectively). You should see the following figure (small variances are usual):

Compare your estimate with the numbers stated in the figures. If you have differences ***DO NOT SAVE*** *your estimate. You can easily find out what went wrong if your numbers are different (if in Itemization there are differences regarding quantities of rows, but the total value is equal, you do not have to correct anything):*

- *If you miss rows of Type "**E**" compared to the figure below, you forgot something in your routing. In that case go to transaction CA02 and check your routing operations you have defined before.*
- *If you miss rows of Type "**M**", you forgot something in your BOM. In that case go to transaction CS02 and check your BOM components you have defined before.*



ItmNo	...	Resource	Cost Element	Total Value	Fixed Value	COCr	Quantity	Un
1	E	NAPR1000 ASSY1000 LABOR	800000	25,00	0,00	USD	0,500	H
2	E	NAPR1000 ASSY1000 LABOR	800000	0,00	0,00	USD	0	H
3	M	DL00 CARB-FRAME-9995	720000	750,00	0,00	USD	1	EA
4	M	DL00 GEARING-9995	720000	500,00	0,00	USD	1	EA
5	E	NAPR1000 ASSY1000 LABOR	800000	0,00	0,00	USD	0	H
6	E	NAPR1000 ASSY1000 LABOR	800000	50,00	0,00	USD	1	H
7	E	NAPR1000 ASSY1000 LABOR	800000	0,00	0,00	USD	0	H
8	E	NAPR1000 ASSY1000 LABOR	800000	20,00	0,00	USD	0,400	H
				1.345,00	0,00	USD		

Figure 102: Product Cost Calculation: Itemization Basis-Module: SAP-System-Screenshot

- ***Save*** your calculation. In the next dialogue, choose **Itemization** and **Log** if necessary and confirm with *Enter*. The calculation is now saved. Leave the dialogue pressing ***Exit***.

Price update:

Using price updates, you can transfer the results of the product costing in the material master record. Price update consists of two steps: marking and releasing. Therefore, within the tile group **Script 2 – Design-to-Operate** select the app ***Release Material Cost Estimate***.

- Enter the following data:
  - **Posting Period** ***current month*** (e. g. 10 for October)
  - **Company Code** ***US00***
  - **Plant** ***DL00***
  - **Material** ***Basis-Module-xyyy***
  - **Test Run** ***deselect***
  - **With List Output** ***select***
- Execute the marking with **Execute** button.

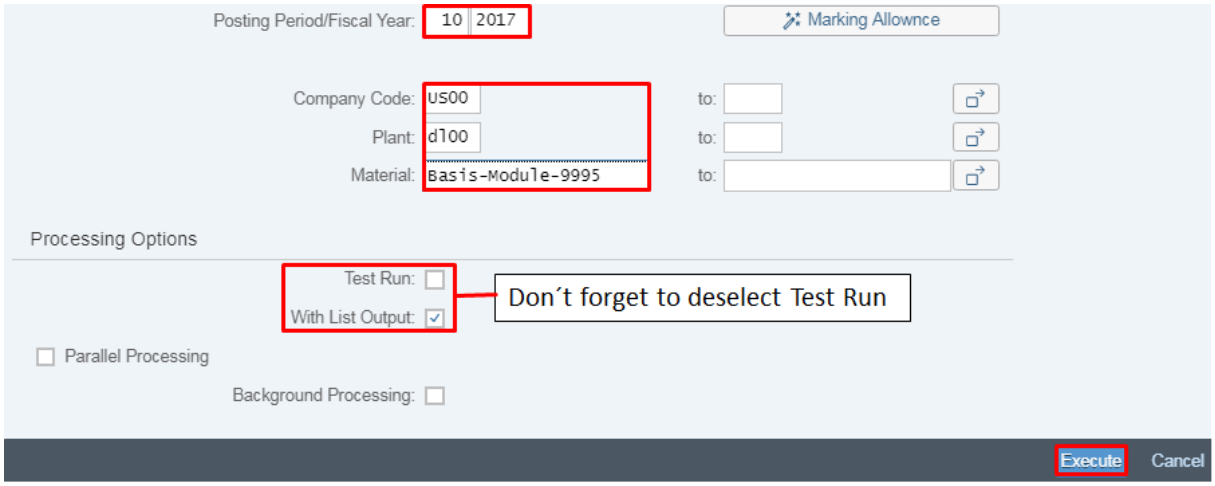


Figure 103: Mark Standard Price: SAP-System-Screenshot

- When successfully completed, the following text is displayed: **Of 1 materials, 1 cost estimates were updated successfully**. Go back one step ( ) in order to see the following screen.

NOTE

*In case you are receiving the notification **Of 0 materials, 0 cost estimates were updated successfully**, proceed as follows: Open the **Change Material** app and for the respective material, check the Costing 2 view. There are 3 options:*

***Option 1**: The new price is not displayed, at all:*
- *Within the **Create Material Cost Estimate** app, create a new cost estimate and save.*
- *Within the **Release Material Cost Estimate** app (Marking view), mark the new price. The price will be stated in the **Future** field in material master record (Costing 2 view).*
- *Within the **Release Material Cost Estimate** app (Releasing view), release the new price. The price will be stated in the **Current** field in material master record (Costing 2 view).*

***Option 2**: The new price is displayed in the Future price field:*
- *Within the **Release Material Cost Estimate** app (Marking view), the marking was already performed.*
- *Release the new price in **Release Material Cost Estimate** (Releasing view).*
- *The price will be then stated in the **Current** field in material master record (Costing 2 view).*

***Option 3**: The new price is displayed in the Current price field:*
- *You already have performed price updating / price releasing. Continue with the next material.*

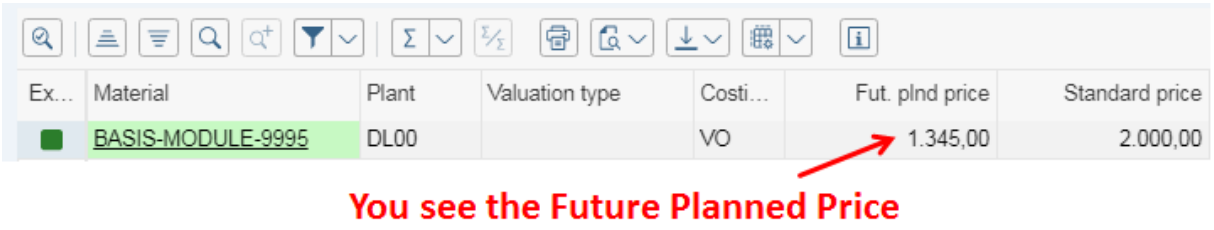


Figure 104: Future Planned Price: SAP-System-Screenshot

You can see the result of the marking in the material master of Basis-Module. Look at the material master. Therefore, within the tile group **Script 2 – Design-to-Operate** select the app ***Display Material***.

1. Enter your material (***Basis-Module-xyyy***) and press *Enter*.
2. Select the ***Costing 2*** view and confirm the dialogue.
3. Enter **plant *Dallas (DL00)***. Go to the next screen.
4. In the **costing column *Planned price***, you can see the marking of the planned future price. Close the view.

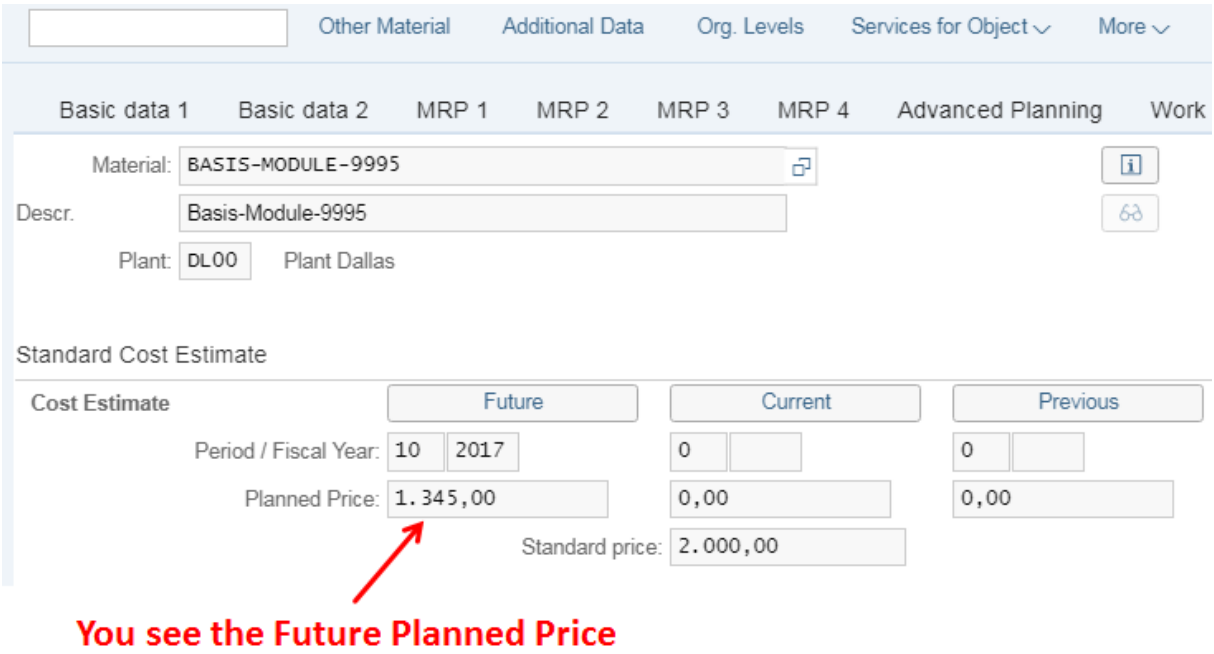


Figure 105: Future Planned Price updated in Material Master: SAP-System-Screenshot

If the price update did not have an impact on your data, you maybe did not deselect the test run. In this case repeat the price update (and this time deselect it).

Now, you need to **release** the planned price. Call up the following transaction:

Therefore, within the tile group **Script 2 – Design-to-Operate** select the app ***Release Material Cost Estimate***.

1. Click on the Release button.
2. Enter the following data:
   - **Posting Period** ***current month*** (e. g. 10 for October)
   - **Company Code** ***US00***
   - **Plant** ***DL00***
   - **Material** ***Basis-Module-xyyy***
   - **Test Run** ***deselect***
   - **With List Output** ***select***
3. Execute the marking with the **Execute** button.
4. Go one step back ( ). You should get the following screen. Note that the column header says "Standard price" now. When you marked the cost estimate the column title said "Future planned price". Close the view by pressing ***Exit***.

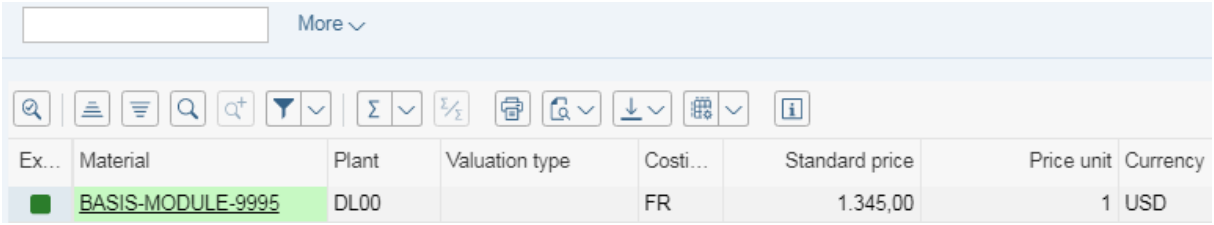


Figure 106: Released Standard Price: SAP-System-Screenshot

Take a closer look at the result of the release. Therefore, call again within the tile group **Script 2 – Design-to-Operate** select the app ***Display Material***.

1. Enter your **material** (***Basis-Module-xyyy***) and select the ***Costing 2*** view. Continue with ***Enter***.
2. Enter **plant *DL00 (Dallas)***. Go to the next screen.
3. In the middle column (**current**), you can see the previously marked **future planned price** as **planned and standard price** for the current period.

For comparison:
Your result should look like this. You will note that the actual costs, which consider the BOM and the routing, are about 655 USD less than the previously entered 2000 USD.

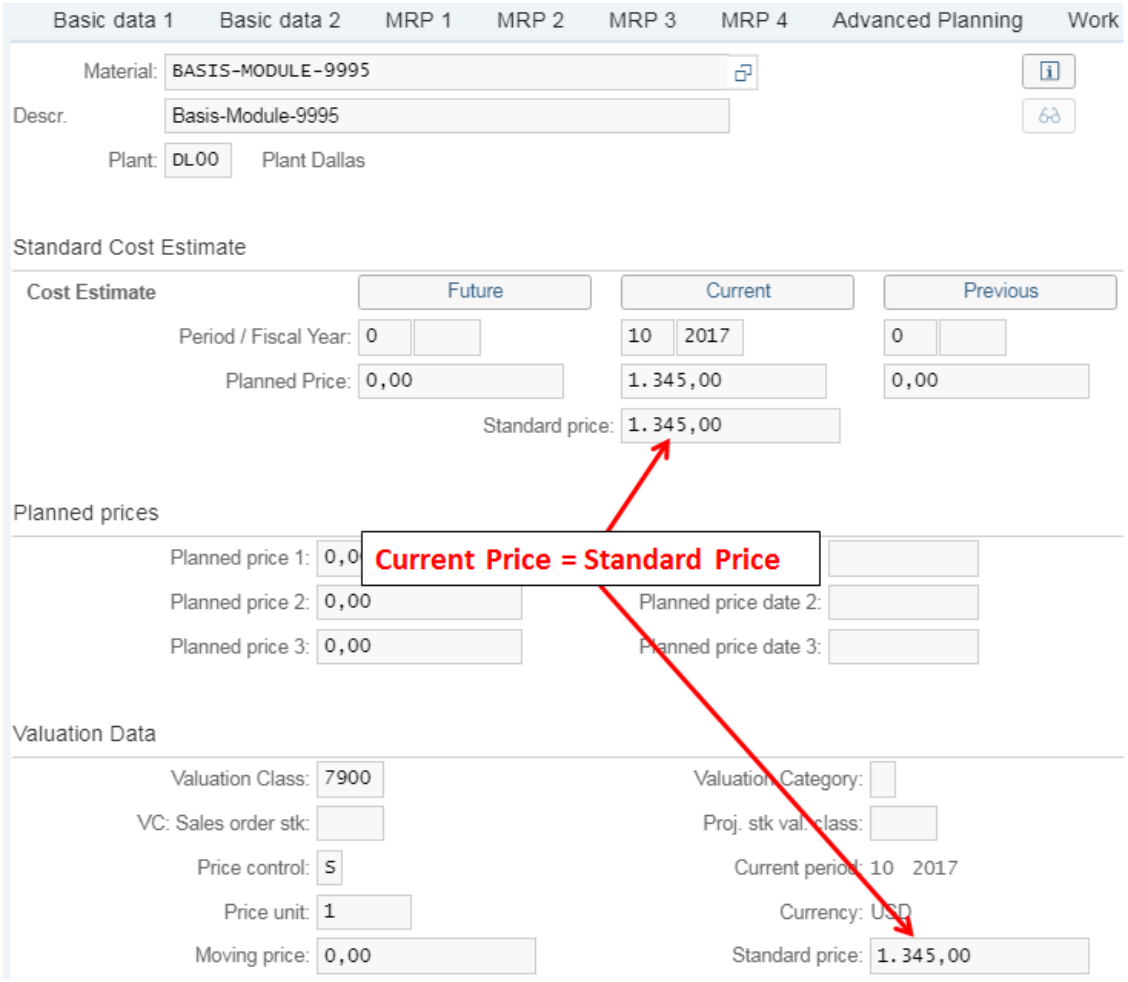


Figure 107: Result of the Price Update for the Basis-Module: SAP-System-Screenshot

In case your results differ, there are 3 options:

***Option 1**: The new price is not displayed, at all:*

- *Within the **Create Material Cost Estimate** app, create a new cost estimate and save.*
- *Within the **Release Material Cost Estimate** app (Marking view), mark the new price. The price will be stated in the **Future** field in material master record (Costing 2 view).*
- *Within the **Release Material Cost Estimate** app (Releasing view), release the new price. The price will be stated in the **Current** field in material master record (Costing 2 view).*

***Option 2**: The new price is displayed in the Future price field:*

- *Within the **Release Material Cost Estimate** app (Marking view), the marking was already performed.*
- *Release the new price in **Release Material Cost Estimate** (Releasing view).*
- *The price will be then stated in the **Current** field in material master record (Costing 2 view).*

***Option 3**: The new price is displayed in the Current price field:*
You already have performed price updating / price releasing. Continue with the next material.

3.2.1.2 Product Cost Calculation: Speedstar

Now, we need to carry out the same procedure for our finished product Speedstar. Therefore, within the tile group **Script 2 – Design-to-Operate** select the app ***Create Material Cost Estimate***.

1. In the **Create Material Cost Estimate** dialog, enter the following data:
   - **Material** ***Speedstar-xyyy***
   - **Plant** ***DL00***
   - **Costing Variant** ***PPC1 (Standard Cost Est.)***
   - **Costing Version** ***01 (Calculation Version 01)***
   - **Costing Lot Size** ***1***
   - Confirm with *Enter*.
2. The system automatically goes to the next tab. Set the following date:
   - **Costing Date From** ***current date***
   - Confirm with *Enter*.

The system now calculates the material costs. This is carried out with reference to the routing and the BOM. In the status bar, you receive the ***log with the system messages generated***.

For comparison:
Costs with reference to the costing lot size 1 were displayed. Costs should approximately be consistent with the following figure (small variances of approx. 1 USD are usual).

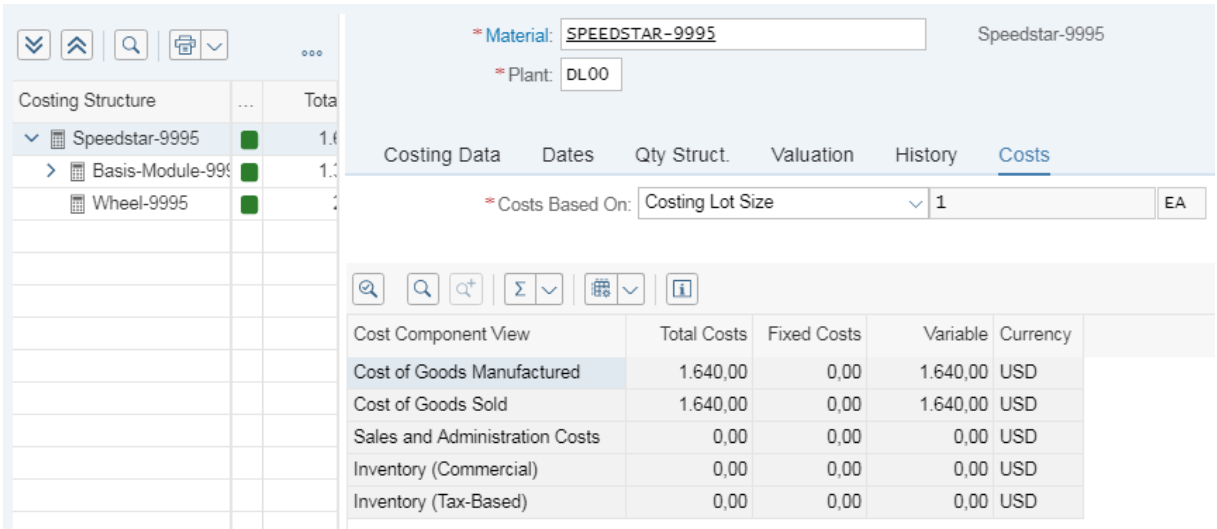
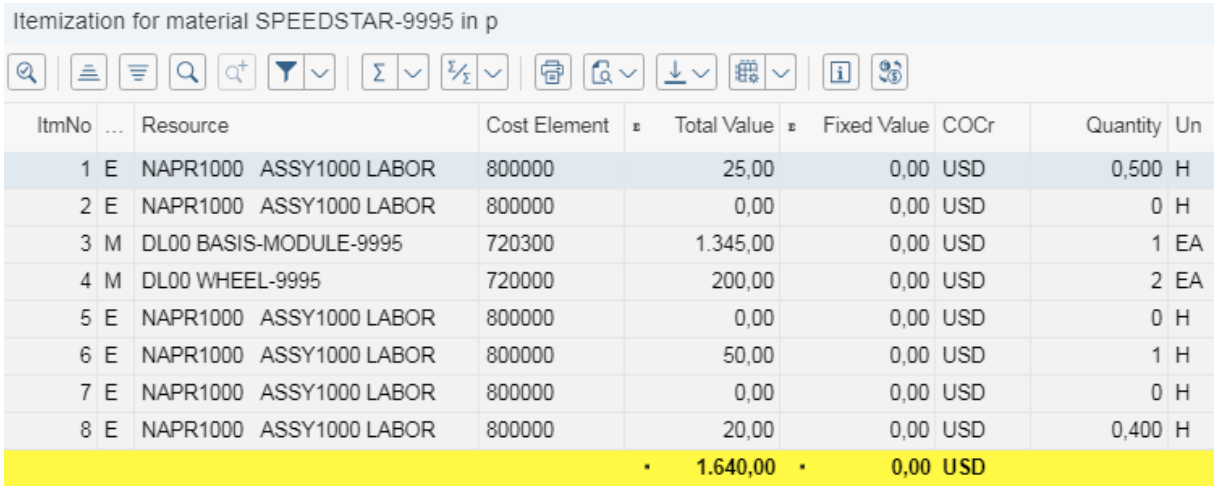


Figure 108: Product Cost Calculation Speedstar: SAP-System-Screenshot

In the lower part of the screen, you can see the itemization (if not, go to the menu and select **More → Costs → Itemization** or press **F6**, respectively). You should see the following figure (small variances are usual):
You can see that the cost calculation is estimated for the wheels as well as for your semi-finished Basis-Module. Overall, the result is an amount of ***USD 1545,00*** (total of lines with **item category M**) and ***USD 95,00*** for the internal activities.



Itemization for material SPEEDSTAR-9995 in p

ItmNo	...	Resource	Cost Element	Total Value	Fixed Value	COCr	Quantity	Un
1	E	NAPR1000 ASSY1000 LABOR	800000	25,00	0,00	USD	0,500	H
2	E	NAPR1000 ASSY1000 LABOR	800000	0,00	0,00	USD	0	H
3	M	DL00 BASIS-MODULE-9995	720300	1.345,00	0,00	USD	1	EA
4	M	DL00 WHEEL-9995	720000	200,00	0,00	USD	2	EA
5	E	NAPR1000 ASSY1000 LABOR	800000	0,00	0,00	USD	0	H
6	E	NAPR1000 ASSY1000 LABOR	800000	50,00	0,00	USD	1	H
7	E	NAPR1000 ASSY1000 LABOR	800000	0,00	0,00	USD	0	H
8	E	NAPR1000 ASSY1000 LABOR	800000	20,00	0,00	USD	0,400	H
				1.640,00	0,00	USD		

Figure 109: Product Cost Calculation: Itemization Speedstar: SAP-System-Screenshot

In case of large variances, please contact your tutor.

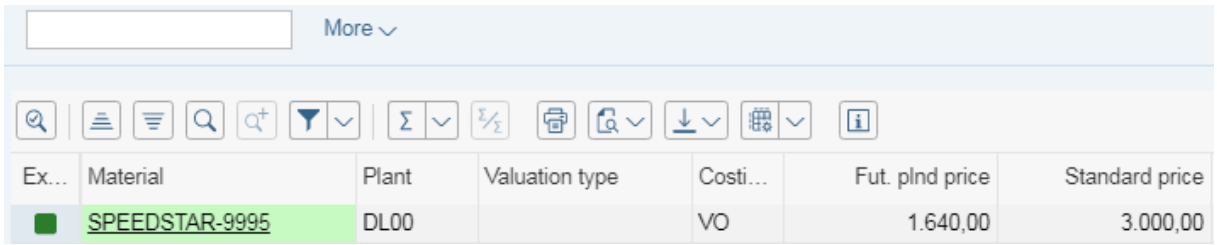
3. ***Save*** your calculation. In the next dialogue, choose **itemization** and **log** if necessary and confirm with *Enter*. The calculation is now saved. Leave the dialogue by pressing ***Exit***.

Price update:
Using price updates, you can transfer the results of the product costing in the material master record. Price update consists of two steps: marking and releasing. Therefore, call up the following transaction:

Therefore, within the tile group **Script 2 – Design-to-Operate** select the app ***Release Material Cost Estimate***.

1. Enter the following data:
   - **Posting Period** ***current month*** (e.g., 10 for October)
   - **Company Code** ***US00***
   - **Plant** ***DL00***
   - **Material** ***Speedstar-xyyy***
   - **Test Run** ***deselect***
   - **With List Output** ***select***
2. Execute the marking with the **Execute** button. When successfully completed, the following text is displayed: **of 1 materials, 1 cost estimates were updated successfully**.

   Go one step back ( ) and leave the dialogue by pressing ***Exit***..



More

Ex...	Material	Plant	Valuation type	Costi...	Fut. plnd price	Standard price
	SPEEDSTAR-9995	DL00		VO	1.640,00	3.000,00

Figure 110: Future Planned Price: SAP-System-Screenshot

You can see the result of the marking in the material master of Speedstar. Look at the material master. Therefore, choose the following transaction:
Therefore, within the tile group **Script 2 – Design-to-Operate** select the app ***Display Material***.

1. Enter your material (***Speedstar-xyyy***) and press *Enter*.
2. Select the ***Costing 2*** view and confirm the dialogue.
3. Enter **plant *Dallas (DL00)***. Go to the next screen.
4. In the **costing column *planned price***, you can see the marking of the planned future price.

Now, you need to **release** the planned price. Call up the following transaction:
Therefore, within the tile group **Script 2 – Design-to-Operate** select the app ***Release Material Cost Estimate***.

1. Click the Release button.
2. Enter the following data:
   - **Posting Period** ***current month*** (e.g., 10 for October)
   - **Company Code** ***US00***
   - **Plant** ***DL00***
   - **Material** ***Speedstar-xyyy***
   - **Test Run** ***deselect***
   - **With List Output** ***select***
3. Execute the marking with the **Execute** button.
4. Go one step back ( ). The following screen will show up. Note that the column header says "Standard price" now. When you marked the cost estimate the column title said "Future planned price". Close the current view by pressing ***Exit***.

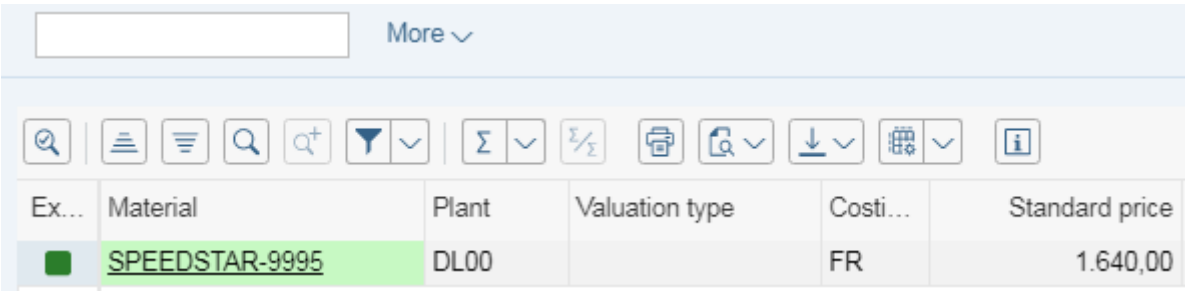


Figure 111: Standard Price: SAP System-Screenshot

Take a closer look at the result of the release. Therefore, call again within the tile group **Script 2 – Design-to-Operate** select the app ***Display Material***.

1. Enter your **material** (***Speedstar-xyyy***) and select the ***Costing 2*** view. Continue with ***Enter***.
2. Enter **plant *Dallas (DL00)***. Go to the next screen.
3. In the middle column (**current**), you can see the previously marked **future planned price** as **planned and standard price** for the current period.

For comparison:
Your result should look like this. You will note that the actual costs, which consider the BOM and the routing, are about 1360 USD less than the previously entered 3.000 USD.

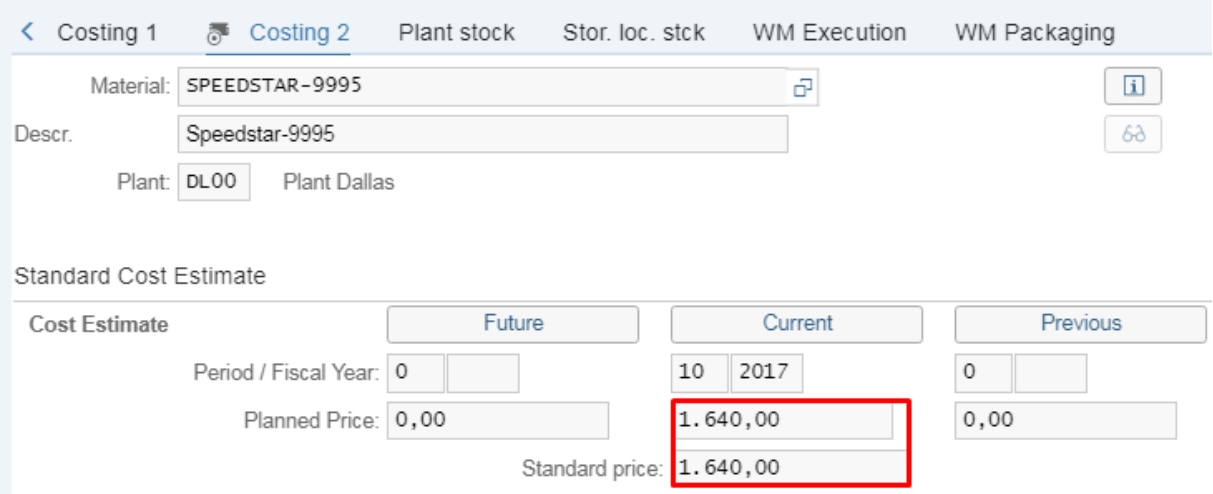


Figure 112: Result of the Price Update for Speedstar: SAP-System-Screenshot

3.2.2 Product Cost Calculation for Speedstarlett

Carry out independently the product cost calculation, first for **Basis-Module 2** and then for the **Speedstarlett** in ***exactly the same way*** as you did for the Speedstar before.

After saving material cost estimate, do not forget to close the rexpective view. Otherwise, you will be blocked while further proceeding.

Before continuing, check the values of the following figures. ***Do not*** *save the material cost estimate as long your values are not equal to the respective figures.*

You have to complete the following steps:

1. Costing for Basis-Module2-xyyy: App ***Create Material Cost Estimate***.
2. Price update for Basis-Module2-xyyy: App ***Release Material Cost Estimate***.
3. Releasing (Release) the planned price for Basis-Module2-xyyy: App ***Release Material Cost Estimate***.
4. Costing for Speedstarlett-xyyy: App ***Create Material Cost Estimate***.
5. Price update for Speedstarlett-xyyy: App ***Release Material Cost Estimate***.
6. Releasing (Release) the planned price for Speedstarlett -xyyy: App ***Release Material Cost Estimate***.

*In case you receive large variances in the total costs of goods manufactured field after completing costing (App **Create Material Cost Estimate**) to the values 845 and 1140 USD of the following figures, **do not release the calculation (!)**. This would lead to further problems if a released costing needs to be deleted. In case of variances, there are two possible causes: BOM or routing. Take a look at the BOM (CS02) and the routing (CA02) and check if the master records were created properly. After correcting the error execute the calculation once again via **Create Material Cost Estimate*** app.

After completing step 1 you should get the following results:

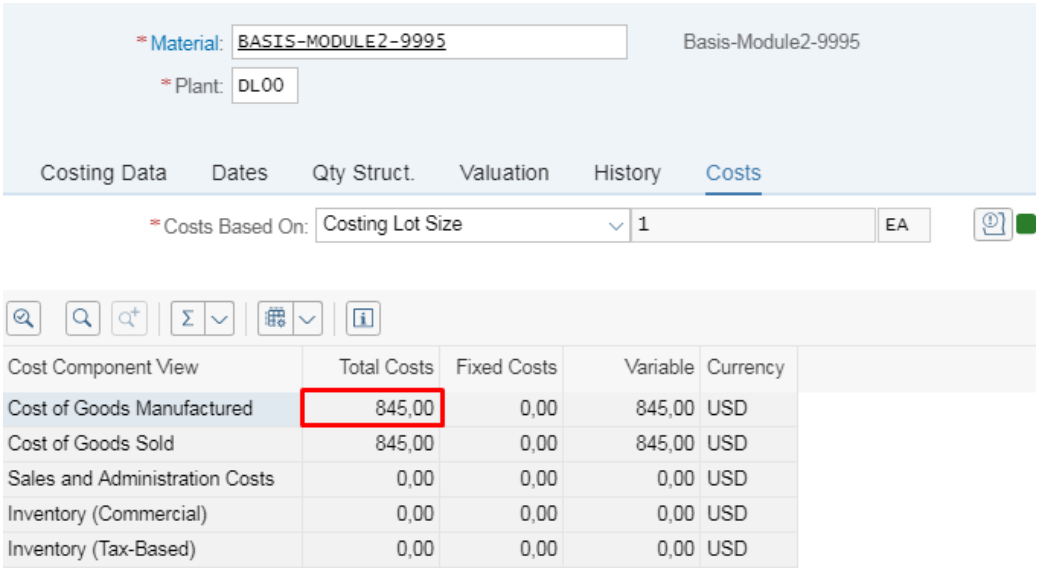


Figure 113: Estimate Basis-Module2: SAP-System-Screenshot

After completing steps 2 and 3, you should get the following results:

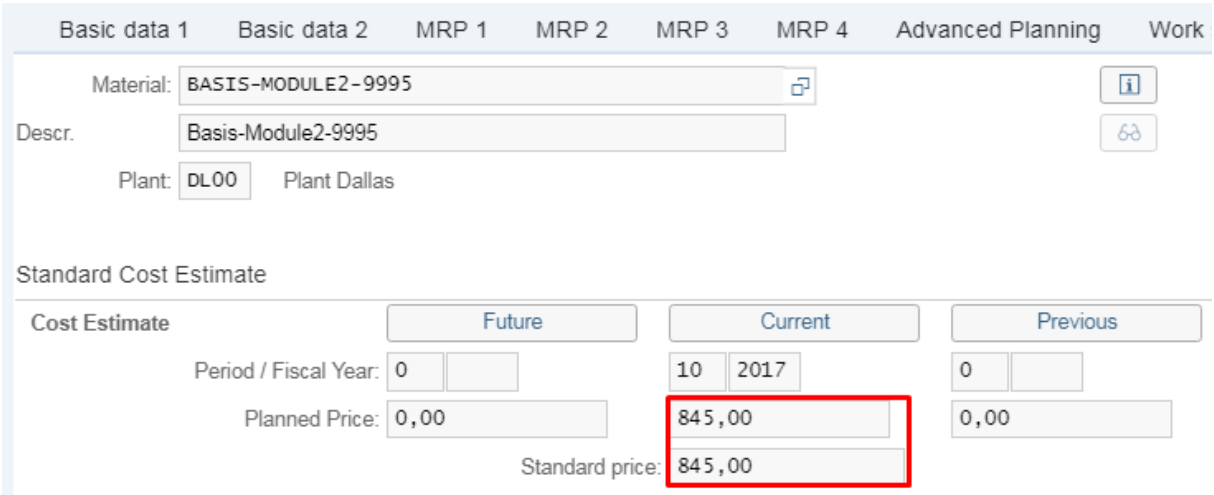
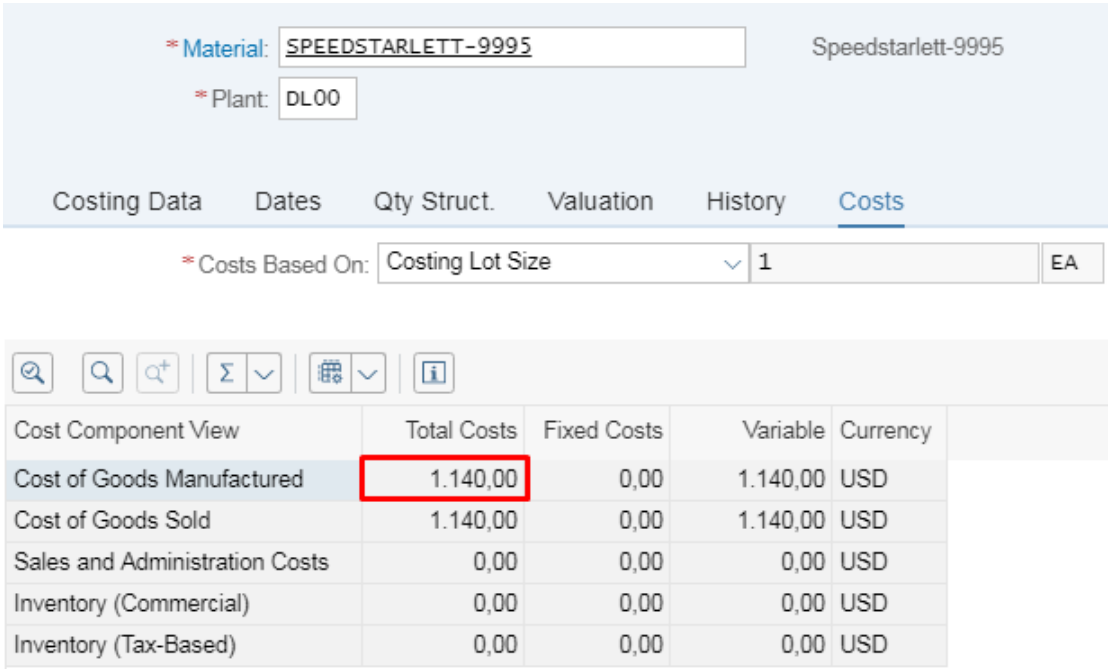


Figure 114: Standard Price Basis-Module2: SAP-System-Screenshot

After completing step 4 you should get the following results:



Cost Component View	Total Costs	Fixed Costs	Variable	Currency
Cost of Goods Manufactured	1.140,00	0,00	1.140,00	USD
Cost of Goods Sold	1.140,00	0,00	1.140,00	USD
Sales and Administration Costs	0,00	0,00	0,00	USD
Inventory (Commercial)	0,00	0,00	0,00	USD
Inventory (Tax-Based)	0,00	0,00	0,00	USD

Figure 115: Estimate Speedstarlett: SAP-System-Screenshot

After completing step 5 and 6 you should get the following results:

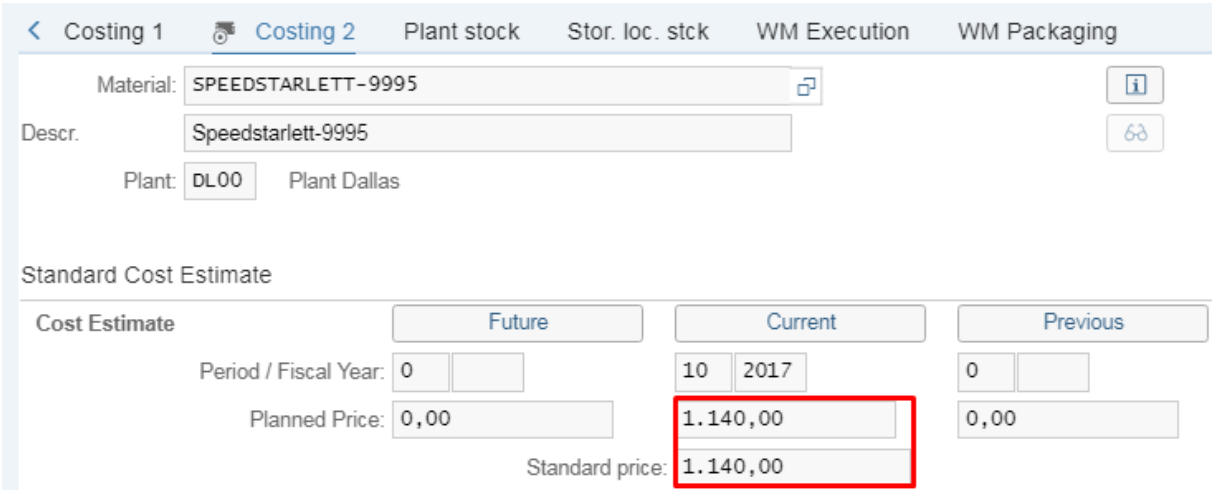
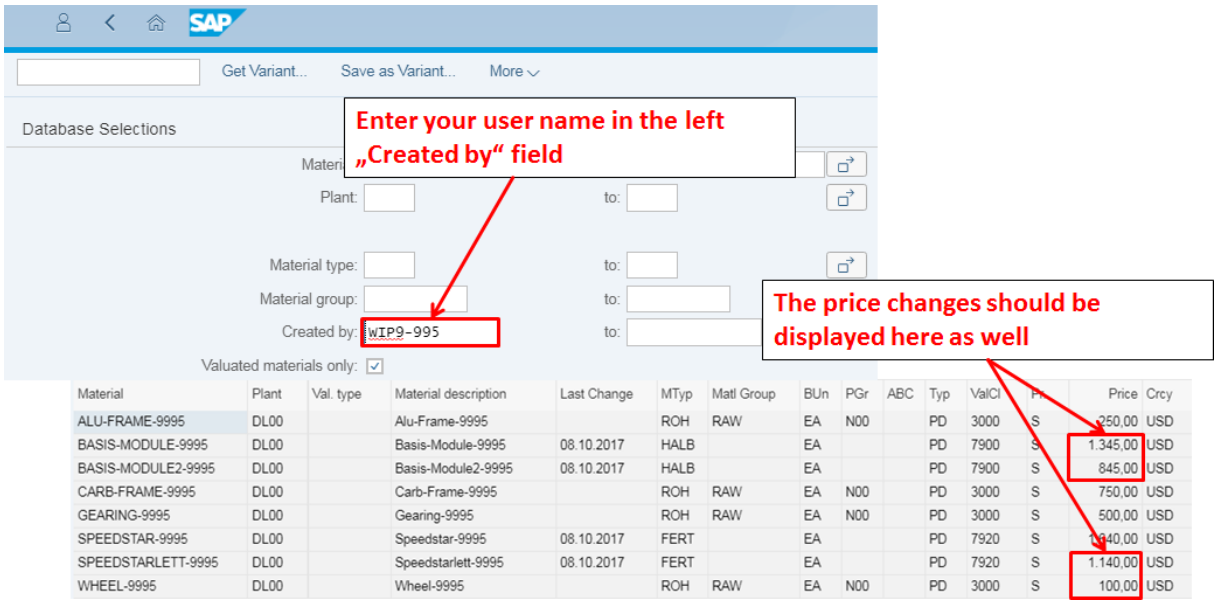


Figure 116: Price Speedstarlett: SAP-System-Screenshot

You can double-check your results within the app **Materials List** (enter your **User Name** and make sure that the **Material** field is empty).



Material	Plant	Val. type	Material description	Last Change	MTyp	Matl Group	BUn	PGr	ABC	Typ	ValCl	PI	Price	Crcy
ALU-FRAME-9995	DL00		Alu-Frame-9995		ROH	RAW	EA	N00		PD	3000	S	250,00	USD
BASIS-MODULE-9995	DL00		Basis-Module-9995	08.10.2017	HALB		EA			PD	7900	S	1.345,00	USD
BASIS-MODULE2-9995	DL00		Basis-Module2-9995	08.10.2017	HALB		EA			PD	7900	S	845,00	USD
CARB-FRAME-9995	DL00		Carb-Frame-9995		ROH	RAW	EA	N00		PD	3000	S	750,00	USD
GEARING-9995	DL00		Gearing-9995		ROH	RAW	EA	N00		PD	3000	S	500,00	USD
SPEEDSTAR-9995	DL00		Speedstar-9995	08.10.2017	FERT		EA			PD	7920	S	1.640,00	USD
SPEEDSTARLETT-9995	DL00		Speedstarlett-9995	08.10.2017	FERT		EA			PD	7920	S	1.140,00	USD
WHEEL-9995	DL00		Wheel-9995		ROH	RAW	EA	N00		PD	3000	S	100,00	USD

Figure 117: Double-check Price Update: SAP-System-Screenshot

Conclusion:

You have done the cost estimating for the goods and semi-finished goods you produce in in-house production. The estimate considers the BOMs and routings of the materials for the calculation. Hence, you now know how much the production of the goods really costs.

You have released the estimates to material management and, thus, updated the previously entered standard price in the material masters. The price changes are:

- Basis-Module from 2000 to 1345,00
- Speedstar from 3000 to 1640,00
- Basis-Module2 from 1500 to 845,00
- Speedstarlett from 2500 to 1140,00

3.3 Practice: Sales and Operations Planning

PRACTICE

You are supposed to plan the two racing bicycles using sales and operations planning. Since the two products are new developments, no historical sales data is available for sales and operations planning.

3.3.1 Sales Plan and Master Production Plan

Generally, future sales figures are forecasted using historical sales data using methods such as trend extrapolation, life-cycle models, etc. Another option is sales figure forecasting using the Bass model (Marketing model developed by Frank Bass to forecast product diffusion). When, for example, no historical sales figures are available, you can derive parameters based on sales figures of similar products and then forecast the future sales figures of the new product under certain assumptions.

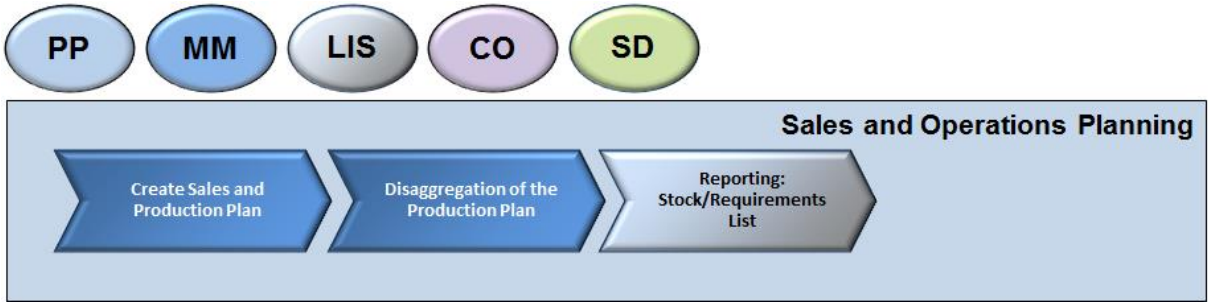


Figure 118: Process Overview: Sales and Operations Planning

3.3.1.1 Create Sales and Production Plan

Now, you will create a sales and production plan for your product group Racing-Bicycle-xyyy. Following this, both plans will be aggregated to the material level using the proportion factors.

Therefore, within the tile group **Script 2 – Design-to-Operate** select the app ***Change Production Plan***.

1. On the *Change Plan: Initial Screen*, enter your **Product group *Racing-Bike-xyyy*** and **plant *DL00***. Press *Enter*.
2. Press Active version to plan in the active planning version A00.
3. Now you enter the *Change Rough-Cut Plan* screen.

In our fictive story, we suppose that the market research department has already estimated the sales figures for the next months. How they got these numbers is irrelevant to us; we just hope that they did their work thoroughly.

The following table shows the estimated numbers for the next 6 months for the product group racing-bicycle.

Month	Estimated sales figures
Current month + 2	2000
Current month + 3	1500
Current month + 4	1000
Current month + 5	1500
Current month + 6	2000
Current month + 7	1750

Thus, the **planned independent requirements** for bicycle production are already known.

4. Create a sales plan, starting with the **second month into future** (i.e., if the current month is October, the second month to come would be December). Enter the information from the table above in the **sales** row.

NOTE

If necessary, use the > *button (Column right; next…) at the bottom of the table to display more rows.*

5. Due to market uncertainties, stock quantity has to be available for up to **3** days. To set this in your plan, enter **3** in the ***target days' supply field*** for each month, starting from the second month to come.
6. Press ***Enter***. The system automatically calculates and fills in the stock row.

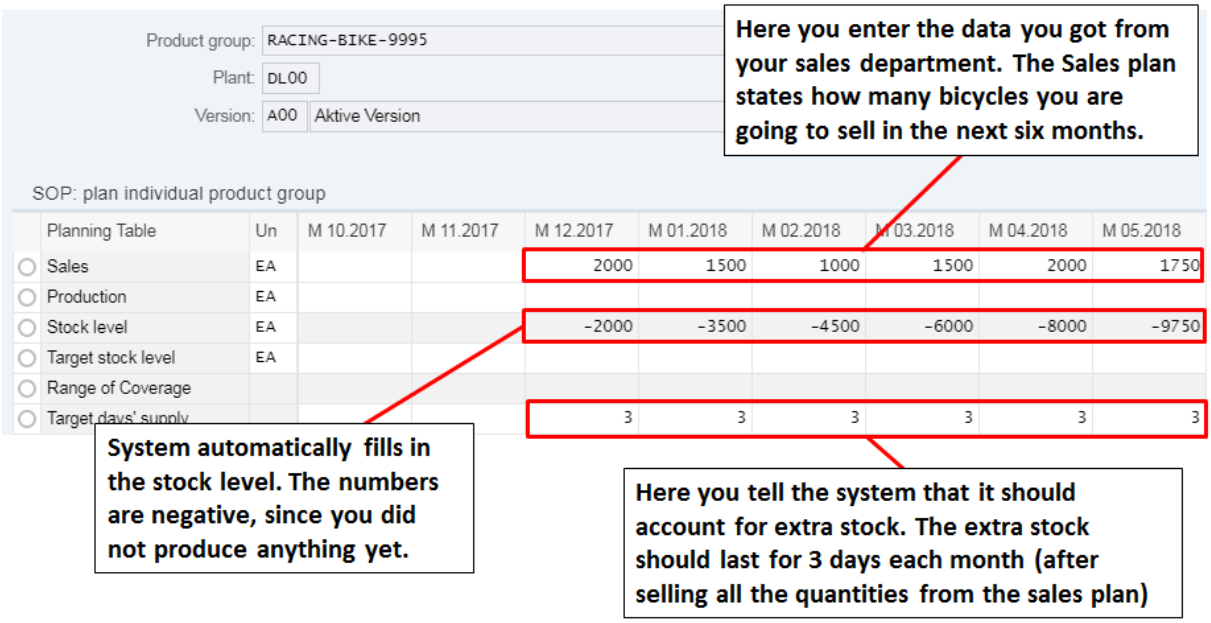
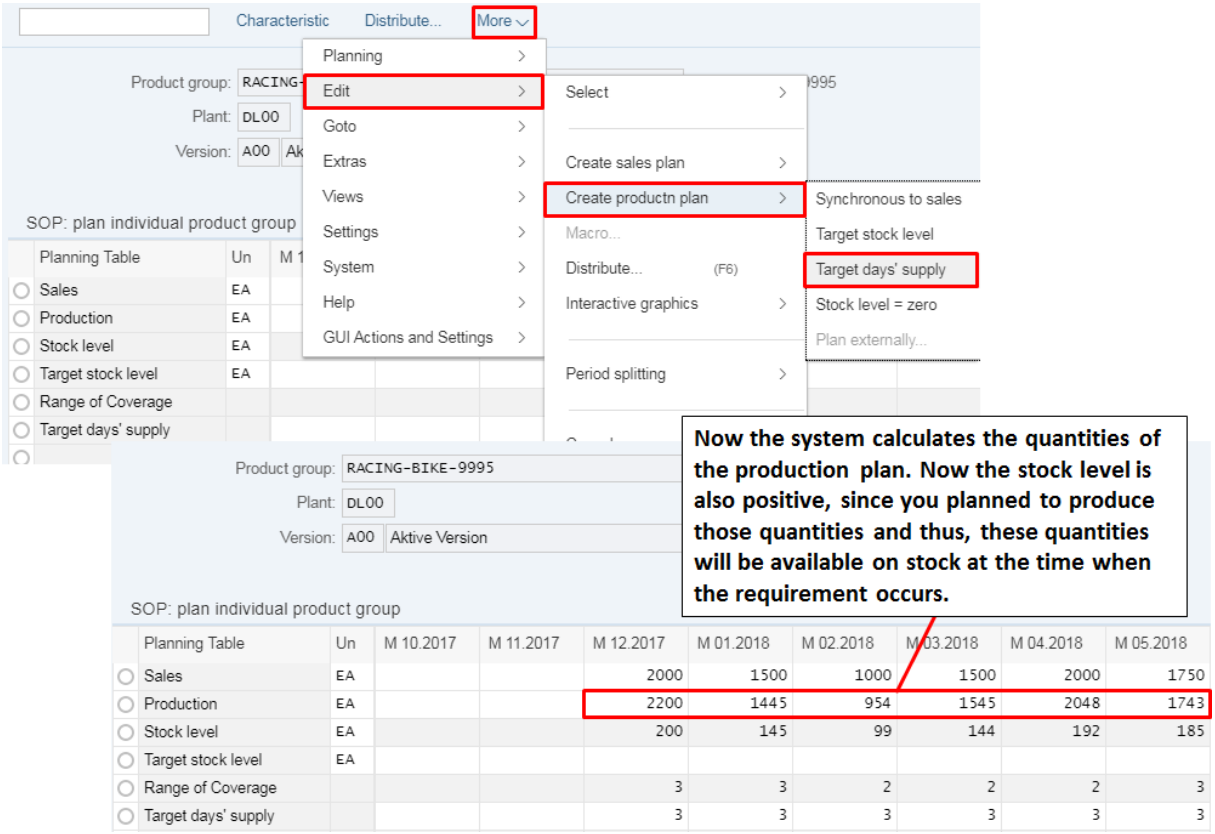


Figure 119: Create Sales and Production Plan: SAP-System-Screenshot

7. Create a production plan for your product group Racing-Bike-xyyy based on the sales plan and the desired target stock level. Therefore, choose ***More → Edit → Create productn plan → Target days' supply*** from the menu. You should see that the system calculated the production numbers for the individual periods.



Planning Table	Un	M 10.2017	M 11.2017	M 12.2017	M 01.2018	M 02.2018	M 03.2018	M 04.2018	M 05.2018
Sales	EA			2000	1500	1000	1500	2000	1750
Production	EA			2200	1445	954	1545	2048	1743
Stock level	EA			200	145	99	144	192	185
Target stock level	EA								
Range of Coverage				3	3	2	2	2	3
Target days' supply				3	3	3	3	3	3

Figure 120: Create Production Plan: SAP-System-Screenshot

Small deviations from the numbers in the figure above are not only possible but are common. That is, a result of the time you execute this planning. If you execute it at a time where you have the same amount of days left in the month and the same month length, you probably will get the same figures. Consider that the system uses the given periods to calculate the production plan.
Thus, if you have deviation at this point, you also will have the same small deviations in the following parts of the case studies regarding screenshots of MRP lists etc. (approx. 50 pc).
However, you can also manually adjust the numbers in the production row, so that they comply with the screenshot above (this might affect the target days' supply, but that is ok). In this case you receive the same results as described in this script.
You can also change numbers subsequently using transaction MC82. Then, you need to enter the product group and the active version. The next steps of planning (e.g., disaggregation) need to be carried out again if you should change the plan.

8. ***Save*** your entries and leave the view by pressing ***Exit***.

3.3.1.2 Disaggregation of the Production Plan

Now that you have created the production plan for the racing-bicycle product group, you need to disaggregate it to determine the production quantities of the individual product group members. Disaggregate the **production plan** for your production group (Racing-Bicycle-xyyy) and transfer the production plans for the Speedstar-xyyy and the Speedstarlett-xyyy for detailed production planning to **demand management**. Therefore, within the tile group **Script 2 – Design-to-Operate** select the app ***Transfer PG to Demand Management***.

1. In the *Transfer Planning Data to Demand Management* screen, enter the following data:
   - **Product group** ***Racing-Bike-xyyy***
   - **Plant** ***DL00***
   - **Version** ***A00***
   - **Prod. plan for mat. or PG members as a proportion** ***selected***
   - **From date** ***current date***
   - **Invisible transfer** ***not selected***
   - **Active indicator** ***selected***
2. Click the Transfer now button to execute transfer of the production plan to demand management.

*If you deselect the **invisible transfer** box, results of the disaggregation are displayed on another screen allowing the planner to manually change results according to management demands before saving.*

3. When you look at the transfer results, you can see that 60% of the production plan of the product group (Racing-Bicycle) was assigned to your product Speedstar-xyyy. List the value for the fifth month for the Speedstar on your data sheet:

Speedstar 5th month:

4. Review the results for the Speedstar and ***save***.
5. 40% of the production plan of the product group (Racing-Bicycle) was assigned to the Speedstarlett-xyyy. The results for Speedstarlett are displayed below. ***Save*** the results for the Speedstarlett as well.

Table Items Schedule Lines

Material	MRP Area	V	A	BU	M 12.2017	M 01.2018	M 02.2018	M 03.2018	M 04.2018	M 05.2018
SPEEDSTARLETT-9995	DL00	AG	☑	EA	880	578	382	618	819	697

Figure 121: Planned Independent Requirements – Planning Table: SAP-System-Screenshot

3.3.1.3 Reporting: Stock/Requirements List

The effects of demand management are the creation of the *planned independent requirements*. They can be displayed using the stock/requirements list. Therefore, within the tile group **Script 2 – Design-to-Operate** select the app ***Monitor Stock / Requirements List***.

Enter material ***Speedstar-xyyy***, plant ***DL00*** and choose *Enter*. You can see that the *planned independent requirements* were transferred into the stock/requirements list. Thus, the production numbers for the next six displayed months (in the example, December - May) were listed. In the MRP column, you can see the abbreviation **IndReq**, which states that it is an individual requirement.

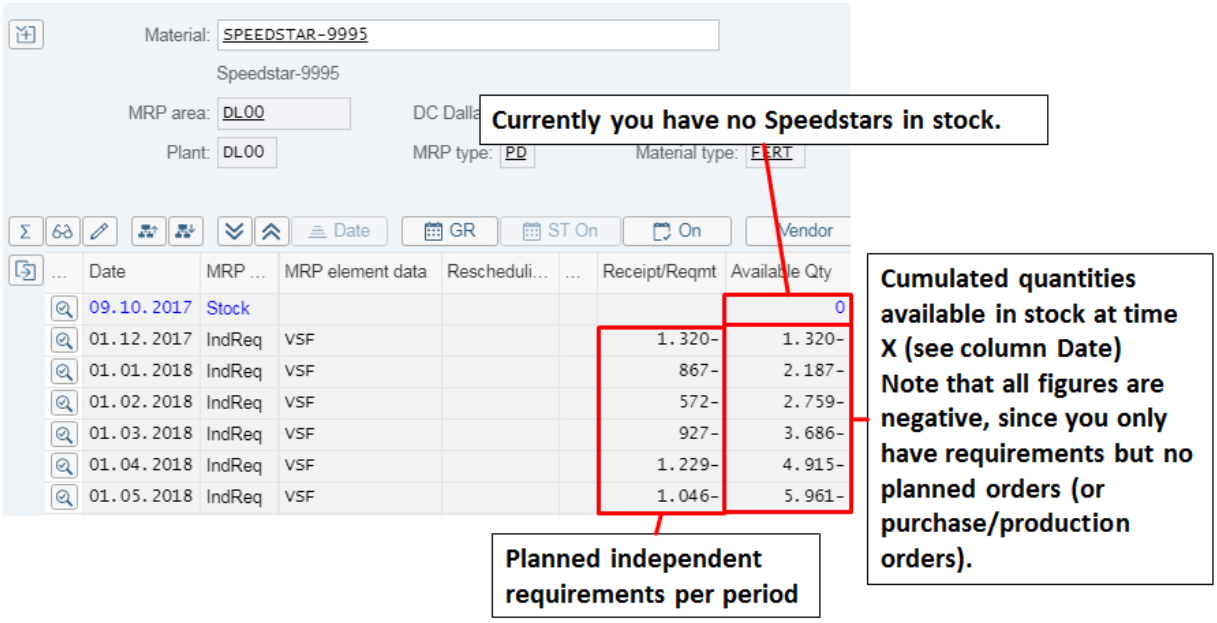


Figure 122: Stock/Requirements List: SAP-System-Screenshot

In the **Receipt/Requirement quantity (Receipt/Reqmt)** column, the required or, e.g. in case of a production or purchase order, received quantities for a particular product are displayed. The **available quantity** column displays the units of a product that are in ***unrestricted-use stock***. Check the stock/requirements list for your **Speedstarlett** on your own. What is the amount of the ***unrestricted-use stock*** in the last month of planning? List the answer on your data sheet.

Speedstarlett unrestricted-use stock:

Look at the stock/requirements list for the ***Basis-Module-xyyy*** assembly as well. You should see that no dependent requirements emerged. This is because **MRP** was not carried out yet. Only when MRP is executed together with BoM ***explosion*** and determination of **dependent requirements,** the system creates dependent requirements for the components.

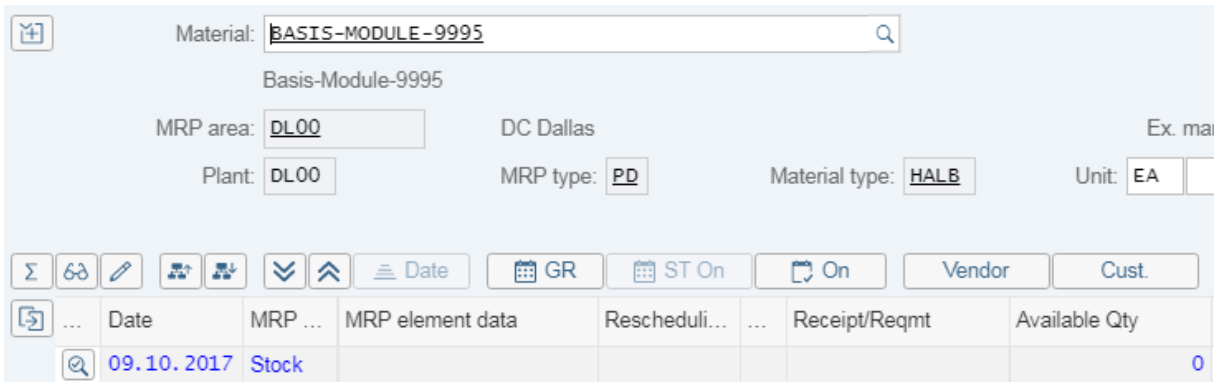


Figure 123: Stock/Requirements List Components: SAP-System-Screenshot

The ***planned orders column does not cover the planned independent requirements*** as you can see in the **MRP element** column. Therefore, you need to execute **MRP**. This is your next task. Carry out ***material requirements planning*** for the two products Speedstar and Speedstarlett.

3.3.2 Material Requirements Planning (MRP)

In this section, you will perform MRP for your product group.

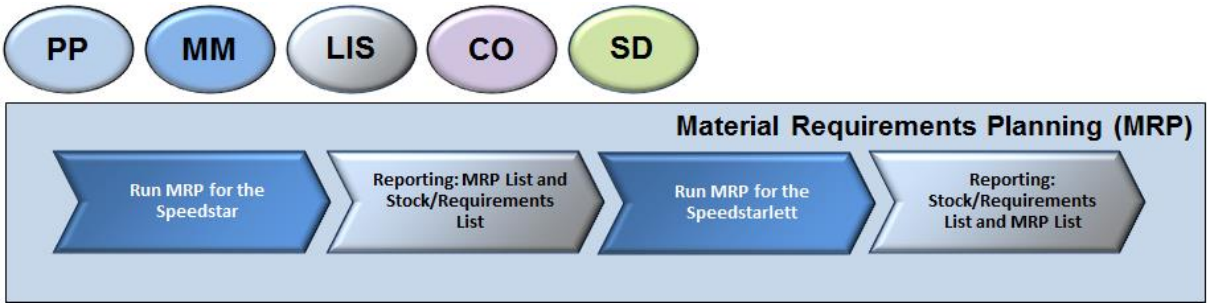


Figure 124: Process Overview: Material Requirements Planning (MRP)

3.3.2.1 Run MRP for the Speedstar

Run MRP for the entire BoM for the ***Speedstar-xyyy*** in plant ***DL00***. Therefore, within the tile group **Script 2 – Design-to-Operate** select the app ***Schedule MRP Runs***.

1. Click on the New button and enter the following data:
   - **Job Template** ***Material Requirements Planning (MRP)***
   - **Job Name** ***Material Requirements Planning (MRP)***
   - **Start Immediately** ***select***
   - **Plant** ***DL00***
   - **Material** ***Speedstar-xyyy***
   - **MRP controller** ***000***
   - **BOM Components** ***select***
   - **Scheduling** ***1***
   - **Planning Mode** ***3***

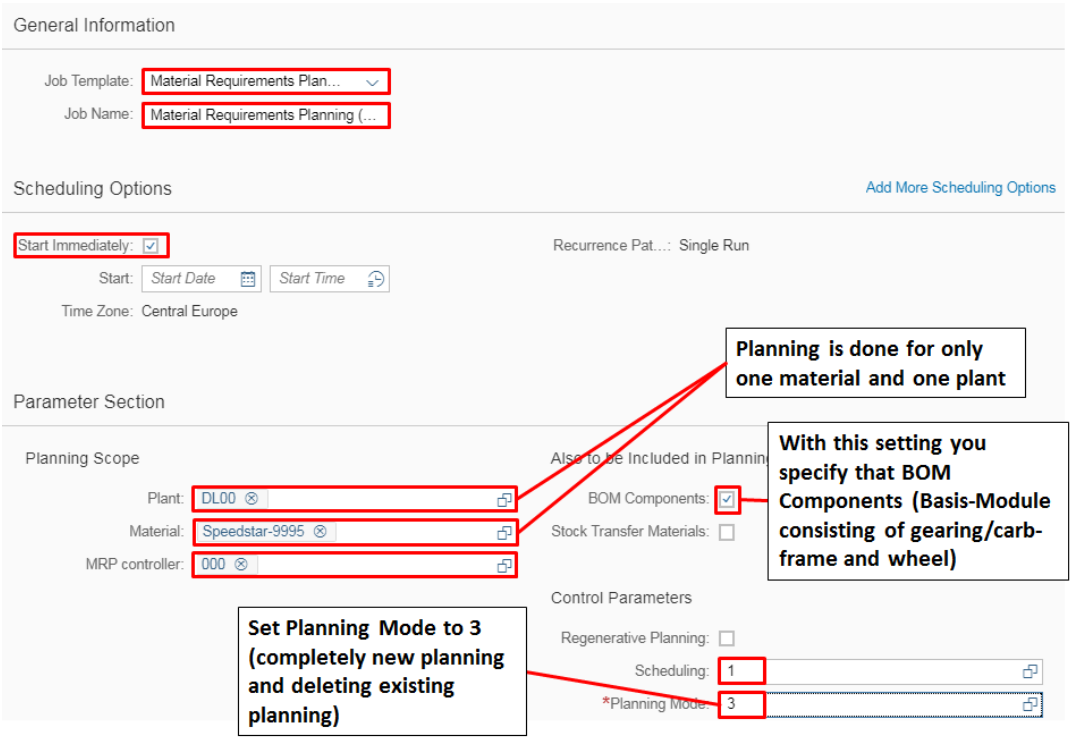


Figure 125: MRP run: SAP-System-Screenshot

2. Choose *Schedule* and leave the current view ( ).
3. Check the scheduling result. After scheduling wait 2-3 minutes and then, within the tile group **Script 2 – Design-to-Operate** open the app ***Display MRP Key Figures*** and pressing ***Go***.
4. The key figures are displayed in ascending order by default. That is, the current schedulings are displayed in the upper area.

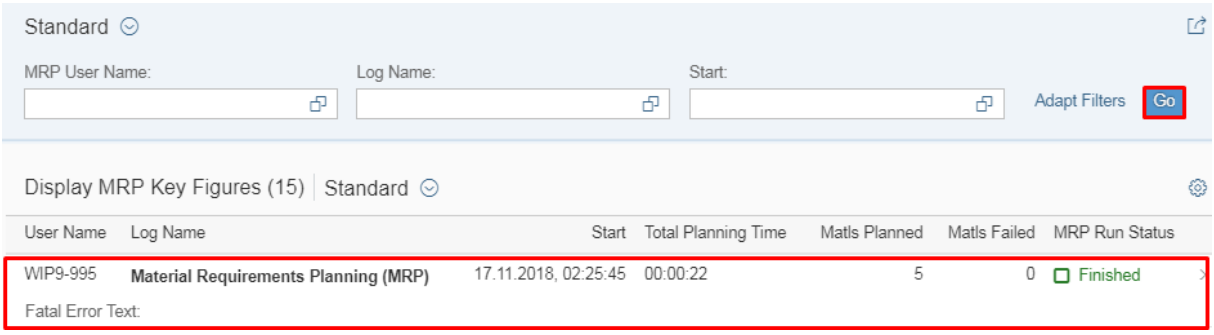


Figure 126: Display MRP Key Figure (1): SAP-System-Screenshot

5. Select the row, which contains the data regarding your just performed scheduling and look at the statistics. you can see that ***5 materials*** were planned. This corresponds with the five (Basis-Module-xyyy, Frame-xyyy, Wheel-xyyy, Gearing-xyyy, and Speedstar-xyyy), which the system includes in determination of requirements.

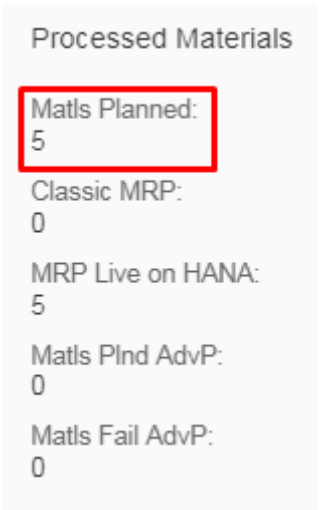
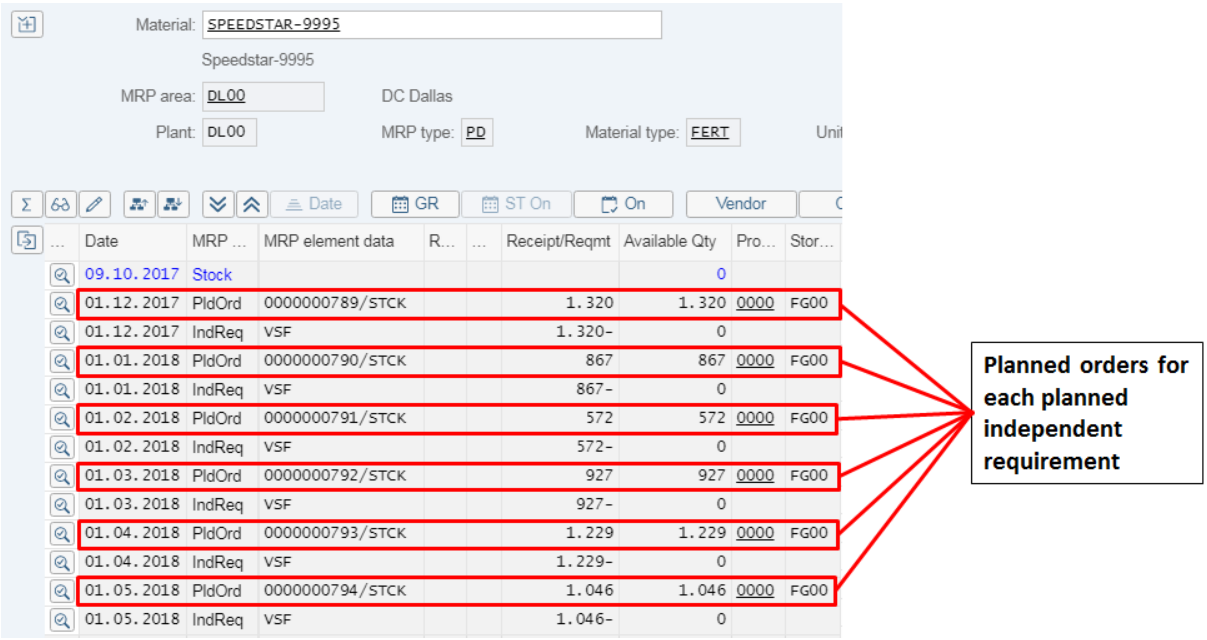


Figure 127: Display MRP Key Figure (2): SAP-System-Screenshot

6. You can gain a detailed insight in the MRP situation when calling up the stock/requirements list once again. (tile group **Script 2 – Design-to-Operate** select the app ***Monitor Stock / Requirements List***)
7. Enter material ***Speedstar-xyyy*** and plant ***DL00***. You can now see the effects of the MRP run.

NOTE

Consider, that your values may differ dependent on the values of your sales and production plan.



Date	MRP ...	MRP element data	R...	...	Receipt/Reqmt	Available Qty	Pro...	Stor...
09.10.2017	Stock					0		
01.12.2017	PldOrd	0000000789/STCK			1.320	1.320	0000	FG00
01.12.2017	IndReq	VSF			1.320-	0		
01.01.2018	PldOrd	0000000790/STCK			867	867	0000	FG00
01.01.2018	IndReq	VSF			867-	0		
01.02.2018	PldOrd	0000000791/STCK			572	572	0000	FG00
01.02.2018	IndReq	VSF			572-	0		
01.03.2018	PldOrd	0000000792/STCK			927	927	0000	FG00
01.03.2018	IndReq	VSF			927-	0		
01.04.2018	PldOrd	0000000793/STCK			1.229	1.229	0000	FG00
01.04.2018	IndReq	VSF			1.229-	0		
01.05.2018	PldOrd	0000000794/STCK			1.046	1.046	0000	FG00
01.05.2018	IndReq	VSF			1.046-	0		

Figure 128: Stock/Requirements List after MRP: SAP-System-Screenshot

You can see that **planned orders** were created for each planned independent requirement. The planned orders are characterized by the **PlOrd.** Entry in the MRP element column. Thus, the planned independent requirements are also covered by planned orders. The available quantities column, in which no negative numbers are listed anymore, shows this. A positive amount is added by the planned order and consumes the independent planning requirements (0).

In the MRP element column, double-click on the first entry **PlOrd**. A small window opens. In this window, you can determine **follow-up activities** for the **planned order**. Since the Speedstar is a finished product, the system provides the following buttons

- **Production Order** -> Prod.Ord.
- **Partial Production Order** -> PartConvProdOrder
- **Process Order** -> Proc.Ord.
- **Sub Process Order** -> SubProcOrd
- **Purchase Requisition** -> Pur.Req.

The first four options allow you to convert the planned order into a **production order** to work on it in **production**. **Purchase Requisition** is for **external procurement**. This option converts the planned order into a purchase requisition that can be carried out by **purchasing** in form of a purchase order.

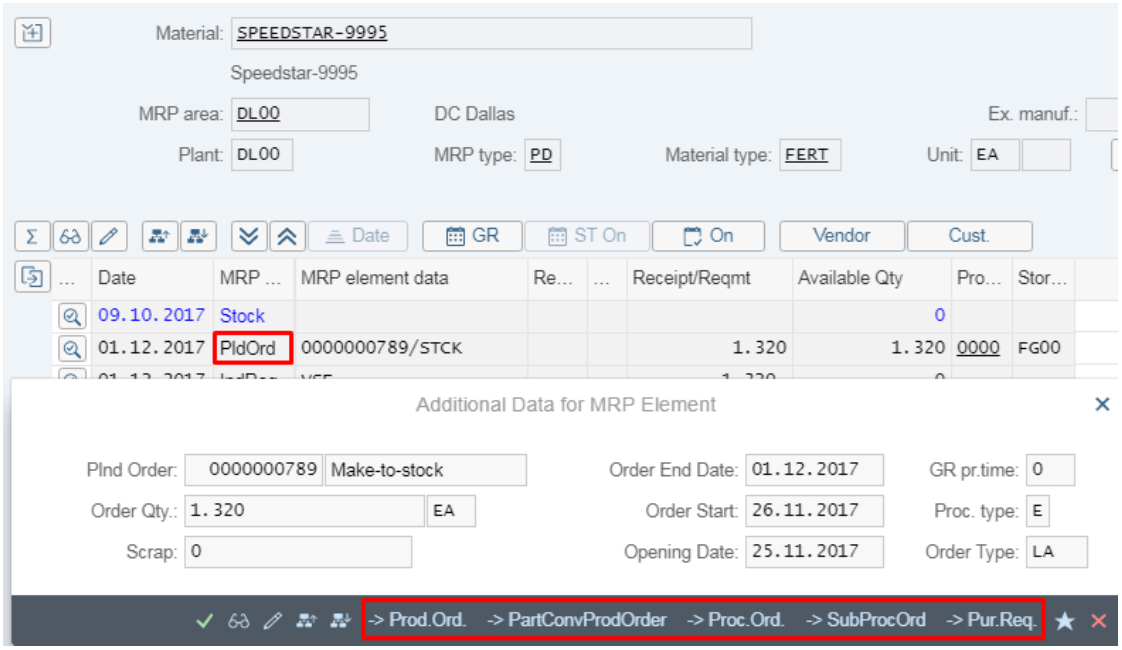


Figure 129: MRP – Follow-up Activities: SAP-System-Screenshot

8. Close the window with ✓.
9. Choose the icon. You receive additional planning data for the material, predominantly from the material master record.

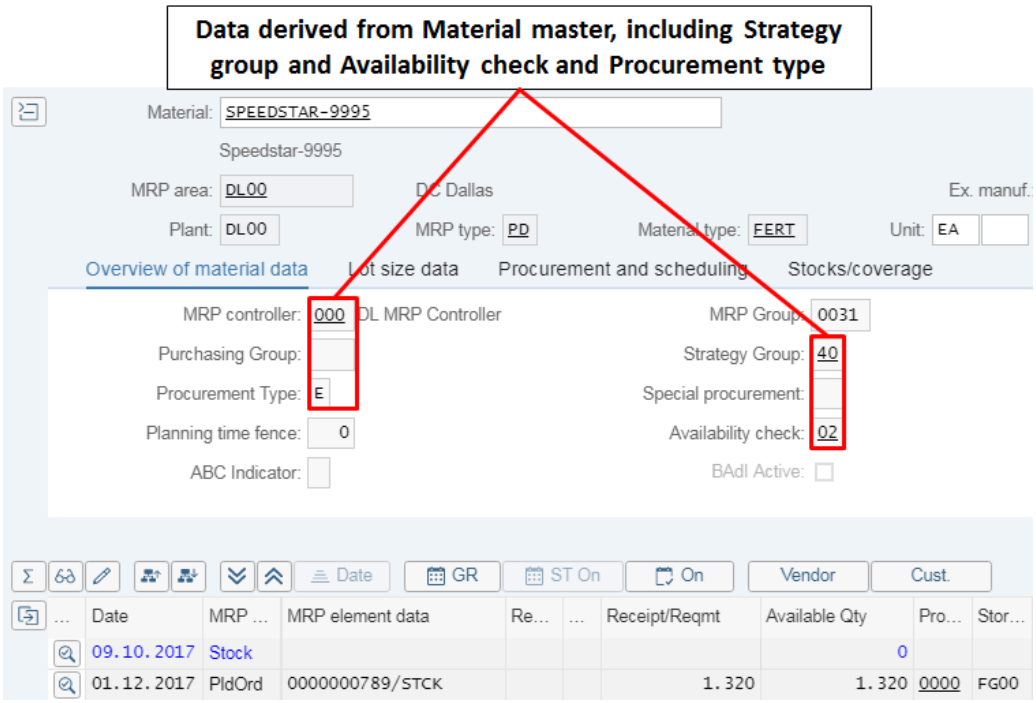


Figure 130: Additional Planning Information: SAP-System-Screenshot

Also check the requirements list and the follow-up activities for the other components. You will see that, for example, for the gearing component, only the purchase requisition option is selectable since it is a raw material that is procured externally. Moreover, in the MRP element column, DepReq is displayed (dependent requirement), as opposed to IndReq (individual requirement).

Since we will focus on follow-up activities later, look at the MRP list, first.

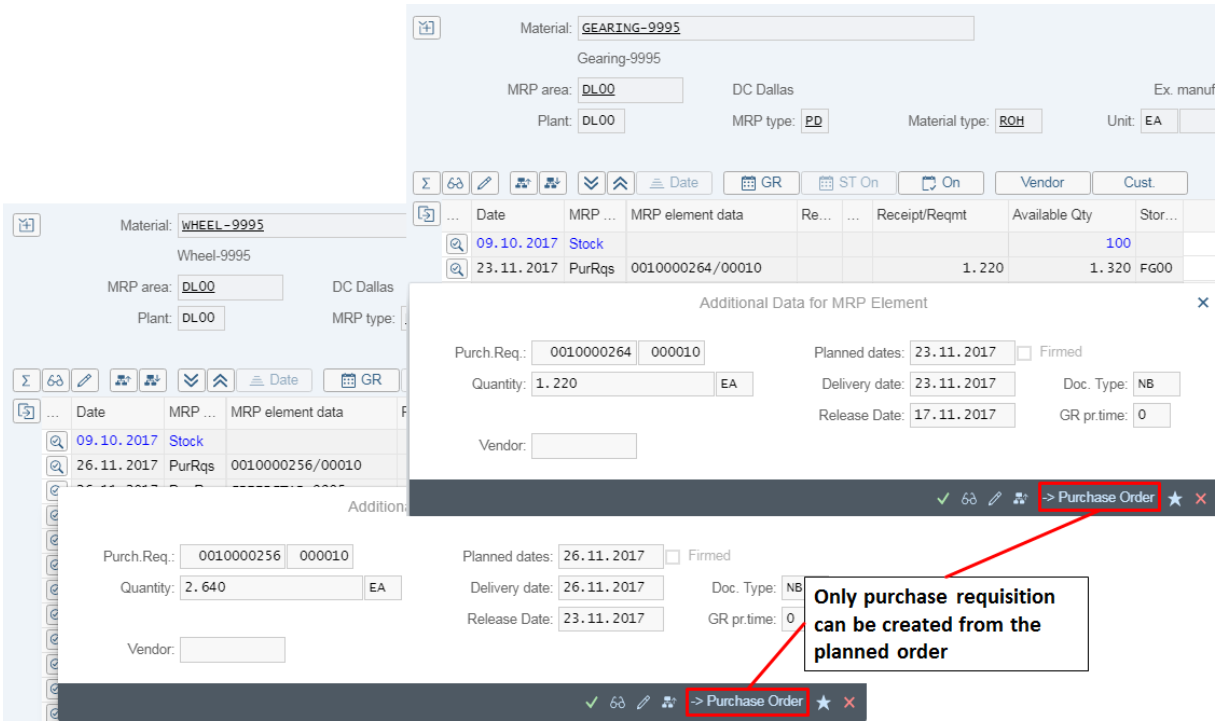


Figure 131: Planned Order - Purchase Requisition for Component: SAP-System-Screenshot

3.3.2.2 Run MRP for the Speedstarlett

Execute requirements planning for the entire BoM of the **Speedstar*lett-xyyy*** in plant ***DL00.*** Therefore, within the tile group **Script 2 – Design-to-Operate** select the app ***Schedule MRP Runs***.

1. Click on the New button and enter the following data:
   - **Job Template** ***Material Requirements Planning (MRP)***
   - **Job Name** ***Material Requirements Planning (MRP)***
   - **Start Immediately** ***select***
   - **Plant** ***DL00***
   - **Material** ***Speedstarlett-xyyy***
   - **MRP controller** ***000***
   - **BOM Components** ***select***
   - **Scheduling** ***1***
   - **Planning Mode** ***3***
2. Choose *Schedule* and leave the current view ( ).
3. Check the scheduling result. After scheduling wait 2-3 minutes and then, within the tile group **Script 2 – Design-to-Operate** open the app ***Display MRP Key Figures*** and press the ***Go*** button.
4. Select the row, which contains the data regarding your just performed scheduling.

Again, you can see that ***5 materials*** were planned (Basis-Module2, Alu-Frame, Wheel, Gearing and Speedstarlett-xyyy),

3.3.2.3 Reporting: Stock/Requirements List and MRP List

Review the result in the stock/requirements lists (MD04) independently.

1. Open the Stock/Requirements List for the Speedstarlett-xyyy in plant DL00.

Material: SPEEDSTARLETT-9995
Speedstarlett-9995
MRP area: DL00 DC Dallas Ex. manuf.:
Plant: DL00 MRP type: PD Material type: FERT Unit: EA

Date | GR | ST On | On | Vendor | Cust.

Date	MRP ...	MRP element data	Rescheduli...	...	Receipt/Reqmt	Available Qty	Pro...	Stor...
09.10.2017	Stock					0		
01.12.2017	PldOrd	0000000807/STCK			880	880	0000	FG00
01.12.2017	IndReq	VSF			880-	0		
01.01.2018	PldOrd	0000000808/STCK			578	578	0000	FG00
01.01.2018	IndReq	VSF			578-	0		
01.02.2018	PldOrd	0000000809/STCK			382	382	0000	FG00
01.02.2018	IndReq	VSF			382-	0		
01.03.2018	PldOrd	0000000810/STCK			618	618	0000	FG00
01.03.2018	IndReq	VSF			618-	0		
01.04.2018	PldOrd	0000000811/STCK			819	819	0000	FG00
01.04.2018	IndReq	VSF			819-	0		
01.05.2018	PldOrd	0000000812/STCK			697	697	0000	FG00
01.05.2018	IndReq	VSF			697-	0		

Figure 132: Stock/Requirements List for Speedstarlett: SAP-System-Screenshot

Review the result for the **Gearing** in the stock/requirements lists.

2. In the next figure, you can see that for the **gearing**, a dependent requirement was created both for Basis-module 1 as well as for Basis-module 2. The planned order for the period was updated accordingly. Please also note the unrestricted-use stock from the first case study (100 units of measure).

Material: GEARING-9995
Gearing-9995
MRP area: DL00 DC Dallas
Plant: DL00 MRP type: PD Material type: ROH

Date | GR | ST On | On | Vendor

Date	MRP ...	MRP element data	...	...	Receipt/Reqmt	Available Qty	Sto...
09.10.2017	Stock					100	
23.11.2017	PurRqs	0010000274/00010			2.100	2.200	FG00
23.11.2017	DepReq	BASIS-MODULE-9995			1.320-	880	FG00
23.11.2017	DepReq	BASIS-MODULE2-9995			880-	0	FG00
24.12.2017	PurRqs	0010000275/00010			1.445	1.445	FG00
24.12.2017	DepReq	BASIS-MODULE-9995			867-	578	FG00
24.12.2017	DepReq	BASIS-MODULE2-9995			578-	0	FG00

100 pc are available on stock from case study 1

These two dependent requirements are merged to one planned order

Figure 133: Stock/Requirements List for Gearing: SAP-System-Screenshot

3.3.3 Sales Order Management

You receive your fist sales order from a customer (1000 – Rocky Mountain Bikes) the customer orders 100 Speedstars and 100 Speedstarletts. Capture the sales order in the SAP S/4HANA system.

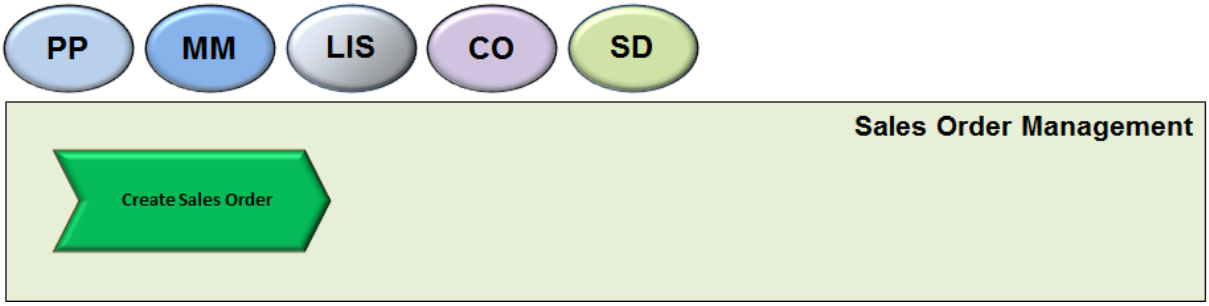


Figure 134: Process Overview: Sales Order Management

NOTE

Entering a Sales order is a function of SD and not of PP/MM. Nevertheless, you should enter the sales order at this point to be able to understand the effects on MRP. In case you cannot remember the theoretical section, please note that requirements to be planned are not only planned independent requirements but also sales orders, which are actual requirements, as opposed to planned requirements.

Next, create the sales order. Therefore, within the tile group **Script 2 – Design-to-Operate** select the app ***Manage Sales Orders***. Then, press the ***Create Sales Order*** button.

1. In the **Create Sales Order: Initial Screen**, enter the following data:
   - **Order Type** ***OR***
   - **Sales Organization** ***UW00***
   - **Distribution Channel** ***WH***
   - **Division** ***BI (Bicycles)***
   - Confirm with *Enter*.
2. On the **Create Standard Order: Overview** screen, enter the following data:
   - **Sold-To Party** ***1000 (customer already exists in GBI)***
   - **Ship-To Party** ***1000***
   - **Cust.Reference** ***order-xyyy***
   - **Req. deliv. date.** ***15th day of current month + 3 (!) months***

CAUTION

+3 months means that if the current month is for example 15th October 2017, the date to enter would be 15th January 2018.

3. In the *All items* area enter the following data:
   - **Material position 10** ***Speedstar-xyyy***
   - **Material position 20** ***Speedstarlett-xyyy***

- **Order quantity position 10** ***100***
- **Order quantity position 20** ***100***

- Confirm with *Enter* and skip any system messages with *Enter*.
- If the *Standard Order: Availability Control* screen appears, press ✓ within the *Complete delivery* area **twice**. Notifications regarding pricing error will be handled at the next step.

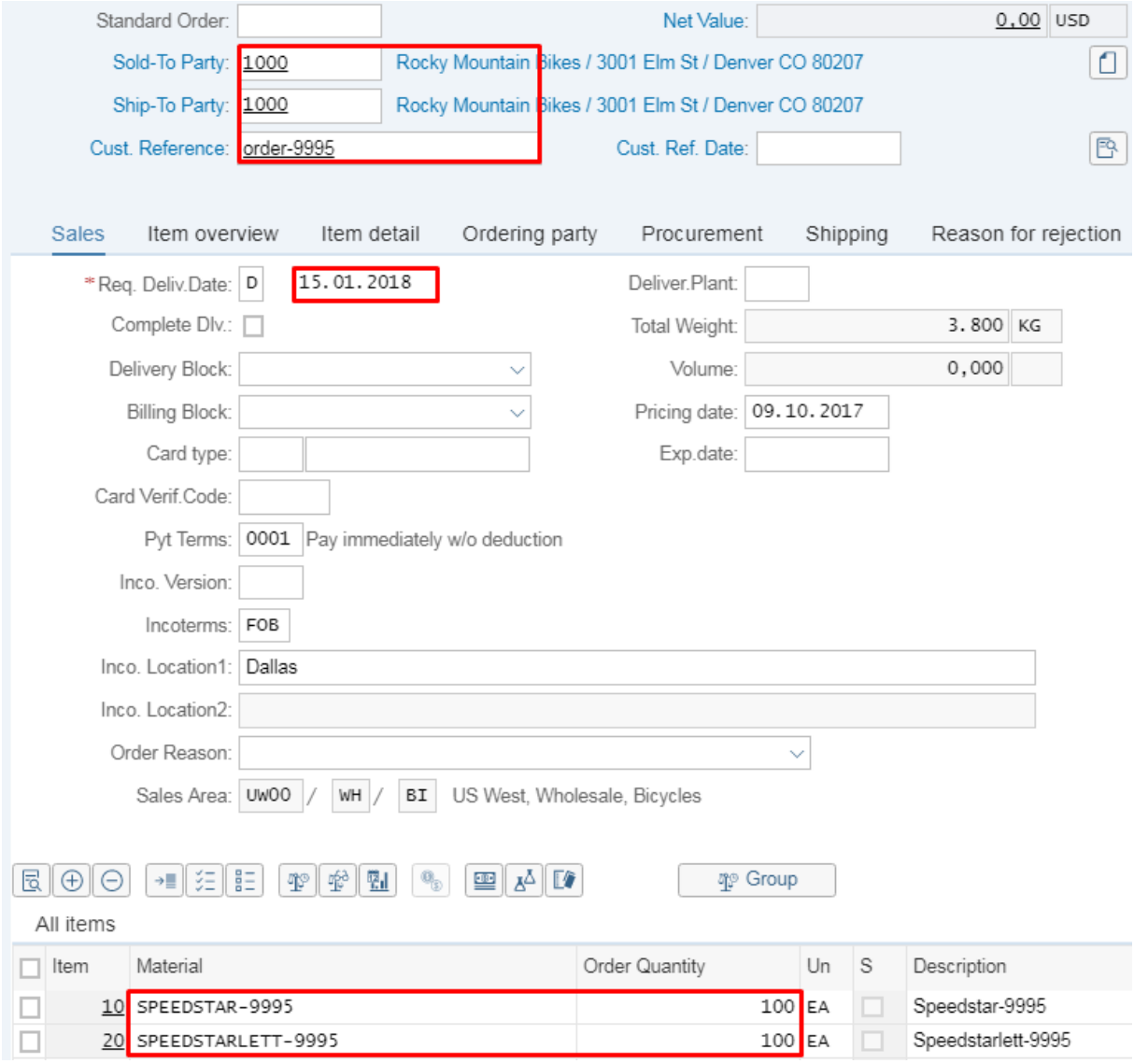


Figure 135: Create Sales Order: SAP-System-Screenshot

Since no sales price conditions are present for bicycles yet (part of the SD functional area; this will be focused on later), you will manually enter sales prices at this point.

4. Select both rows in the position overview (Speedstar + Speedstarlett) and choose ***More → Goto → Item → Conditions*** from the menu.

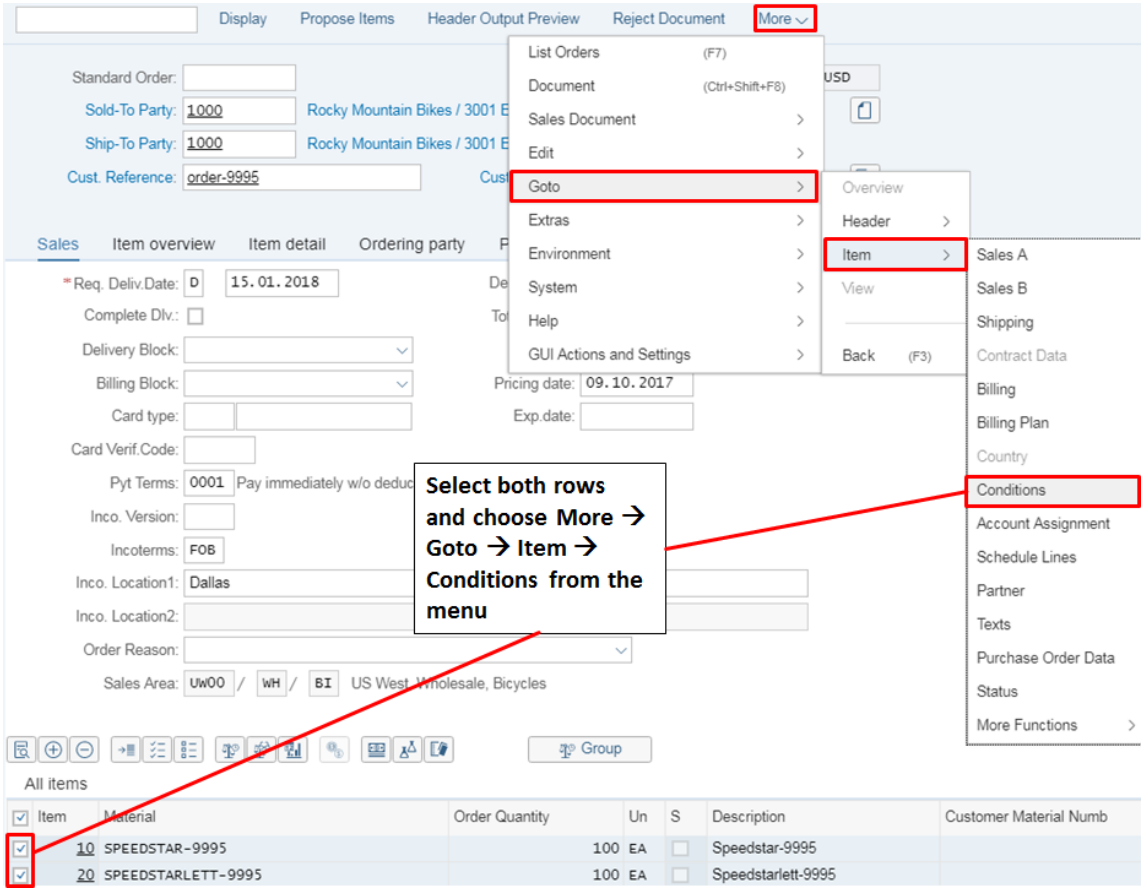


Figure 136: Maintain Sales Conditions (1): SAP-System-Screenshot

5. Scroll down to the first white row (which is not greyed out) of the **CnTy** column and enter the condition ***PR00***. In the **Amount** column enter ***3000***. The transfer price already named in the condition originates from the material master record of the Speedstar. Confirm with *Enter*.

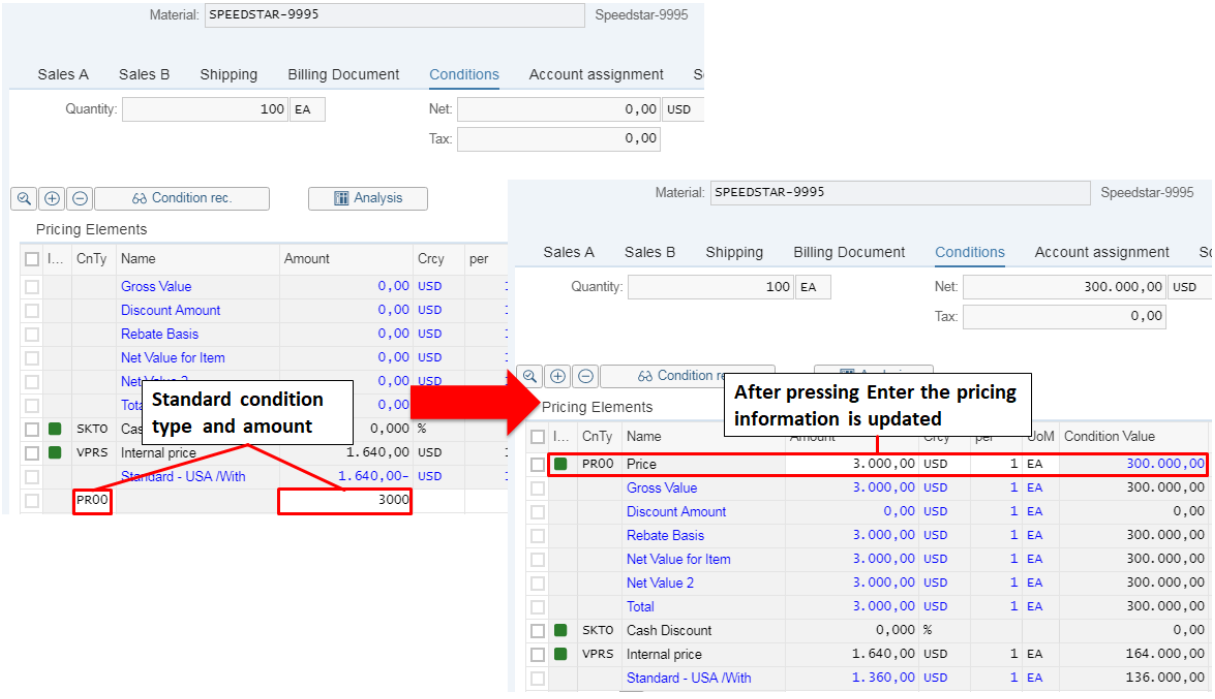


Figure 137: Maintain Sales Conditions (2): SAP-System-Screenshot

6. Press (Next Item).
7. Repeat the procedure for your **Speedstarlett** with condition type ***PR00*** and amount ***2500***. Confirm with ***Enter***.
8. Go one step back ( ) to return to the initial screen of the order.
9. The net value of your order should be 550.000 USD, now. If not, the sales conditions were not maintained correctly. In this case repeat sales condition maintenance for Speedstar and / or Speedstarlett.

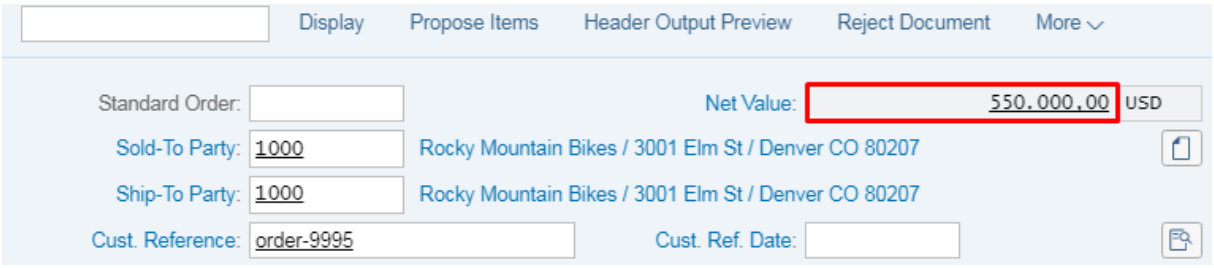


Figure 138: Net Value Sales Order: SAP-System-Screenshot

NOTE

*Make sure you do not confuse **sales price conditions** for a **customer** with conditions you created in the first case study (procurement). Those were **purchasing conditions** for **vendors**.*

10. ***Save*** the sales order and note the sales order number (from the status bar) on your data sheet. Finally, press ***Exit***.

Sales Order Number:

3.3.4 Material Requirements Planning (MRP)

Finally, you will take a closer look at the stock/requirements list to get an insight into the MRP situation after material planning.

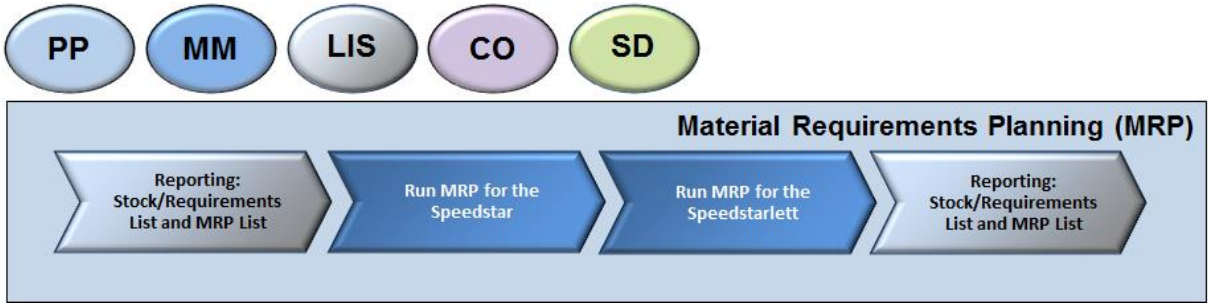


Figure 139: Process Overview: Material Requirements Planning (MRP)

3.3.4.1 Reporting: Stock/Requirements List and MRP List

Display the stock/requirements list for the ***Speedstar-xyyy*** and plant ***DL00*** once again.

Therefore, within the tile group **Script 2 – Design-to-Operate** select the app ***Monitor Stock / Requirements List***.
You should see that the sales order was planned in requirements planning. Moreover, the sales order consumes the requirements from planning. In the example below, the value for period 01 (January) was reduced by 100 units of measure.

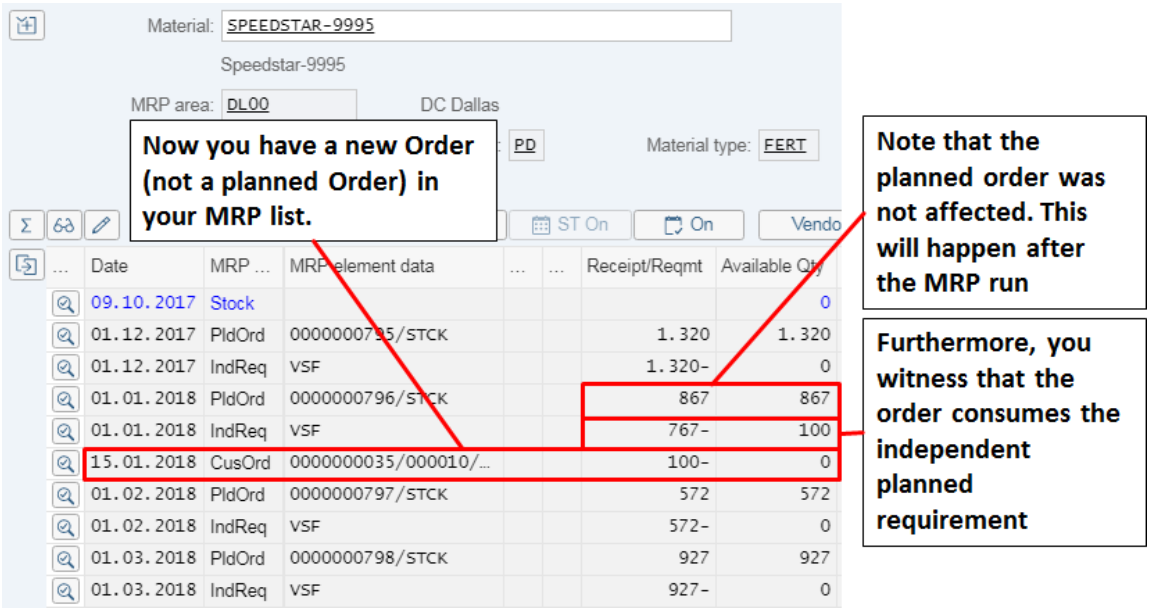


Figure 140: Stock/Requirements List Speedstar: SAP-System-Screenshot

3.3.4.2 Run MRP for the Speedstar

Carry out materials requirements planning for the entire BoM of product ***Speedstar-xyyy*** in plant ***DL00***. Therefore, within the tile group **Script 2 – Design-to-Operate** select the app ***Schedule MRP Runs***.

1. Click on the New button and enter the following data:
   - **Job Template** ***Material Requirements Planning (MRP)***
   - **Job Name** ***Material Requirements Planning (MRP)***
   - **Start Immediately** ***select***
   - **Plant** ***DL00***
   - **Material** ***Speedstar-xyyy***
   - **MRP controller** ***000***
   - **BOM Components** ***select***
   - **Scheduling** ***1***
   - **Planning Mode** ***3***
2. Choose ***Schedule*** and leave the current view ( ).

3.3.4.3 Run for the Speedstarlett

Execute requirements planning for the entire BoM of the Speedstar***lett-xyyy*** in plant ***DL00***. Therefore, within the tile group **Script 2 – Design-to-Operate** select the app ***Schedule MRP Runs***.

1. Click on the New button and enter the following data:

- **Job Template** ***Material Requirements Planning (MRP)***
- **Job Name** ***Material Requirements Planning (MRP)***
- **Start Immediately** ***select***
- **Plant** ***DL00***
- **Material** ***Speedstarlett-xyyy***
- **MRP controller** ***000***
- **BOM Components** ***select***
- **Scheduling** ***1***
- **Planning Mode** ***3***

2. Choose ***Schedule*** and leave the current view ( ).

3.3.4.4 Reporting: Stock/Requirements List and MRP List

Display the stock/requirements list for the ***Speedstar*** and plant ***DL00*** once again.
Therefore, within the tile group **Script 2 – Design-to-Operate** select the app ***Monitor Stock / Requirements List***.
You can see that due to the sales order, a new planned order was created. Simultaneously, the planned order for the planned independent requirements was reduced by the quantity of the sales order requirements.

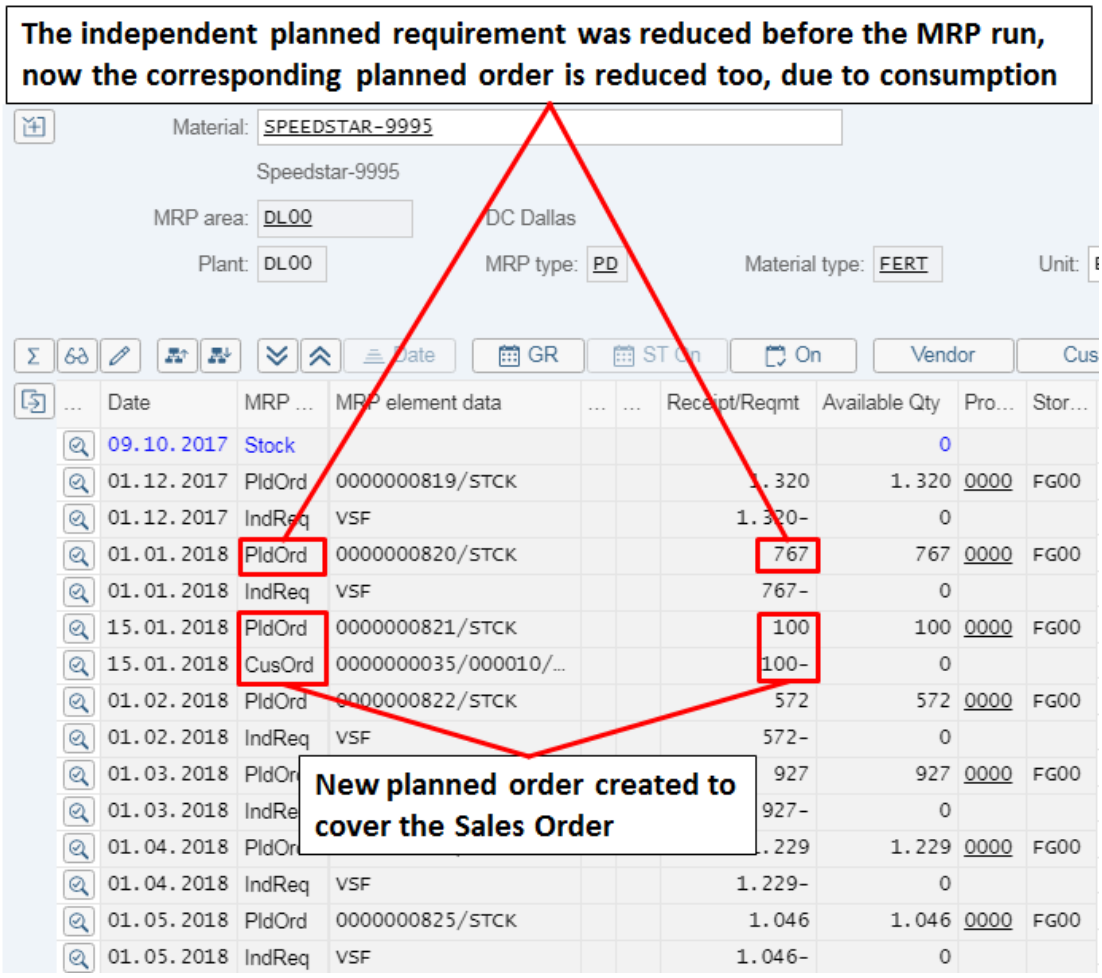


Figure 141: Stock/Requirements list for Speedstar: SAP-System-Screenshot

In our planning scenario this ensures that planned independent requirements consume sales orders when they actually occur. Consider that the planned independent requirements are nothing else but the forecast of those very sales orders.

3.4 Theory: Production Execution

In this chapter, you will become acquainted with the production control process in the SAP system. Production Control is a functionality of the SAP application SAP PP. We have already discussed the planning part of the process, which encompasses Strategic Planning and Detailed Planning. The results of the Detailed Planning – more specifically MRP – were planned orders, purchase requisitions, and schedule lines that are further processed in Materials Management (Source-to-Pay business process) and Production Control (Manufacturing Execution).

Production order and in particular the selection of the production type is determined by several criteria in a company, e. g., the production process, the complexity of a product, and production stability. For this reason, SAP ERP supports multiple production types to satisfy different requirements to shop floor control.

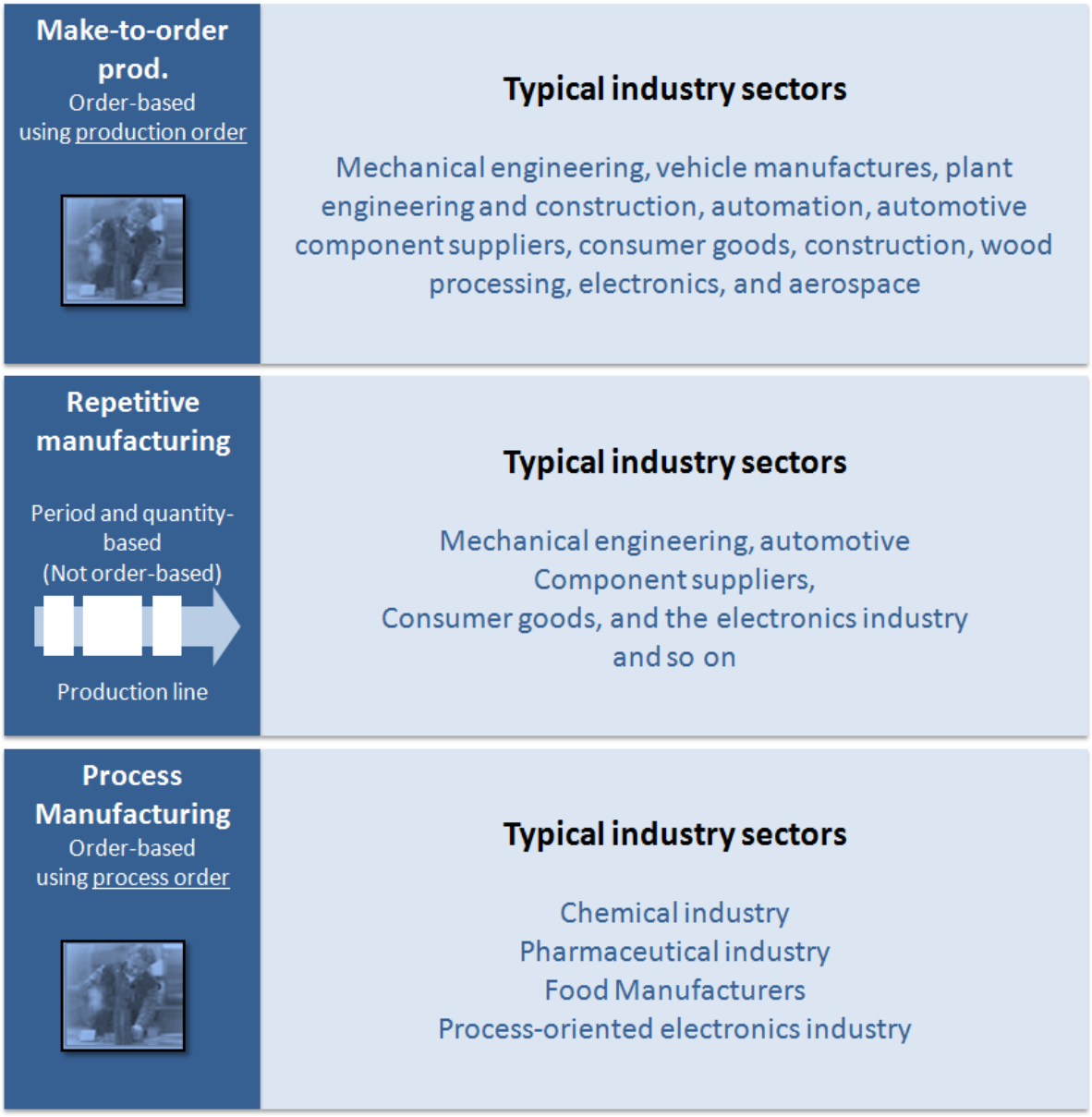


Figure 142: Production types in SAP S/4HANA (1)

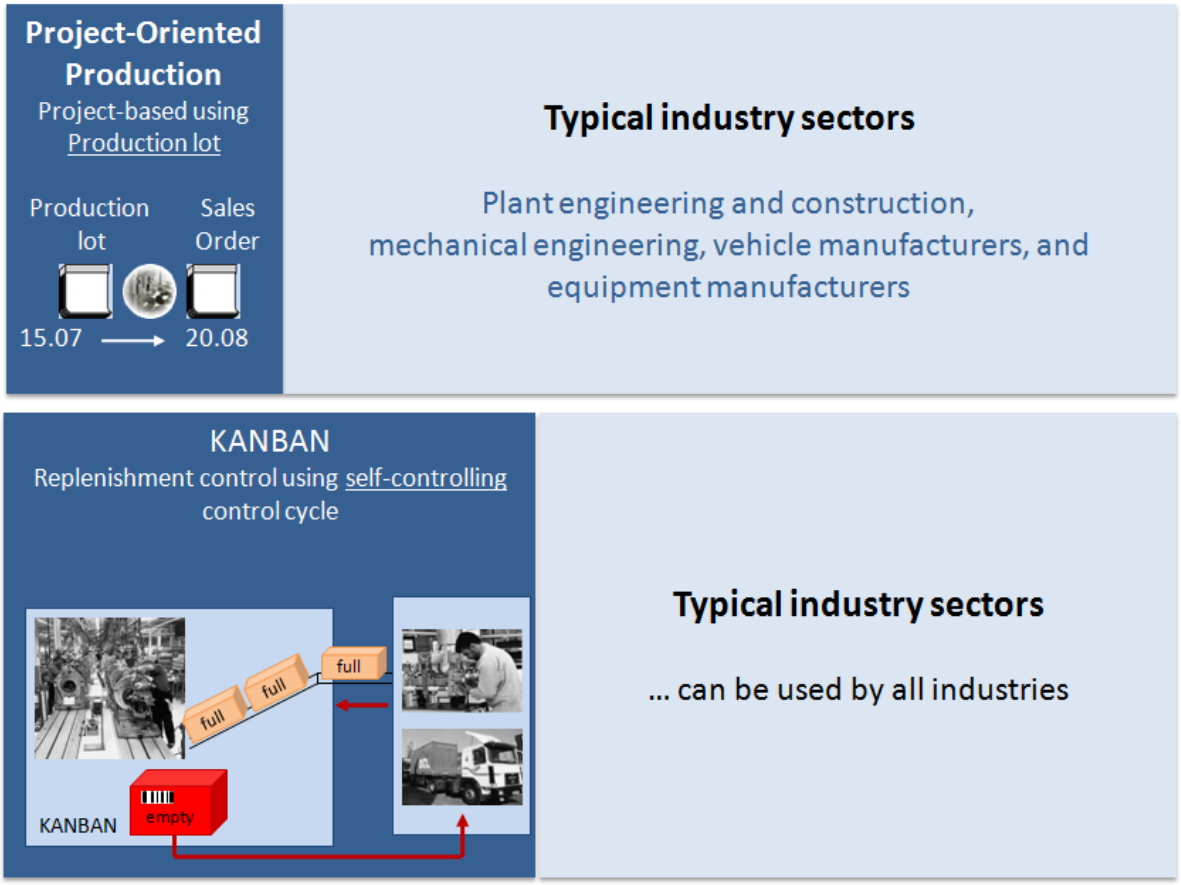


Figure 143: Production Types in SAP S/4HANA (2)

We will now focus on make-to-order production (discrete manufacturing).

3.4.1 Overview of the Manufacturing Process

The manufacturing process encompasses multiple steps such as order creation, scheduling, release, printing papers, material withdrawal, execution, confirmation, goods receipt and settlement. These functions are integrated with other areas in the company, such as controlling and warehouse management. For this reason, you must take into account the extensive integration relationships of production orders during implementation. The following figure displays the consecutive steps in the manufacturing process. Not all steps are mandatory (e.g., PDC and print are optional), some steps can be automated or executed in background:

1. **Order Request**: A request for manufacturing a product can be of several origins. For instance, a planned order (from planning in SAP MM) or a sales order (from SAP SD) can be requests for a production order.
2. **Order Creation**: A production order can be created manually without being previously requested. Alternatively, they can be (automatically) created with reference to a *planned order*, a *sales order* or a *project*. After creation, the ***status*** of the production order is ***CRTD*** (Created). Depending on production type settings (forward, backward) scheduling is carried out to determine production dates and capacity requirements. Order creation can also be executed in a ***background*** job.
3. **Availability Check**: The availability check, in Shop Floor Control, checks whether the *components* (materials), *production resources/tool* (PRT) or *capacities on the work centers* required for a production order are available. Availability checks can be

executed manually or ***automatically***. Availability checks can also be executed in a ***background*** job.

4. **Machine Commitment**: Work center capacity, if available, can be reserved exclusively for the production order. This activity can also be executed in a ***background*** job.
5. **Order Release**: A production order must be released, before it can be processed. A newly created production order initially receives the status CRTD (created). The following restrictions apply to production orders that have been created but not released:
   - Confirmations for the order cannot be executed, yet.
   - Shop floor papers cannot be printed.
   - Goods movements (receipt, issue) for the order cannot be executed, yet.

   After releasing a production order (status REL) those process steps are possible. Order releasing can be executed manually or ***automatically***.

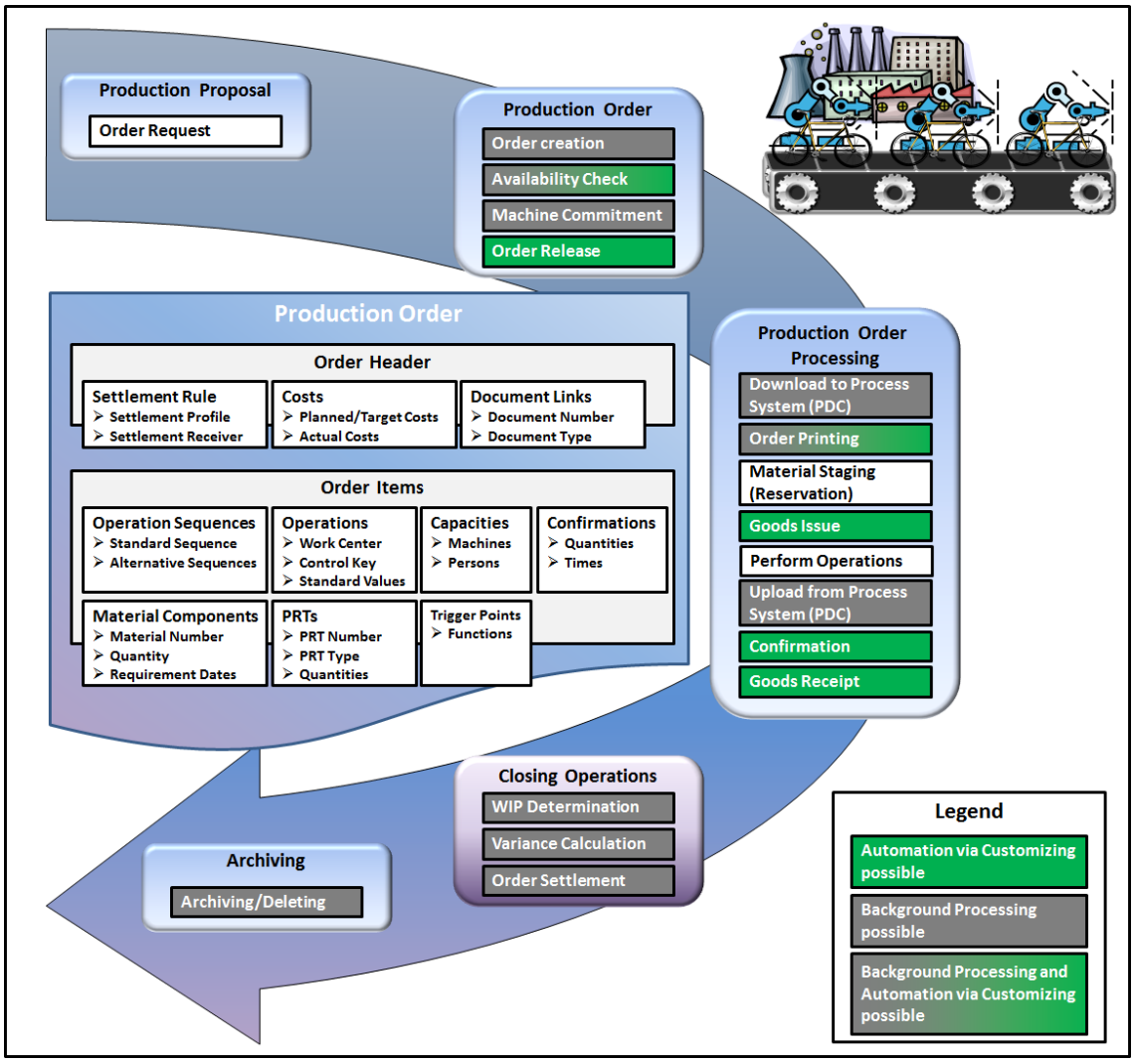


Figure 144: Processing Production Orders

6. **Download to PDC System (Process System)**: The PP-PDC interface is available for **p**lant **d**ata **c**ollection. You can use the interface to connect sub-systems used for entering time ticket and time event confirmations during production execution. PDC might be a sub-system that controls the individual machines (e.g., production robots) or employees in the factory. This activity can also be executed in a ***background*** job.

7. **Order Print**: Order documents, like general order information or shop floor papers can be printed manually or automatically upon order release. This activity can also be executed in a ***background*** job.
8. **Material Staging**: You can reserve materials for the production order and request the system to pick the material required for production from the warehouse and stage it for production supply. This can only be done for a released order (REL).
9. **Goods Issue (Material Consumption Posting)**: Before you can start producing a material, all the necessary material components have to be issued from stock via ***goods issues***. A goods issue triggers the following transactions in the system:
   - A material document is created to record the goods movement.
   - The stock quantities of the material are updated (reduced).
   - The stock values are updated (reduced) in the material master record and the stock/consumption accounts are updated (debit/credit postings in SAP FI).
10. **Perform Operations**: In this step workers and machines perform the operations described in the production order.
11. **Upload from PDC System (process system)**: Time and work data etc. collected during production execution by the PDC system can be transferred back to the SAP system. This activity can also be executed in a ***background*** job.
12. **Confirmation**: A confirmation documents the processing status of the orders. It is an instrument for controlling orders and is generally the last step of producing the product. With a confirmation you specify data like quantity produced, how much work was actually done, which work center was used for the operation, which carried out the operation, etc. After confirmation is executed the status of the production order is set to CONF (confirmed). Confirmation can be executed manually or ***automatically***.
13. **Goods Receipt**: The delivery to stock of the manufactured material is documented in the system via a goods receipt. A goods receipt (like the goods issue) triggers the following transactions in the system:
    - A material document is created to record the goods movement.
    - The stock quantities of the material are updated (increased).
    - The stock values are updated (increased) in the material master record and the stock/consumption accounts are updated (debit/credit postings in SAP FI).

The next three process steps are activities that are generally executed periodically (e.g. at the end of each month) in the Controlling application:

14. **WIP Determination**: You can determine the quantity and value of items that are not finished yet or waiting in a queue for further processing. This activity can also be executed in a ***background*** job.
15. **Variance Calculation**: Here you can calculate the variance between the planned (target) costs and the actual costs of a production order. The actual costs (work force time, material, etc.) are updated during the whole production process and are accounted on the cost object (depending on the settlement rule and the production order type settings that can be the production order, a sales order, a cost center, other type of orders, etc.). This activity can also be executed in a ***background*** job.
16. **Order Settlement**: When a production order is settled, the actual costs incurred for the order are settled to one or more receiver cost-objects (e.g., to the account for the material

produced or to a sales order). Offsetting entries are generated automatically to credit the production order:

- If the costs for the production order are settled to a material account, the order is credited each time material is delivered to stock. The material stock account is debited accordingly.
- If the costs for the production order are settled to another receiver (e.g., to a sales order), the order is credited automatically at the time of settlement. The cost-objects are debited accordingly.

The debit posting remains in the production order and can be displayed even after the costs have been settled. The settled costs are updated in the receiver cost-object and can be displayed in reporting. This activity can also be executed in a ***background*** job.

17. **Archiving/Deleting**: Production orders can be deleted (if not released yet) or they can be archived. This activity can also be executed in a ***background*** job.

3.4.2 Produce Material

Production and shop floor control is initiated by creating a production order for a material. The production order contains all the information for controlling (e.g., BoM, routing) and settling (e.g., settlement rule) of the production process.

3.4.2.1 Creating and Releasing Production Orders

The production order is the central document for performing and controlling the manufacturing process and its individual process steps (activities/operations). As such, it contains a wide range of information and functionalities to allow controlling all aspects of the manufacturing process.

3.4.2.1.1 Creating a Production Order

Production orders can be created manually and independently from any previous document using transaction CO01 or Fiori UX App *Create Production Order*. However, generally, the manufacturing process is embedded in a Design-to-Operate business process where production is planned based on sales and operation plans. As mentioned before, for any ***internally procured material (In-house Production)*** the MRP run creates planned orders based on the Demand Program transferred from Demand Management.

A **planned order** is a request created in the planning run for a material at a determined time. It specifies when the inward material movement should be made and the quantity of material that is expected. In addition to the dates and quantity, a planned order also contains basic requirements for the components for production in the form of dependent requirements. Additionally, capacities on work centers can already be planned, based on the planned orders generated in plant. Last, a planned order for internally procured materials is converted into a ***production order*** in order to start the manufacturing process.

3.4.2.1.2 Production Orders

A **production order** is a request or instruction to internally produce a specific product at a specific time. Production orders are used to control production operations and associated costs. Among others, they define the following elements:

Material produced	The material entered in a production order is the finished product or semi-finished product that is going to be manufactured with this production order.
Quantity produced	The quantity that is to be produced is also determined in the production order.
Routing	The routing of the material that is going to be manufactured with the production order contains all information about work centers (manufacturing locations) that are involved and operations (work activities) that must be performed in order to manufacture that material. The routing master data of the material is therefore copied into the production order.
Bill of Materials	The BoM of the material that is going to be manufactured with the production order contains all information about the components (raw materials, resources, etc.) that are required for manufacturing that material. The BoM master data of the material is therefore copied into the production order.
Manufacturing costs	Based on the information from the BoM and the routing, Product Cost Controlling (SAP CO-PC) estimates the manufacturing costs of a material. This cost analysis can also be executed and invoked in the production order. The settlement rule set for a production order is used to allocate the costs of the production order to other costing objects in Controlling (e.g., cost centers, sales orders, etc.).
Scheduling	This functionality is used to calculate the production dates and capacity requirements for all operations within an order. Thereby, the production order uses several master data records that are available for the material (BoM, routing, material master, work center). These data records are transferred to the production order and, as a rule, can still be changed there.

The following figure displays the structure and the components of a production order in the SAP system.

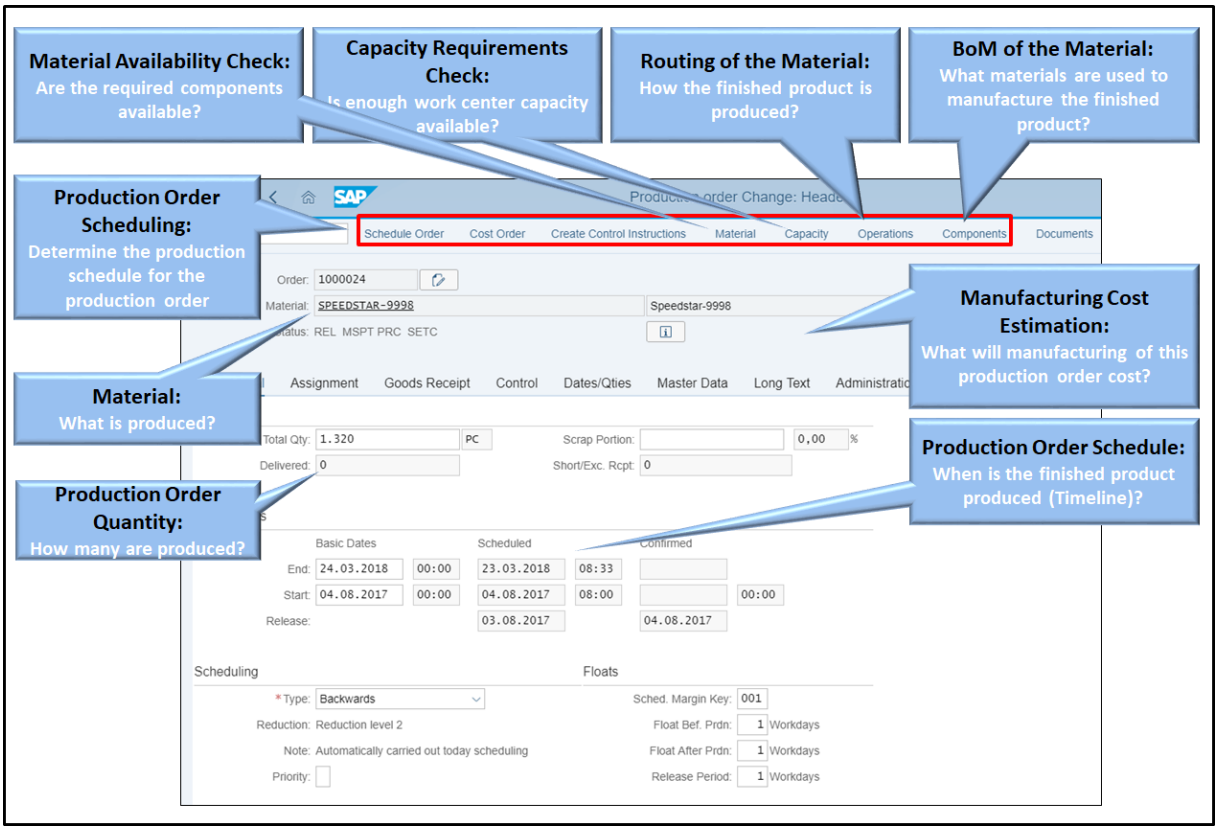


Figure 145: Production Order: SAP-System-Screenshot

Production Order Structure

The production order structure consists of the following main components:

1. **Order Header**: General information like order number, plant, production scheduler (person responsible for scheduling)
2. **Operations**:
   - Contains the routing operations (Standard Sequence or Parallel or Alternative Sequence).
   - The standard sequence must have at least one operation. If no operation is available, the system assigns a default operation.
   - **Sub-operations** are allowed within an operation.
   - Work center, control key, and standard value are retrieved from the materials routing. You can also assign/change them manually.
   - You can add **material components, production resources/tools,** and **trigger points** to an operation.
3. **Operation Sequences**:
   - You can create **multiple (parallel) operation sequences**
   - You can choose from different **alternative sequences** if available and assign one of them
4. **Capacity**: You can calculate capacity requirements, reserve machines, display and edit capacity planning tables and assign capacities manually. You can also split capacities, if e.g. your order is too big.
5. **Settlement Rule**: When running production costs like work force, material consumption, etc. are generated. These costs are determined at the **operation level**. That is, each operation in the routing creates activity-based costs (still remember the link to the activity types;-)) and e.g. material consumed. These costs are then transferred to **Order Head Level** and are collected there. The settlement rule defines how these costs are accounted on other accounting objects (e.g., sales order) and is only created for order-related COC.
6. **Costs**: You can access cost analysis embedded in the production order. This enables you to analyze differences between planned costs and actual costs of production.
7. **Documents**: Production orders can be linked to documents (texts, specifications, order descriptions, etc.) in the **document management system (DMS)**.

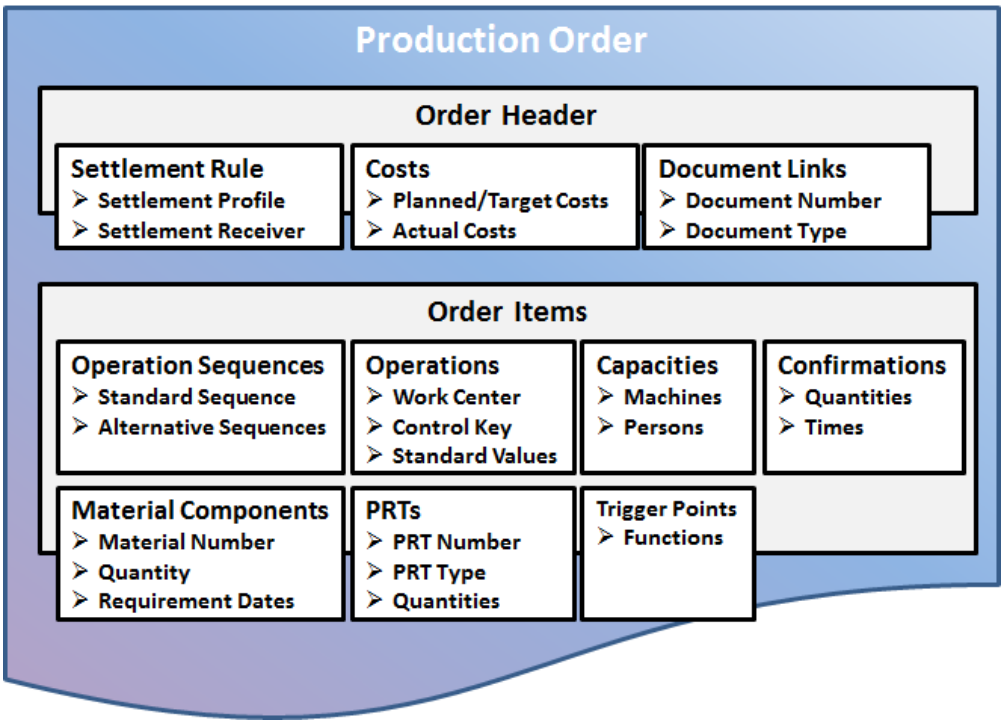


Figure 146: Components of a Production Order

3.4.2.1.3 Releasing a Production Order

The time between scheduling and releasing an order is used for component checks and preparations required for the processing of the production order. Before the production process can start, the production order needs to be released. Upon creation, the production order has the status CRTD (Created). There are two release processes available for a production order:

- At the ***Header Level*** the entire production order and all its operations are released for processing. Thereby, the production order status changes from CRTD to REL (Released).
- At the ***Operation Level*** each operation within the production order is released individually. Thereby, the production order status changes from CRTD to PREL (Partially Released). When the last operation of the material's routing is released, the order status changes to REL.

A production order can either be released manually by an employee or automatically by the system upon saving. This depends on the settings of the used production order type in the system's customizing.

After a production order has been released, it is ready for execution. No further activities can be executed before the status of the production order is REL or PREL. After the production order release:

- shop floor documents can be printed
- goods movements (goods issues and goods receipts) can be posted against the production order
- routing operations of the production order can be confirmed
- closing operations (WIP and variance determination, settlement) can be performed

3.4.2.2 Production Order Processing

Once the production order has been released, the manufacturing process can start. Important process steps of the manufacturing process are:

- Goods issue postings
- Confirmation of operations
- Goods receipt posting

3.4.2.2.1 Material Withdrawal: Goods Issue to Production Order

When a production order is created, information about the production structure is copied from the BoM into the production order. Thus, the production order knows what components and in what quantities components are required to produce a material. It then places a reservation on the inventory stock on those materials (components) in the required quantity.

After the production order (or production order operation) has been released, these reserved materials (components) can then be withdrawn from inventory. This material withdrawal is processed by posting a ***goods issue*** to the production order, which documents the movement of the materials from the unrestricted-use stock to the manufacturing facility.

The goods issue posting leads to several follow-up activities and document creations that are generated automatically by the system:

- The **stock** and **consumption fields** at the involved storage location are updated.
  For instance, the stock quantity of gearings in storage location RM00 of plant DL00 is at 1000 pieces, before the goods issue posting. With the goods issue 100 units of gearings are withdrawn for the manufacturing process. Thus, the stock quantity of gearings in that storage location is reduced to 900. The quantity decrease is documented with a material document; the value decrease in inventory is documented with an accounting document.
- If materials were reserved by the production order beforehand (planned withdrawal), the quantity in this stock type is reduced.
  For instance, the stock quantity of gearings in stock type ***reserved*** in storage location RM00 of plant DL00 is reduced by the quantity withdrawn.
- The production order is updated and the **actual costs (valuation)** for the materials that were withdrawn (planned and unplanned) are determined. That is, the costs of the material withdrawal are accounted on the production order. In Customizing, you can set a plant-specific or company-code-specific valuation variant to define the valuation of material consumption.
- With a goods issue posting, the following **four** documents are created, which document the goods movement and the effects on Financial Accounting and Controlling:
  - One **material document** is created which contains information about goods movements from a materials management (stock) point of view.
  - One **material ledger document** is created.
  - The **accounting document** describes goods movement from a financial accounting perspective. An accounting document always refers to a company code. There may be no accounting documents, one accounting document, or several accounting documents for a goods movement, depending on the type of goods movement (within a plant, cross-plant, cross company code, etc.).

- The **controlling documents** are used for various cost analyses purposes, such as Profit Center reports (statistical posting), cost center accounting (real posting).
- SAP allows the branching from the display of the material document to display other relevant information regarding accounting and cost accounting. Thus, you can access an associated accounting and controlling document directly from the material document (and vice versa).

- The **goods issue document** can be printed after the goods issue has been posted.

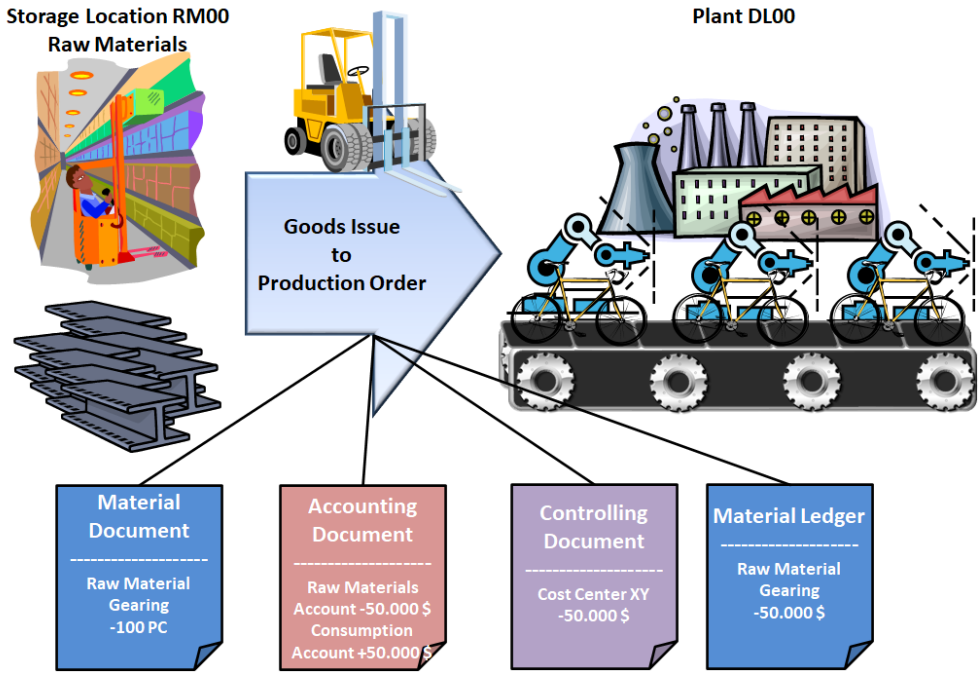


Figure 147: Goods Issue Posting to Production Order

For posting a goods issue in the SAP system, the movement type (261) is used. This movement type controls all aspects of the posting (e.g., which accounts are credited and debited in Financial Accounting). This goods issue procedure can be carried out both manually or automatically.
Goods issue postings can also be posted to withdraw materials for a production order that are not listed as components in the order. These *unplanned withdrawals* have the same effect as planned withdrawals, except for the update of the reserved stock type in the storage location, since there were no reservations made for an unplanned withdrawal beforehand.

3.4.2.2.2 Production Order Confirmation

After the manufacturing activities of a production order or individual operations of the production order have been accomplished, the production order (or individual operations) must be confirmed by the production execution manager or workers in the SAP system. With confirmation of a production order, the employee in charge of executing manufacturing processes tells the system that process steps in the production have been accomplished.
Thus, confirmations are used to monitor and track the progress of a production order through its production cycle. Thereby, prompt confirmation of operations shortly after they have been completed is essential for realistic production planning and control. With a confirmation, you specify:

1. The quantity of the material in an operation that was produced as yield, scrap, and the quantity to be reworked
2. How much work was actually done and, consequently, how much internal activities were consumed by the production order
3. Which work center was used for the operation and how subsequent capacity requirements planning is affected
4. Who carried out the operation

With a confirmation of a production order you tell the system that process steps in the production have been accomplished. The operations in the routing of the product that have been produced contain activities (assembling, welding, etc.), which are processed on work centers and might also include components like raw materials, which are consumed. Running those activities and consuming the raw materials produces costs on the work center. The work center in turn is assigned to a cost center, which determines the costs of the activities. The material (components) costs are derived from the material master. All these **actual costs** of production are captured with the confirmation and stored in the production order. The production order thereby is a cost collector.
When you confirm a production order (or individual operations in the routing of the production order) various additional functions are executed:

- Working hours of employees are defined in the SAP system as activity types. These activity types have a planned or actual price, which is calculated in Controlling (SAP CO - see teaching unit 9) based on the total costs of the corresponding cost center. The quantity of **working hours** consumed for the production order is transferred to the human capital management module of the SAP system.
- The work centers that provide the activities needed for the production process have a certain capacity of working hours. For instance, a working center with one employee can work 40 hours a week. The **capacities** used for the production order (e.g., 10 hours) are ***reduced*** due to the confirmation. Thus, the work center has 30 hours of capacity left in that week. The capacity reduction occurs in proportion to the quantity or activity consumed.
- If the production order you processed and confirmed was initiated by a **sales order**, schedule lines and delivery/availability dates of the sales order are updated for the delivery of the product to the customer.
- For the goods movement to storage location (goods receipt), a **material document** is created for the produced material, no matter if the **goods receipt** was posted manually or automatically (see control key in the following).
- If the routing of the production order contains multiple operations (1. assembling 2. welding 3. delivery to warehouse), you can confirm them individually and, thus, assure **real time confirmation**. When confirming an individual operation, which contains processing of materials, the system can post an **automatic goods issue** for all components needed for this individual operation if you have the "**backflush**" parameters maintained (either in the production order or in the material master). When the production order is set to "backflush"-operation, the material is taken from stock whenever an operation, which needs materials, is confirmed.

In the practice chapter of this teaching unit, you manually post the materials you needed for production as goods issue in the App *Post Goods Movement*. The posting is done before the production order was confirmed.

- An **automatic goods receipt** can be posted after the last operation of the routing is confirmed if you have set a specific control key in the routing of the material produced. In the practice chapter of this teaching unit, you post the goods receipt to the storage location manually using the App *Post Goods Movement*.

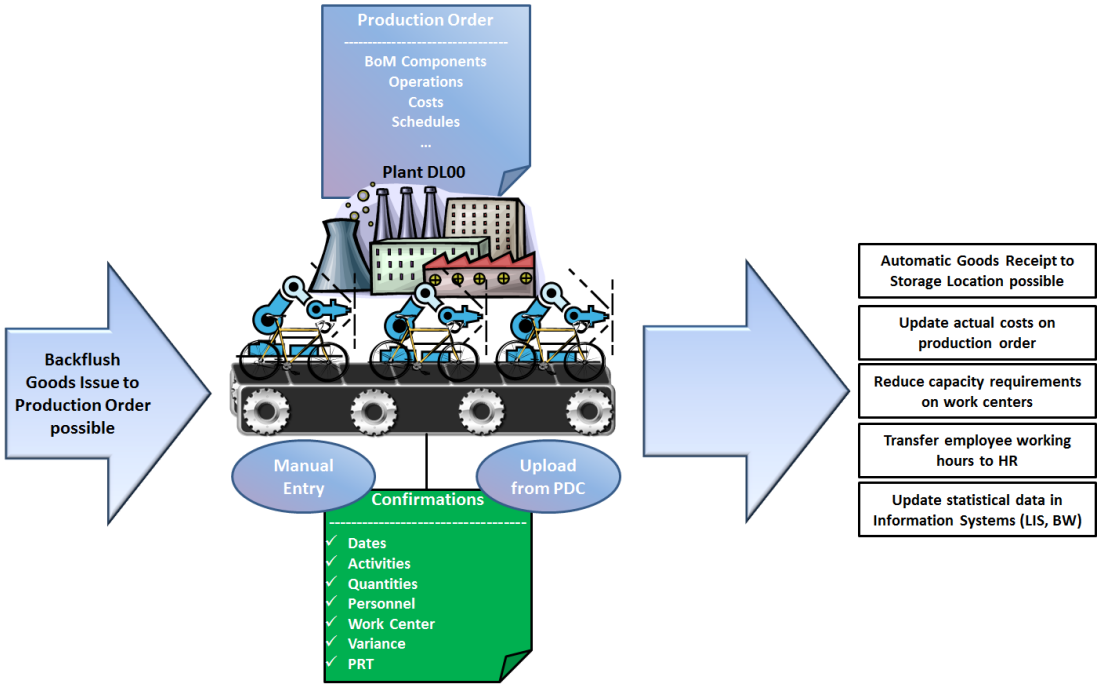


Figure 148: Confirmation of a Production Order

You can enter a **confirmation manually** or **upload confirmations** from PDC systems using the PP-PDC interface. After confirming a production order, the **status** of the order changes to **CNF** (confirmed) and the confirmed quantity is updated in the field quantity delivered in the production order. If a scrap or rework quantity is confirmed, a quality notification can be generated automatically (as of ECC 6.0 EhP3).

3.4.2.2.3 Goods Receipt from Production Order

After (partial) confirmation was executed and the goods were produced, the finished goods must be transported from the work center, where they have been produced, to the storage location. Therefore, you use a **goods receipt posting** to document acceptance of the confirmed quantity of output from the production order into stock. Again, a goods receipt posting (like a goods issue posting) leads to several follow-up activities and document creations, which are generated automatically by the system:

- The inventory stock quantity is updated according to the quantity of finished products moved to the storage location with the goods receipt.
  For instance, if the quantity of Speedstar bicycles in storage location FG00 of plant DL00 is 1000 before the goods receipt has been posted and the goods receipt from the production order moves 100 finished Speedstar bicycles into this storage location, then the quantity increases to 1100. This update is documented in a material document.

- ***Value update***: Since the finished products that are moved into the storage location have a certain value (internal price, production price, etc.), the value of the finished products in the storage location must increase by the value of the newly added materials.
  For instance, if the 100 Speedstar bicycles had a price of 1640 € each, then the value of the finished products in storage location FG00 increases by 164.000 €. This value increase is documented with an accounting document, which posts the value changes to the appropriate accounts in Financial Accounting.
- ***Price update***: Depending on the price type stored in the material master of the finished product, the valuation price for future valuation might change (moving average price).
- ***Production order updated***: The delivered quantity field is updated in the production order. That is, the quantity produced and delivered to the storage location is now stated in the particular field in the production order.
- With a goods receipt posting, the following **four** documents are created, which document the goods movement and the effects on Financial Accounting and Controlling:
  - The **material document** gives information about goods movements from a materials management (stock) point of view.
  - The **material ledger document** updates the moving price.
  - The **accounting document** describes goods movement from a financial accounting perspective.
  - The **cost accounting documents** are used for cost analyses purposes.
  - You can branch from the display of the material document to display other relevant information regarding accounting and cost accounting.

The goods receipt posting is controlled using movement type (101), which each posting refers. This procedure can be carried out both manually or automatically.

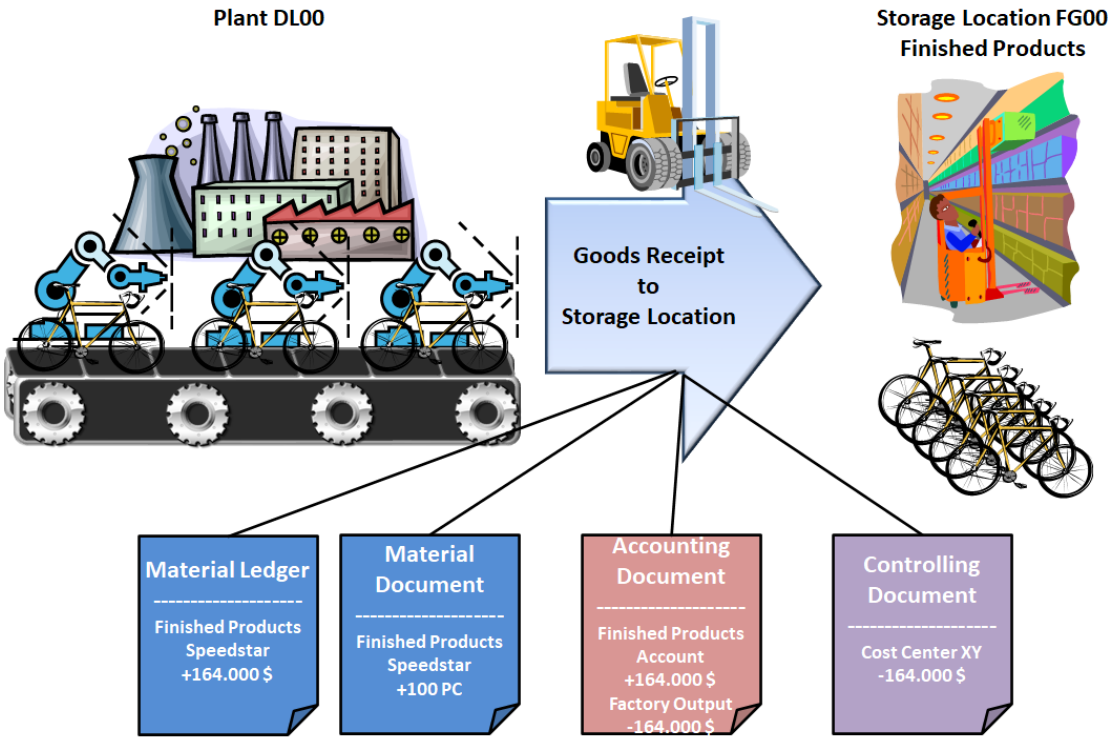


Figure 149: Goods Receipt Posting to Storage Location

3.4.3 Perform Periodic Processing

Production Planning and Control (SAP PP) as well as Controlling (SAP CO) are highly integrated. We have mentioned the integration points between the Design-to-Operate business process and the Management Accounting sub-area Cost Object Controlling (CO-PC-OBJ). CO-PC-OBJ allows collecting costs (e.g., for materials and activity types) that incurred during the production of a product or a service and posting these costs on the particular cost objects that consume these resources. Cost objects that can collect costs during their processing are, e.g., sales orders, production orders, process orders, and production orders.
The main tasks of CO-PC-OBJ are **simultaneous costing** and **period-end closing**:

- ***Simultaneous costing***: This component provides real-time cost management functions that determine the cost of goods manufactured while they occur. For instance, actual production costs (performed activity types) are cumulated alongside material consumption (used raw materials) while the work is completed in a production order. The cost information collected during the production process allows comparing planned and actual costs at any stage of the production process.
- ***Period-end costing***: Once the production process has been accomplished, period-end closing calculates the value of goods in production (work in process), the production scrap, and variances between the product cost estimate (CO-PC-PCP) and the actual costs (CO-PC-OBJ), and settles them to other components such as profitability analysis and Financial Accounting (FI). The cost settlements are also considered in the Actual Costing with Material Ledger component and influence the actual material costs in the Material Ledger.

Cost Object Controlling takes place during the production process.

3.4.3.1 Overview of Cost Object Controlling in the Design-to-Operate Business Process

Costs of production are mainly material, PRT, and activity consumption. The costing structure of a production order is derived from the bill of material and routing used for production and correspondingly from the material cost estimation (which uses the BOM and routing of a material for the calculation). During accomplishment of a production order, all these **actual costs** of production are captured with the production order confirmation and material movements and stored on the production order. Thus, costs of production are accumulated on the production order and the production order thereby is a cost collector from SAP CO point of view.

An example of *cost unit processing* is *order-based production* with a production order that produces a certain amount of a product and then delivers this to the warehouse. Thereby, the following steps are accomplished:

- Before releasing a production order, you can execute a **preliminary costing** to obtain the production costs for a material. That is, before you release a production order, you can calculate the planned costs of a production order based on the materials (BOM) the activities and PRT (routing) needed to produce the product. These costs are stored as planned costs in the production order.
- After releasing the production order costs are initially incurred by **material withdrawals** (goods issue to the production order). The raw materials stock is reduced

and expenses, in the form of cost elements, flow via the respective consumption accounts to the accounting object 'production order'. Similarly, external services via invoices are posted directly on the order using account assignments from Financial Accounting. Here, we speak of individual costs or direct costs of the order.

- **Confirmations** debit a production order with one or more internal activities, which were accomplished during the production process. These activities are performed by a work center and the costs are determined by the associated cost center. Since the cost center costs are not yet fully known when the confirmation is made, a plan price for the activities is allocated here. These costs are either make-to-order production costs or production overheads. As a result, the cost center is credited with the costs in production. If there is a **deficit or surplus** at the end of the month, these **variances** can be allocated subsequently via different functions.
- The **period-end closing** of the cost object calculates of cost fluctuations within the framework of the variants analysis and displays the cause of theses fluctuations. Similarly, you can calculate scrap costs that can be used for the operational production control.
- **Work in process** enables the monthly deferral of costs that are perhaps already posted in FI as expenses but not yet on a finished product. This work in progress is calculated in Management Accounting (CO) and included in the cost object reports as well as in the reports for Financial Accounting (FI) where the WIP is transferred from CO to FI.
- The **delivery** (goods receipt from production order) of the product leads to an increase in the inventories of finished products, whereby unusual internal cost fluctuations are captured as **variances** and can also be posted to price difference accounts in the P/L. This depends on the detail of the price control in the material master and on the account determination.
- In **order settlement** costs of orders (production orders, internal orders, maintenance orders, service orders, etc.) that actually incurred due to activities performed and resources consumed are settled to one or more receiver cost objects. The sender of the costs is the particular order. Receivers of the costs from the order are, e.g., a material, a cost center, an internal order, a sales order, a project, a network, a fixed asset, etc. In order to close a production order, it must not carry any costs. Thus, all costs that have been posted to the production order during the manufacturing process must be settled to final cost objects.

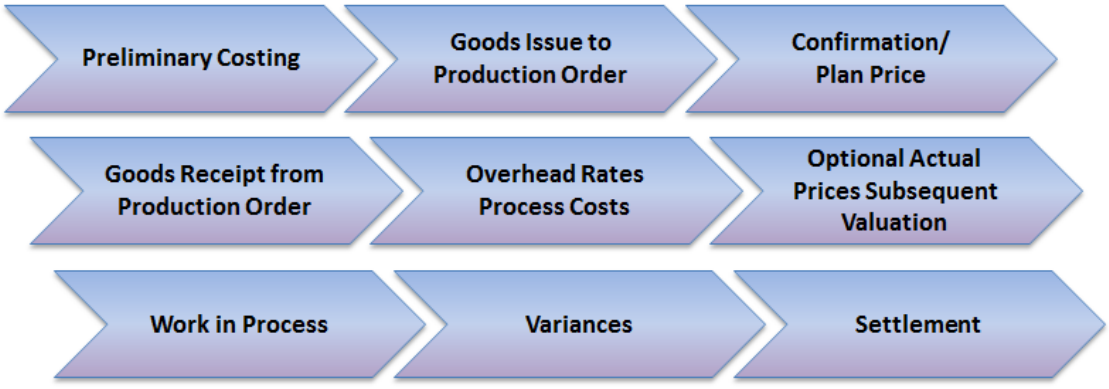


Figure 150: Manufacturing Processing with Management Accounting

3.4.3.2 Production Order Settlement Process

The variant of **cost object controlling** selected in controlling determines the way in which a production order is credited or debited. The two possible variants are **order-related** manner and **product-related** manner.

A production order is credited at the time of order settlement. Depending on controlling settings, a production order serves as cost object. Thus, all costs (material costs, production costs, personnel costs, etc.) incurring during production are debited to the production order object. Consequently, the production order is a cost collector. At the time of order settlement, the costs are posted to the respective accounts (e.g., material consumption account) or to other cost objects (e.g., sales order). Thus, the production order does not bear costs anymore and can be closed both technically and in terms of accounting.

Usually, settlement is periodic (e.g., monthly) and it is controlled via a **settlement profile**.

3.4.3.2.1 Requirements for Settlement

Before the costs of a production order can be settled to other cost objects, valid settlement parameters must be maintained for the production order. This includes setting the settlement profile and a settlement structure:

Settlement Profile

In the SAP system, each order type is by standard assigned to a settlement profile in the system's customizing. The settlement profile specifies:

- to which settlement receivers the order can be settled
- the maximum number of distribution rules
- whether the settlement share is to be calculated as a percentage rate or as equivalence numbers
- a default for the settlement structure

Settlement Structure (Allocation Structure)

The settlement structure determines how the debit cost elements are assigned to settlement cost elements. Each debit cost element may only be assigned to one settlement cost element.

Settlement Rule

Upon production order creation, SAP automatically assigns a ***settlement rule*** to the order based on the settings in the system's customizing.

The settlement rule contains one or more ***distribution rules*** for the production order, which consists of a cost receiver, a settlement share, and a settlement type:

- The cost receiver (*settlement receiver*) determines to which cost object the actual costs of the production order are to be settled. Thereby, costs can be sent from the production order to the following receiving cost objects:
  - a material
  - a cost center
  - an internal order
  - a sales order
  - a project
  - a network
  - a fixed asset

- The *settlement share* determines the percentage rate or the equivalence number to distribute the costs to the individual cost receivers.
- The *settlement type* determines whether all the costs are settled which were incurred for the order (full settlement) or whether the costs collected on the order are to be settled periodically (periodic settlement). The settlement receiver *Material Account* allows periodic settlement only for orders.

3.4.3.2.2 Elucidation: Settling a Production Order to Stock (Material Account)

A production order has been created for the 100 units of the material Speedstar.

Preliminary Costing

By executing the preliminary costing in the production order, the SAP system calculates the **planned costs** for producing the lot of bicycles. The planned costs are calculated based on the BoM and the routing of the Speedstar. These master data records contain:

- Components (e.g., raw materials) used for the production
- PRTs used during the manufacturing process
- Activities (routing operations) performed during the manufacturing process

Components and PRTs are valuated with prices that are stated in the material master of these components or with prices available in purchasing (e.g., purchasing info records). Activities are valuated with the activity type prices that are stated on the cost center that is assigned to the work center that performs the operation.
With this information, preliminary costs determine the **planned** costs of the production order. We assume that the planned costs for the manufacturing process are calculated at 164.000 €.

Manufacturing Process

The manufacturing process includes goods issue, production order confirmation, and goods receipt. Goods issue and confirmations cause actual costs that are posted to the production order as cost collector:

- With the goods issue, **actual** costs of materials (components) that are withdrawn from stock are posted on the production order.
- With confirmations, **actual** costs of activities that are performed during the production process are posted on the production order.

With all these costs that incurred during the manufacturing process, the production order now carries actual costs. We assume that the actual costs of the production order are 174.000 € due to unforeseen material consumption (e.g., wastage), rework on some of the bicycles or longer production processes.

With the goods receipt to the storage location, the costs are allocated from the production order to a final cost object. In our case, we have used a standard production order that posts the costs of finished products to a Material Account in Financial Accounting. That is, the settlement rule in the production order contains a settlement profile that allocates the costs to the receiving object Material.

The following figure illustrates the posting behavior of the SAP system:

- A credit posting is made to the production order with the amount of 174.000 €. Thus, the production order does not carry anymore costs and can be closed
- A debit posting with the amount of 164.000 is made to the material account. The material price is determined by the quantity produced multiplied by the standard price in the material master. In our case 100 units * 1640 €.
- The difference of 10.000 € is posted to a price difference account.

Since production costs were higher than planned, the additional expenditure negatively affects the operating profit. This means that the profit decreases by the amount by which the actual costs charged to the production order exceed the standard price.
The actual costs charged to the production order affect net income just as the posting of the inventory change at the time of the goods receipt. Since the actual expense was 10.000 € higher than expected, the operating profit is 10.000 € lower than it would have been if production had been at standard cost.

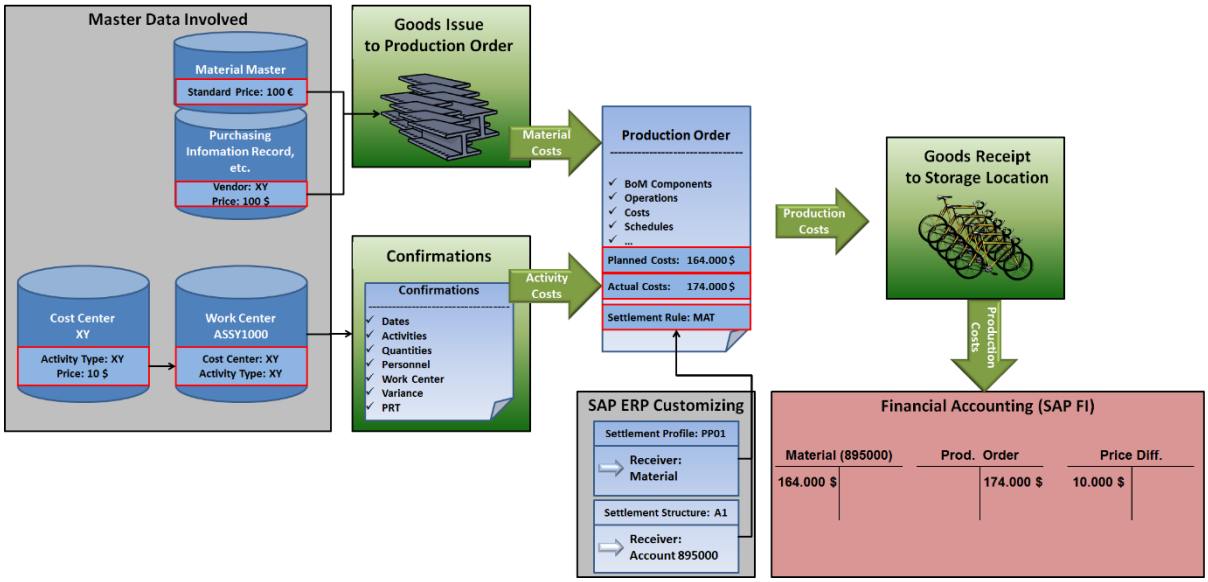


Figure 151: Production Order Settlement

3.4.3.2.3 Standard Price Control vs. Moving Average Price Control

Note that a price difference account is only used, if the pricing indicator of the material is set to Standard Price in the material master. For in-house production of materials, it is generally best to use standard price control.
If the price control indicator in the material master record is ***S (Standard Price)***, a price difference account is credited. That is, the variance in cost calculation is posted on a special account.

Example: You produce a Speedstar and have a variance in production costs of 100 €. This 100 € are posted on the price difference account and the production order is balanced out.

If the price control indicator in the material master record is ***V (Moving Average Price)***, the total stock value and the moving average price change accordingly. That is, the average price of the product on stock rises accordingly to balance the difference out. In this case, no difference account is required, but the price of the material in the material master changes.

Example: You have nine Speedstar with an average price of 1640 € on stock. Now you produce one Speedstar and for some reason the production costs are 1740 €. With the price indicator V the average price of all Speedstar on stock move to 1650 € (9*1640 + 1*1740 = 16500).

3.4.3.2.4 Costs Analysis in Production Orders

Production orders in the SAP system provide tools for analyzing all costs that incur during manufacturing execution. Thereby, the following types of costs are accounted for:

- Primary Costs: materials, external processing, labor (internal processing)
- Secondary costs: PRTs and overhead costs (administration, secretary, IT, telephone, etc.)

The cost analysis can be accessed directly in a production order or in the Cost Analysis Reporting of the SAP PP information system. The SAP system updates the costs of a production order constantly upon their occurrence. Thereby:

- planned costs, target costs, and actual costs of production orders are calculated and analyzed,
- the work-in-process inventory and the finished goods inventory is calculated and updated as well as
- variances between planned and actual costs are calculated and analyzed.

For further processing, results of costs analyses are transferred to:

- Financial Accounting (FI)
- Profitability Analysis (CO-PA)
- Profit Center Accounting (EC-PCA)
- Actual Costing / Material Ledger (CO-PC-ACT)

3.4.3.3 Material Ledger in SAP S/4HANA

The simplification of SAP S/4HANA makes the utilization of the Material Ledger (ML) in SAP FI obligatory for material valuations. When an SAP ERP system is migrated to SAP S/4HANA, the Material Ledger is activated automatically and must be set up in the system's customizing. The benefits of the obligatory usage of the Material Ledger and the new data model for Material Valuation are:

- Flexible valuation methods in multiple currencies
- Parallel accounting standards while simultaneously reducing required system resources and improving scalability of the business processes
- Statistical moving average price: Parallel statistical moving average valuation is not available in SAP S/4HANA, leading to significant increase of transactional data through-put for high volume transactions, especially goods movements.

It is important to distinguish between the role of the Material Ledger as a **subledger in Accounting** (SAP FI) and its business features in **Actual Costing**:

- *Material Ledger as inventory subledger*: In this role, the Material Ledger is used to valuate material inventories in multiple currencies and multiple parallel accounting standards (e.g. GAAP, HGB, IFRS).
- *Material Ledger as basis for Actual Costing*: With the Actual Costing application material inventories, work in process, and cost of goods sold are valuated with weighted average unit costs that are being calculated by evaluating business transactions of one or several posting periods. Another feature Actual Costing provides is e.g., actual cost component split.

Even though Material Ledger is obligatorily set to active in S/4HANA, Actual Costing is not. Activation of Actual Costing is still optional.
If an SAP customer does not use the Material Ledger already with its SAP ERP installation, the ML will automatically be activated during the migration S/4HANA. The following changes take effect immediately:

- In transactions MM02 and MR21, material prices can now be maintained in multiple currencies
- In SAP FI, the inventory account balances are calculated separately for each currency and result, therefore, in a cleaner and more consistent valuation in currencies other than the local currency.

New Database Architecture

In SAP ERP, the inventory valuation tables "**x**BEW**(H)**" contained transactional, as well as master data attributes. The individual tables are **E**BEW, **E**BEW**H**, **M**BEW, **M**BEW**H**, **O**BEW, **O**BEW**H**, **Q**BEW, **Q**BEW**H**. With SAP S/4HANA, these inventory valuation tables still exist as DDIC definitions, as well as database objects. But now, they are only used to store material master data attributes. The fields LBKUM, SALK3, and SALKV for storing transactional data will be retrieved from the Material Ledger and are no longer updated in the original xBEW(H) tables. This leads to less frequent updating need for those fields and consequently leads to a higher throughput due to fewer database locks.
When an SAP ERP system is migrated to S/4HANA, there are still several SAP ERP applications and above all customer enhancements that still use the old database tables and fields. This means that these applications will still try to read data from and write data into the classic xBEW(H) tables. To ensure that the new architecture is compatible with this old code, SAP provides so-called Core Data Service (CDS) Views, which are assigned as proxy objects to all those tables. These CDS views consist of database joins between both master data from the original xBEW(H) table and transactional data from Material Ledger tables. This ensures that each read access to one of the old tables still returns the data as before. All customer coding, reading data from those tables, will work as before because each read access to one of the tables will get redirected in the database interface layer of NetWeaver to the assigned CDS view. If transactional fields are affected, write access to those tables must be adjusted.

Major Innovation in SAP MM

One of the major innovations in SAP S/4HANA in the SAP MM application is the significant increase of transactional data throughput for high volume transactions, above all for goods movement transactions. From a technical point of view, this is enabled by application logic that avoids **exclusive locking** on the application layer. An exclusive lock means that a material

master cannot be changed or processed in a different application as long as the application (e.g. goods movement transaction) that set the lock has not accomplish its processing:

- For goods movements, this can be achieved with few exceptions for materials with price control **Standard**, where the relation between unit costs for material inventory (standard price), and inventory quantity and inventory value is kept constant during goods movements.
- For materials with price control **Moving Average** the same increase of transactional data throughput cannot be achieved, since the system must set exclusive database locks on a material to calculate a consistent moving average valuation. This means that the system will always set a lock on a material with moving average price control as soon as it is used in an application.
- In SAP ERP, for materials with price control *Standard*, the system also calculates a *moving average valuation* (the so-called **"statistical" moving average price**) in parallel. Obviously, this statistical valuation also requires exclusive locking. As said, exclusive locking is limiting the transactional data throughput, and therefore shall be avoided in SAP S/4HANA. Therefore, this parallel statistical moving average valuation can be deactivated in SAP S/4HANA. Even though the deactivation is not mandatory, it is recommended to achieve a significant increase of transactional data throughput for goods movements. It is important to note that the deactivation is not reversible. The deactivation of the statistical moving average is the consequence of a new lock behavior for materials with price control Standard. This new lock behavior does not use exclusive locks anymore. The activation of the new lock behavior leads to the deactivation of the statistical moving average.

As a result, end users, creating material master data in SAP S/4HANA, must select one of the following material valuation methods for a material:

- Price control **Standard** offers a fixed price inventory valuation and no parallel "statistical" moving average valuation. Only dedicated business transactions can change unit costs (for example, MR21). But a significantly increased transactional data throughput for goods movements can be achieved.
- Price control **Moving Average** with which unit costs of material inventory might be changed by any business transaction, but transactional data throughput is still limited by the exclusive locking.

The statistical moving average price is purely statistical and does not have an impact on actual financials-relevant valuation. Without the statistical moving average price in few scenarios an alternative way of valuation needs to be used. This affects, e.g.:

- Balance Sheet Valuation: Selection variants must be checked and adapted.
- Product Cost Planning: Valuation variants must be checked and adapted.

3.5 Practice: Production Scheduling and Shop Floor Control

In the previous units you created all required master data (material master records, routings, BOMs) for the production of the two products and ran the complete SOP process. Thus, the entire structures of the Speedstar and Speedstarlett as well as the production plans are available in the system. Now, your task as a **Production Planer** in the functional area **PP**, is to manufacture Speedstars using a planned order from the Material Planning.

3.5.1 Production Scheduling

You note that the construction department changed the routing for the Speedstar. Since you completed MRP with the old data, you need to carry out MRP again as there were changes to the routing, before you start the manufacturing process. Thereby, you need to use planning mode **3 – Delete and recreate planning data**.

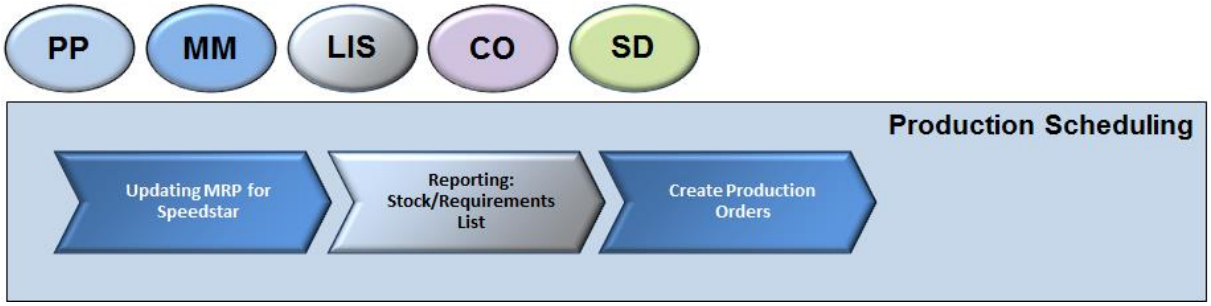


Figure 152: Process Overview: Production Scheduling

3.5.1.1 Update MRP for Speedstar

Within the tile group **Script 2 – Design-to-Operate** select the app ***Schedule MRP Runs***.

1. Click on the New button and enter the following data:
   - **Job Template** ***Material Requirements Planning (MRP)***
   - **Job Name** ***Material Requirements Planning (MRP)***
   - **Start Immediately** ***select***
   - **Plant** ***DL00***
   - **Material** ***Speedstar-xyyy***
   - **MRP controller** ***000***
   - **BOM Components** ***select***
   - **Scheduling** ***1***
   - **Planning Mode** ***3***
2. Choose ***Schedule*** and leave the current view ( ).

3.5.1.2 Reporting: Stock/Requirements List

Briefly check the Stock/Requirements List. You are already familiar with MRP in SAP S/4HANA from the previous units. At this point, you merely need to check which materials are available from stock and if there are shortfalls for some materials.

To check the current Stock/Requirements List, call up within the tile group **Script 2 – Design-to-Operate** select the app ***Monitor Stock/ Requirements List***.

1. Enter **material *Speedstar (Speedstar-xyyy)*** and **plant *Dallas (DL00)***. Confirm with *Enter*. You are already familiar with the screen that appears from the material planning unit. You can see the planned orders (PlOrd.) created by the MRP run, as well as planned independent requirements (+ the sales order). In addition, check the quantity stored of the components Basis-Module (**Basis-Module-xyyy**), wheel (**wheel-xyyy**) and carb-frame (**carb-frame-xyyy**). You can see the planned orders here as well covering the dependent requirements (DepReq).

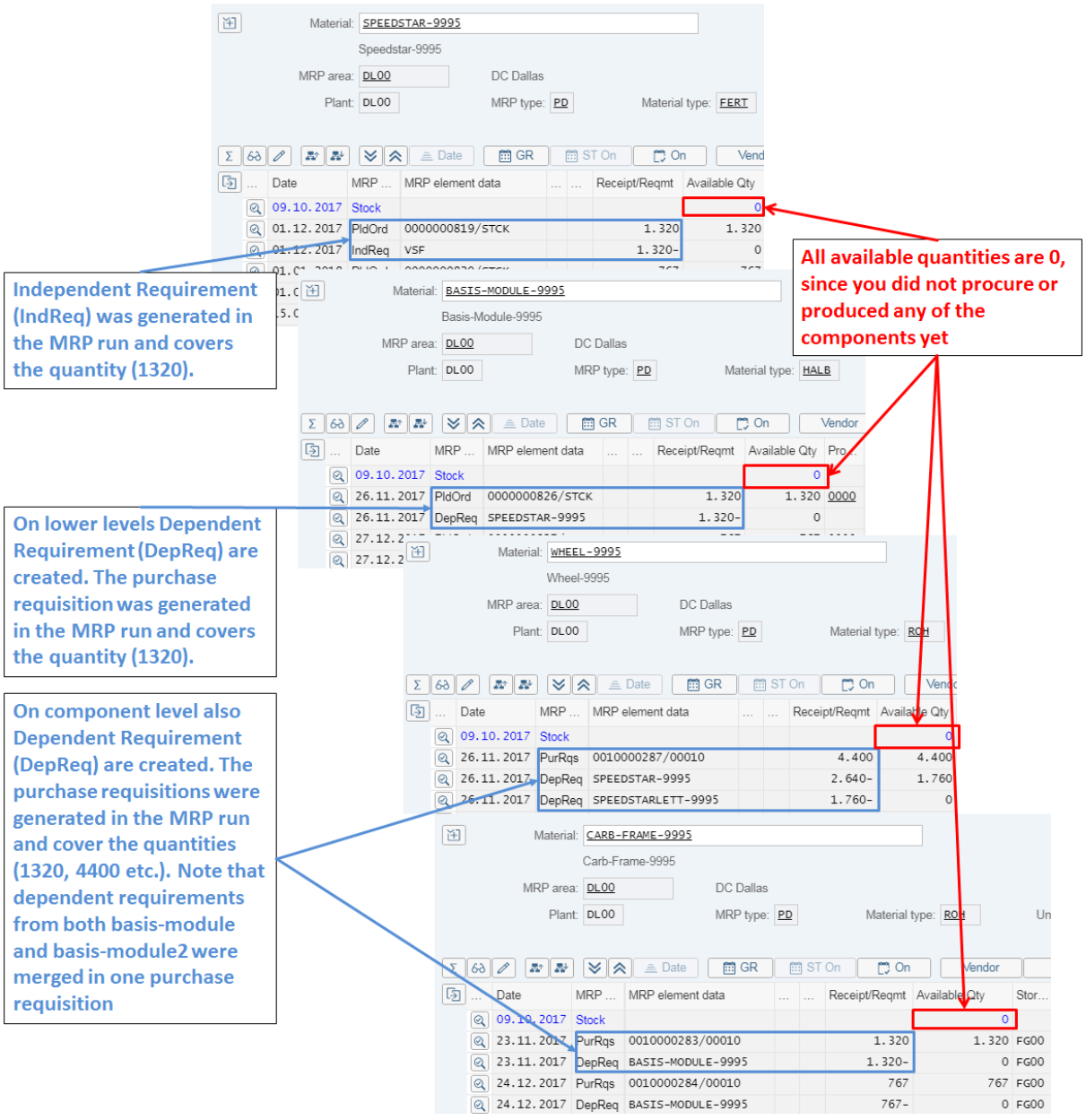


Figure 153: MRP Status (1): SAP-System-Screenshot

2. Also check the stock quantity for the gearings (**gearing-xyyy**). Here, you should have an available quantity of 100 from the Source-to-Pay business process.

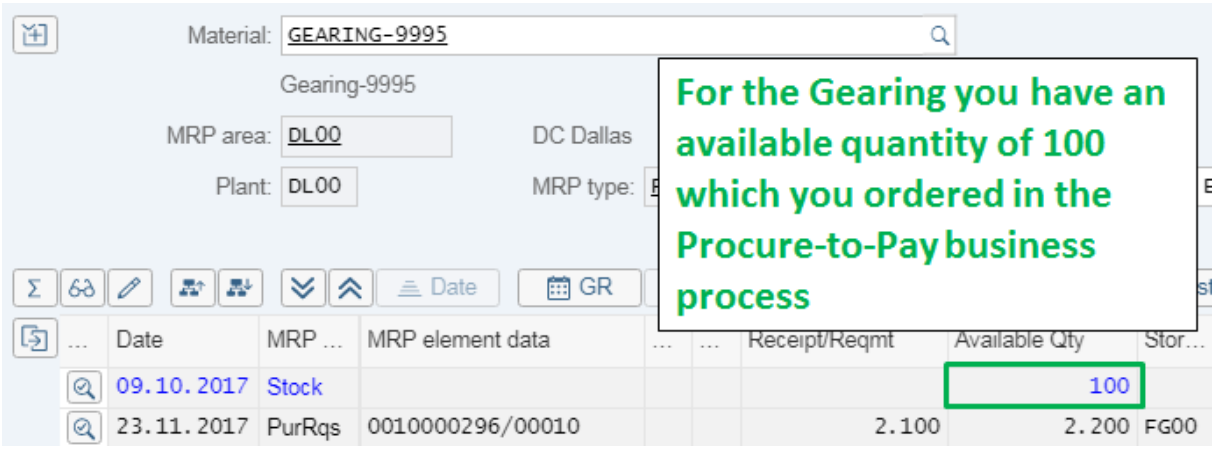


Figure 154: MRP Status (2): SAP-System-Screenshot

The management decided to produce the first planned order of the Speedstar (in the case of the figures here, that is, 1320 units) and of the Speedstarlett (880 units) to keep them in stock. Your task as production manager and manufacturing execution manager is to convert planned orders into production orders.

3.5.1.3 Create Production Orders

In the previous steps, you noted that there are not sufficient finished products in stock to cover your planned independent requirements. Consequently, you need to produce the required number of racing bicycles. Therefore, **create the production order**.
The planned order already contains all required information (e.g., materials to be produced, important dates, BOM, routing). Now you need to convert the planned order for this period (quantity app. 1320) into a production order.

Create Production Order for Basis-Module

Start with the Basis-Module. Therefore, within the tile group **Script 2 – Design-to-Operate** select the app ***Monitor Stock/ Requirements List***.

1. Select the **material *Basis-Module (Basis-Module-xyyy)*** and plant ***Dallas (DL00)***. Choose *Enter*.
2. Double-click the row containing the first planned order (**PlOrd.**). This should be a planned order with a quantity of 13xx (in our example 1320) Basis-Modules (received/required quantity column). Select this order (even if at second or third position), because you will need more than 1000 Speedstars in the sequel of this unit.
3. You can now see the **Additional Data for MRP Element** screen. Click on the -> Prod.Ord. button (**Convert Planned Order to Production Order**).

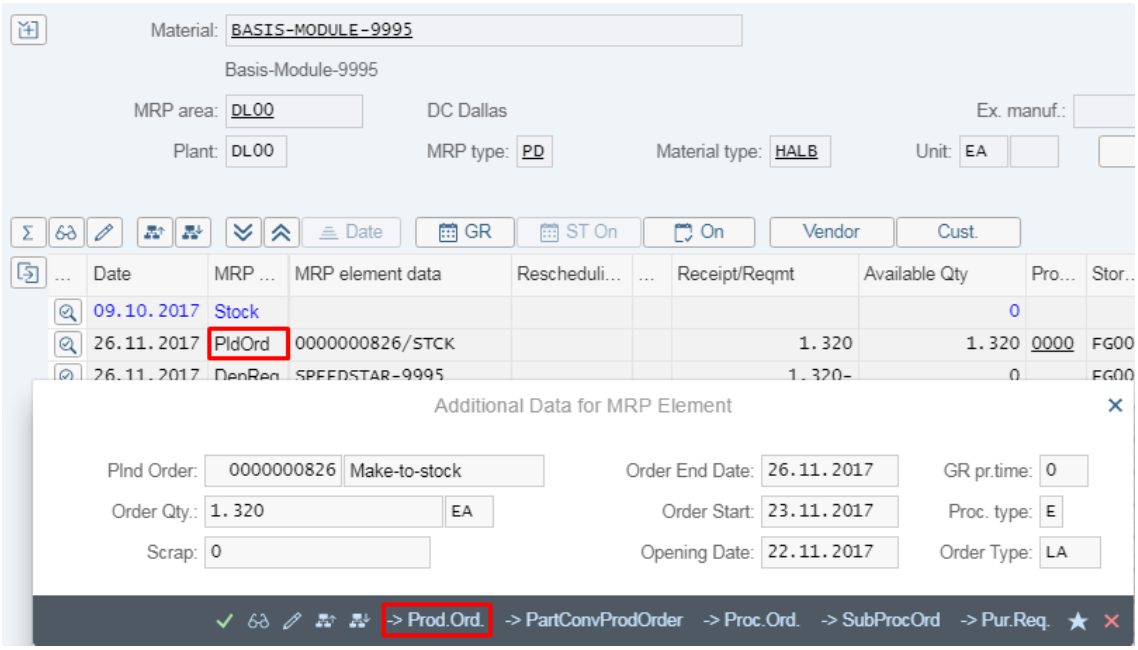


Figure 155: MRP Basis-Module: SAP-System-Screenshot

4. The system copies the data of the planned order and creates a new production order. Next, check the availability of the required components by clicking the Material symbol (**material**).
5. Click the **Missing Parts Overview** button.

For comparison

You can see that available quantities of carb-frames, and gearings are not sufficient.

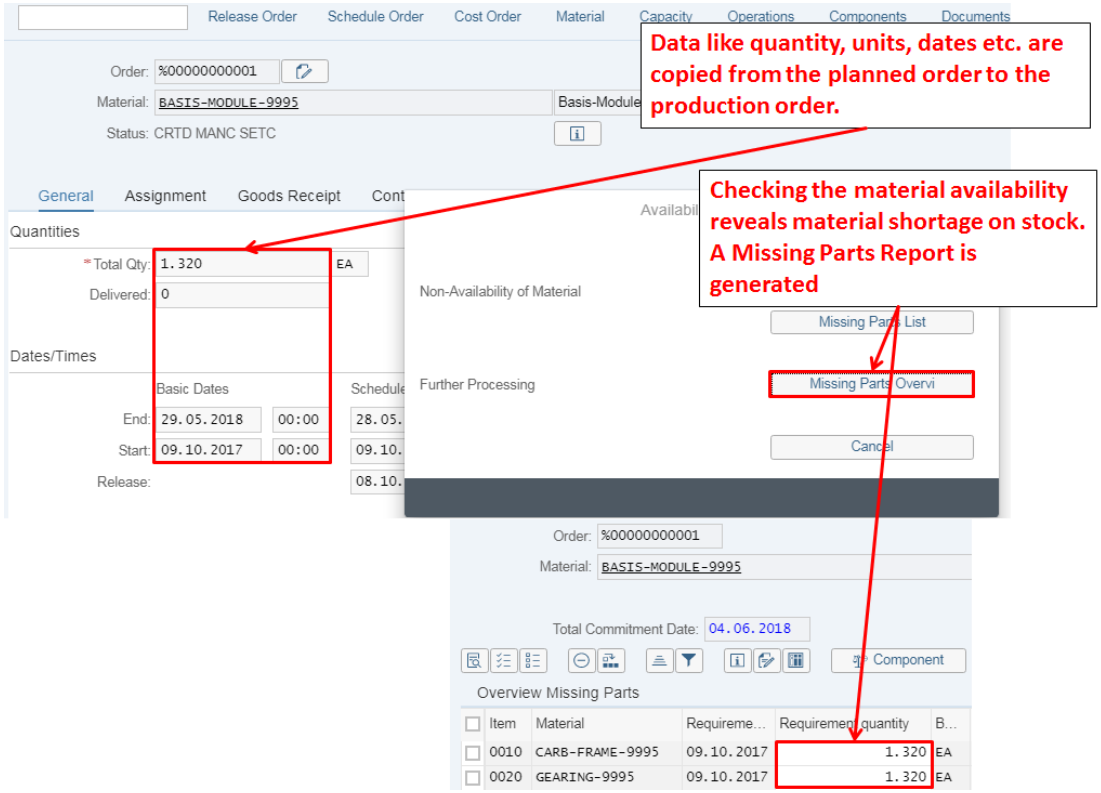


Figure 156: Create Production Order: Material Availability: SAP-System-Screenshot

6. After knowing that the available quantities of frames and gearings are not sufficient to produce the Basis-Module, choose the  button to go back to the **Production order Create: Header** screen.
7. Release the order (the order **Status** is currently **CRTD** – created) by clicking the  symbol. If necessary, click on the  button within the popup. The system confirms the order release in the status bar. The order status changes to **REL** (released).

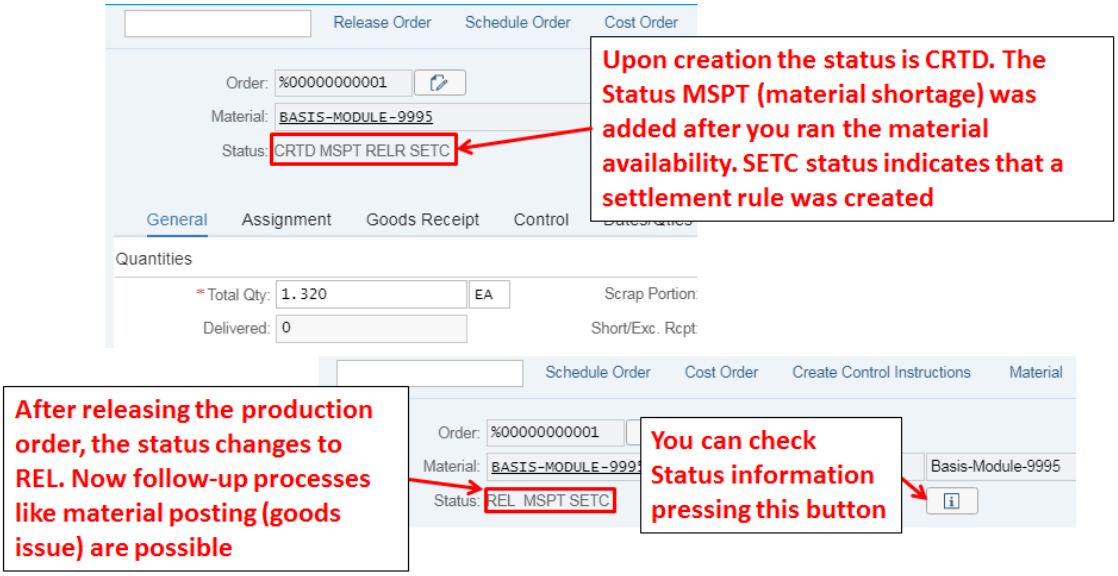
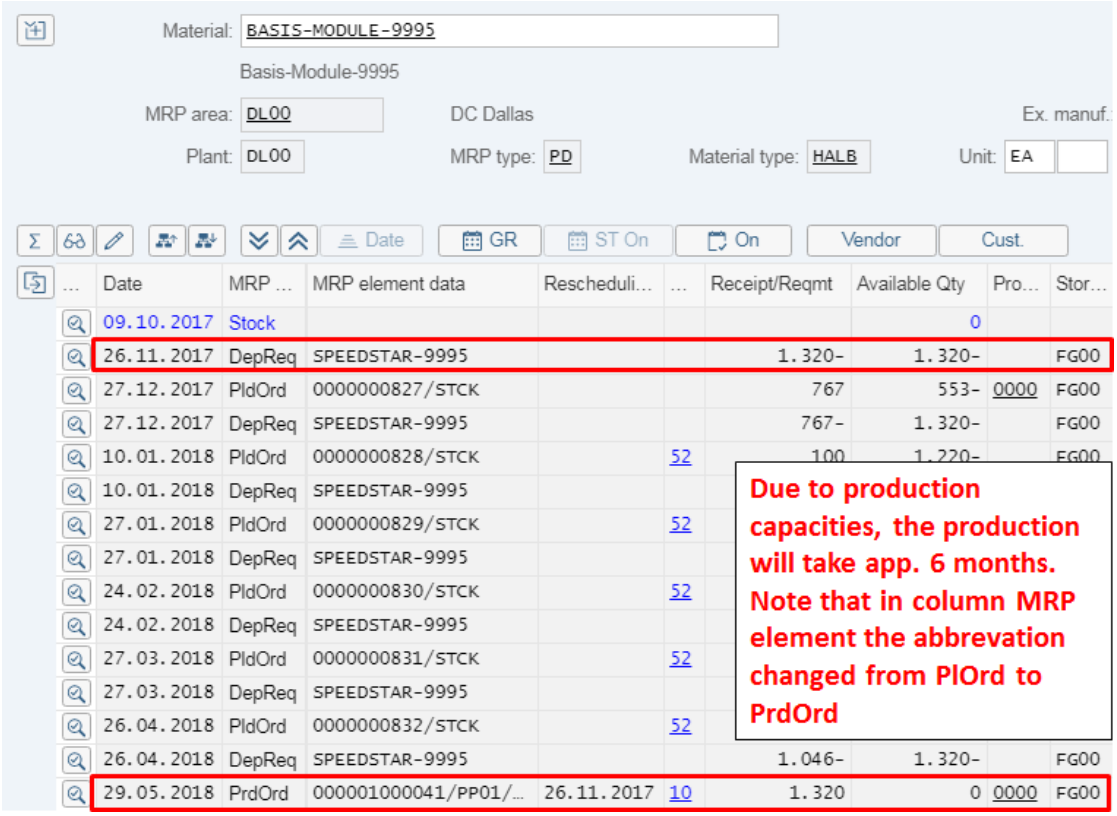


Figure 157: Create Production Order: Order Status: SAP-System-Screenshot

8. ***Save*** the order and list the order number:

Production Order 1 (Basis-Module):

9. Leave the current view and within the tile group **Script 2 – Design-to-Operate** select the app ***Monitor Stock/ Requirements List*** again. Enter your ***Basis-Module-xyyy*** as **Material** and ***DL00*** as **Plant**. Instead of the planned order, the system displays the production order (**Prod.Ord.**).



...	Date	MRP ...	MRP element data	Rescheduli...	...	Receipt/Reqmt	Available Qty	Pro...	Stor...
	09.10.2017	Stock					0		
	26.11.2017	DepReq	SPEEDSTAR-9995			1.320-	1.320-		FG00
	27.12.2017	PldOrd	0000000827/STCK			767	553-	0000	FG00
	27.12.2017	DepReq	SPEEDSTAR-9995			767-	1.320-		FG00
	10.01.2018	PldOrd	0000000828/STCK		52	100	1.220-		FG00
	10.01.2018	DepReq	SPEEDSTAR-9995						
	27.01.2018	PldOrd	0000000829/STCK		52				
	27.01.2018	DepReq	SPEEDSTAR-9995						
	24.02.2018	PldOrd	0000000830/STCK		52				
	24.02.2018	DepReq	SPEEDSTAR-9995						
	27.03.2018	PldOrd	0000000831/STCK		52				
	27.03.2018	DepReq	SPEEDSTAR-9995						
	26.04.2018	PldOrd	0000000832/STCK		52				
	26.04.2018	DepReq	SPEEDSTAR-9995			1.046-	1.320-		FG00
	29.05.2018	PrdOrd	000001000041/PP01/...	26.11.2017	10	1.320	0	0000	FG00

Figure 158: Production Order in Sock/Requirements List: SAP-System-Screenshot

Note that due to the system's scheduling processes, the production order is listed below in the stock/requirements list, since the completion of the order is linked to work center capacities and settings from the routing and thus, the completion will take some time.

Create Production Order for Speedstar

Next, create the second production order using the system-created planned order for the Speedstar. Again, within the tile group **Script 2 – Design-to-Operate** select the app ***Monitor Stock/ Requirements List*** again.

1. Select the **material *Speedstar (Speedstar-xyyy)*** and **plant *Dallas (DL00)***. Choose *Enter*.
2. Double-click the row containing the planned order (**PlOrd.**) with more than **1300 Speedstars**.
3. You can now see the **Additional Data for MRP Element** screen. Click the 

button (**Convert Planned Order into Production Order**). Ignore a possible **notification** regarding the Speedstar-xyyy document with "Yes".

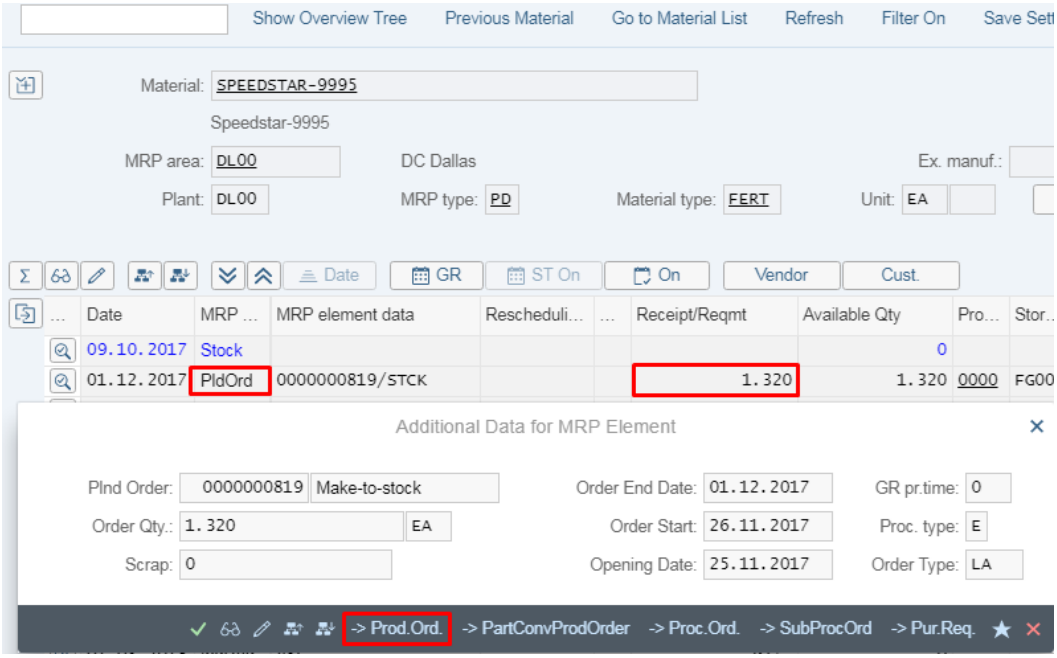


Figure 159: Production Order for Speedstar: SAP-System-Screenshot

4. The system copies the data of the planned order and creates a new production order. You can see that the order status is again **CRTD**, the quantity was copied from the planned order, and a finish date is set.
5. Next, check the availability of the required components by clicking the Material symbol (**material**). Then, click the **Missing Parts Overview** button.

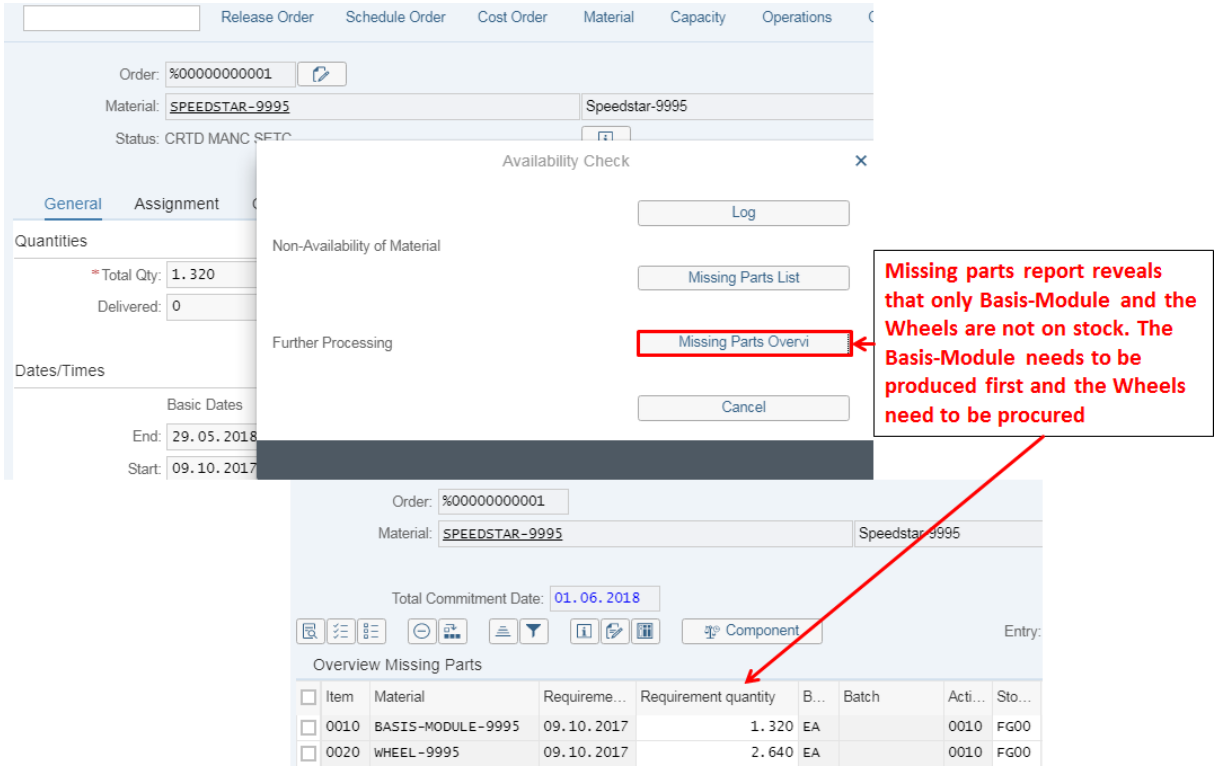


Figure 160: Missing Part Report: SAP-System-Screenshot

6. Choose the button to go back to the **Production order Create: Header** screen.

7. Regarding a production order, you can get information about components linked to the order (from the **BOM**) and about operations linked to the order (from the **routing**). Now, have a look at the components by selecting ***Components*** (or ***More → Components***). You see the following figure with the materials from the BOM.

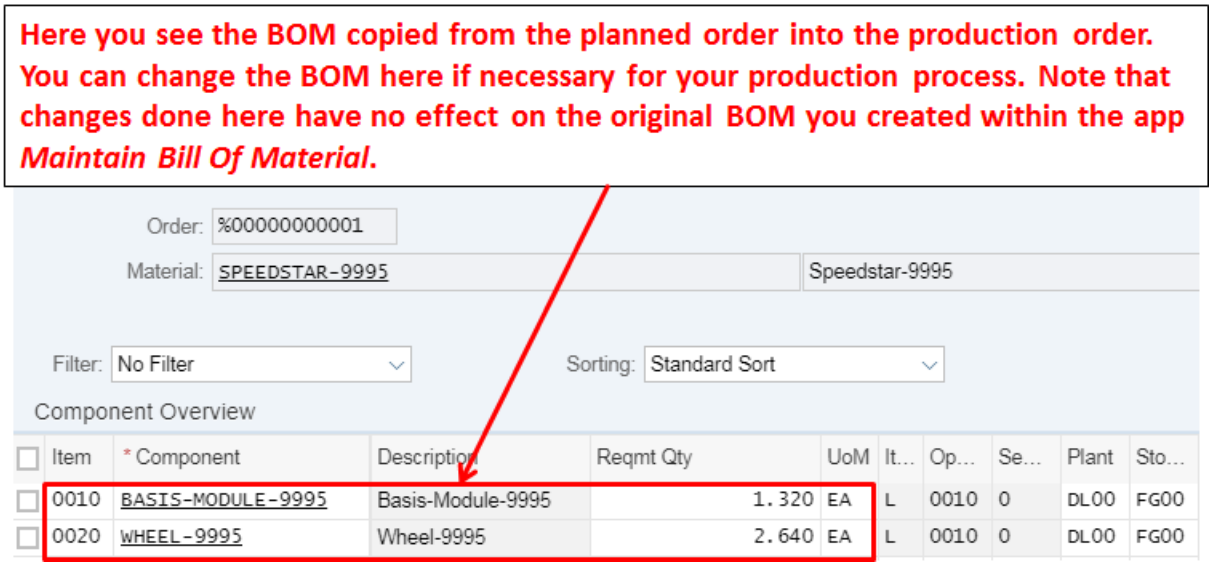


Figure 161: Component Overview Speedstar: SAP-System-Screenshot

8. Return to the previous screen and select ***Operations*** (or ***More → Operations***) to look at the operations from the routing.

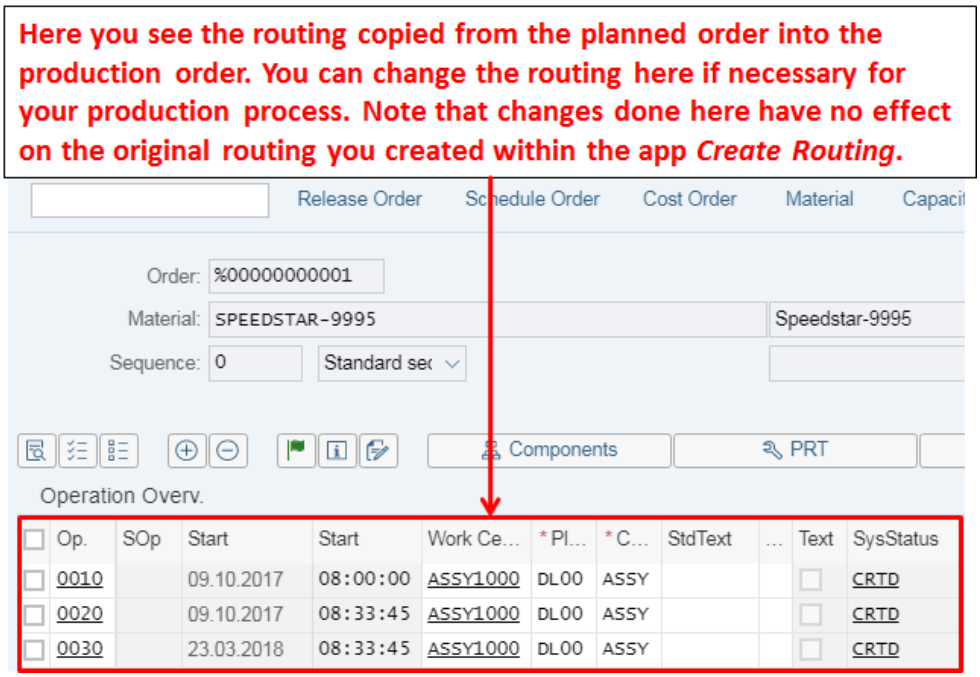


Figure 162: Operations Overview Speedstar: SAP-System-Screenshot

9. Return ( ) to the previous screen and release the order by clicking the Release Order -symbol. If necessary, click on the Release Order -button within the popup.
10. *Save* the order and list the order number.

Production Order 2 (Speedstar):

11. Leave the current view and within the tile group **Script 2 – Design-to-Operate** select the app ***Monitor Stock/ Requirements List*** again. Enter your ***Speedstar-xyyy*** as **Material** and ***DL00*** as **Plant**. Instead of the planned order (if necessary, scroll down), the system displays the production order (**Prod.Ord.**).

3.5.2 Procurement Process

Apparently, you do not have a sufficient quantity of components to produce the Speedstar and the semi-finished product Basis-Module.

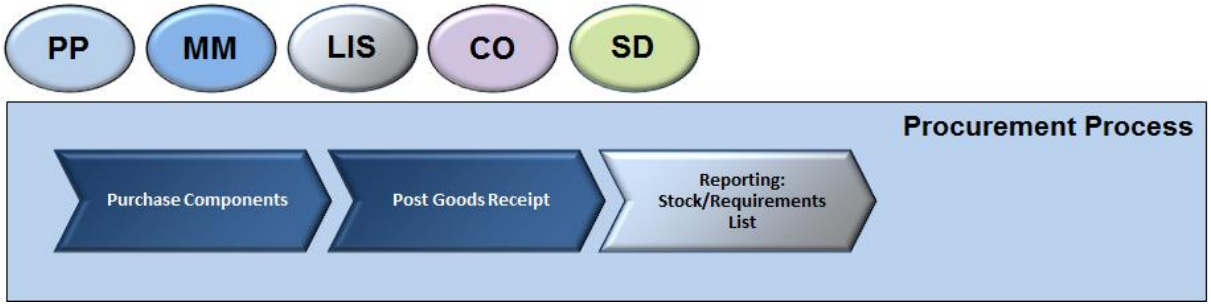


Figure 163: Process Overview: Procurement Process

3.5.2.1 Purchase Components

Purchase orders: Purchase orders for external procured components are also created with reference to the purchase requisitions that were automatically generated by the MRP run. Now, you need to convert these purchase requisitions into purchase orders.

To create a purchase order, you need to convert planned order to purchase requisition first. Choose once again the following transaction:

Therefore, within the tile group **Script 2 – Design-to-Operate** select the app ***Monitor Stock/ Requirements List***.

1. Select the **material** ***gearing (Gearing-xyyy)*** and **plant** ***Dallas (DL00)***. Confirm with ***Enter***.
2. You see the following situation illustrated in the following figure.

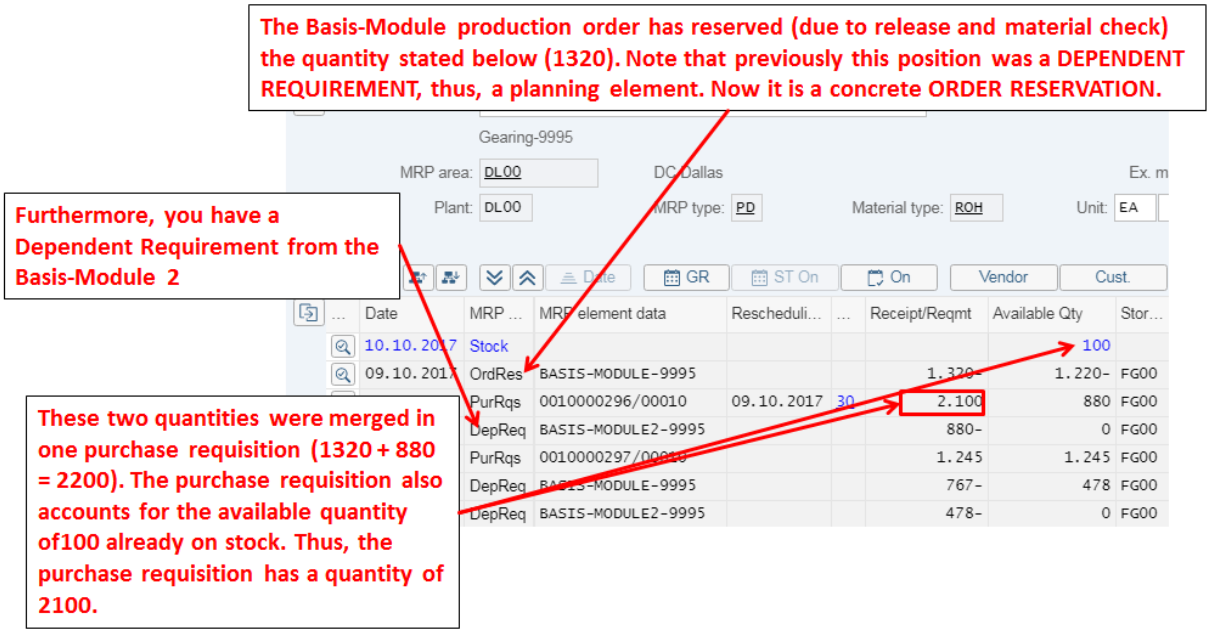


Figure 164: Create Purchase Order (1): SAP-System-Screenshot

3. Double-click the line containing the purchase requisition with the same quantity in the received/required quantity column (approx. 2xxx, in our example this is 2100) like your production order reservation for the Basis-Module and the dependent requirement for the Basis-Module2.

Please bear in mind the following: Always pay attention to the quantities, in this unit and later in "Order-to-Cash" teaching unit, of a finished product (Speedstar or Speedstarlett) or of a semi-finished product (Basis-Module or Basis-Module 2), which you need to produce. You need to previously order the required components (wheels, gearings, etc.) in accordance to these quantities. The production numbers that you get during the case studies may differ from the script considerably! This is not serious if you independently notice how many components are required for your production process.

*Within the **Monitor Stock/ Requirements List** app, always pay attention to the available quantity of a component. That is the first row of the Stock/Requirements row! If e.g. you need to create 1300 Speedstars and the available quantity says 1200 Gearings, then you won't be able to produce 1300 Speedstars.*

So please keep this in mind and do not just quickly click through the case studies ;-)

Example: In case you need to produce 1200 Speedstars (according to your planning process) in contrast to the script, then 1200 Basis-Modules, 1200 gearings, 2400 wheels, etc. are required. When your planning numbers (planned order quantities) for each component do not exactly match the numbers required for production, there are two possible solutions:

a. *Manually change the proposal in the planned order. For instance, your purchase proposal = 999 gearings, but you need 1200 gearings → simply double-click on the purchase requisition, create the purchase order and change the number to 1200 in the purchase order. Then continue as described in the script.*
b. *Convert several planned orders to purchase orders or production orders to meet the required quantity or even exceed it. However, this is more complex!*

4. You see the **Additional Data for MRP Element** screen. Click the -> Purchase Order button to create a purchase order from the purchase requisition.

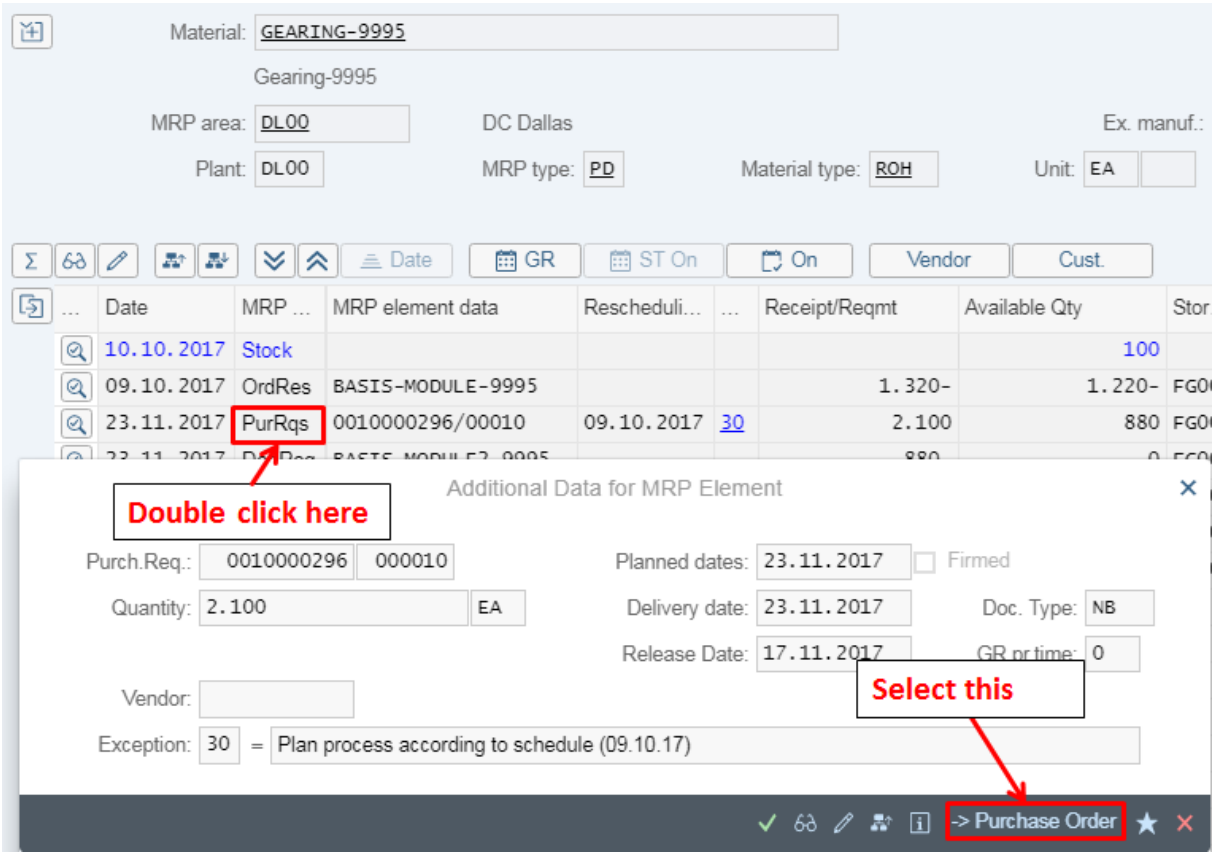


Figure 165: Create Purchase Order (2): SAP-System-Screenshot

5. You are forwarded into the **Create Purchase Order** view (a notification regarding purchasing organization can be ignored since you will enter it later). You should already be familiar with this view from ***Script 1 – Source-to-Pay***.
6. In the left frame (vendor, source of supply, category, etc.) you can see a purchase requisition to your vendor. For clarity reasons, you can enlarge the left window if necessary.
7. Select the number of the open purchase requisitions (on the left hand side below the document overview window) and click the button (**Adopt / Copy**) in the left window. As a result of this, the detailed data from the purchase requisition is copied to the new **purchase order**.

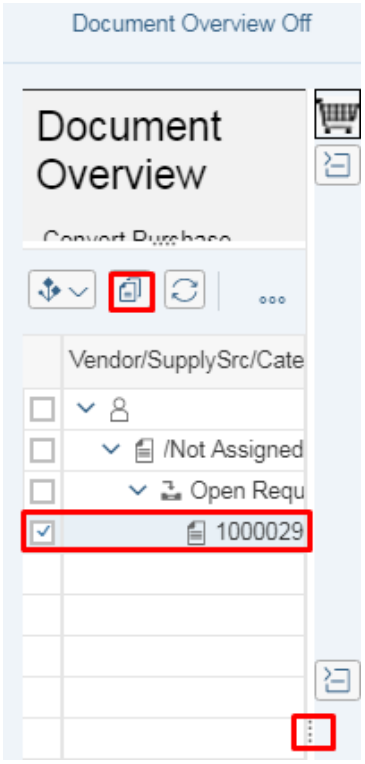


Figure 166: Create Purchase Order (3): SAP-System-Screenshot

8. Now, enter ***US00*** as **Purchasing Organization** and ***your Vendor account*** (s***ee data sheet Source-to-Pay***) as Vendor. Confirm with ***Enter***.
9. Open the header and item details. In each tab, you can view detailed information (vendor, prices, status, delivery, location, etc.) regarding the purchase order. You see that the system retrieved the lower price of 450 (instead of 500) from the purchasing info record, since you are ordering more than 500 units of gearings (scaling condition).

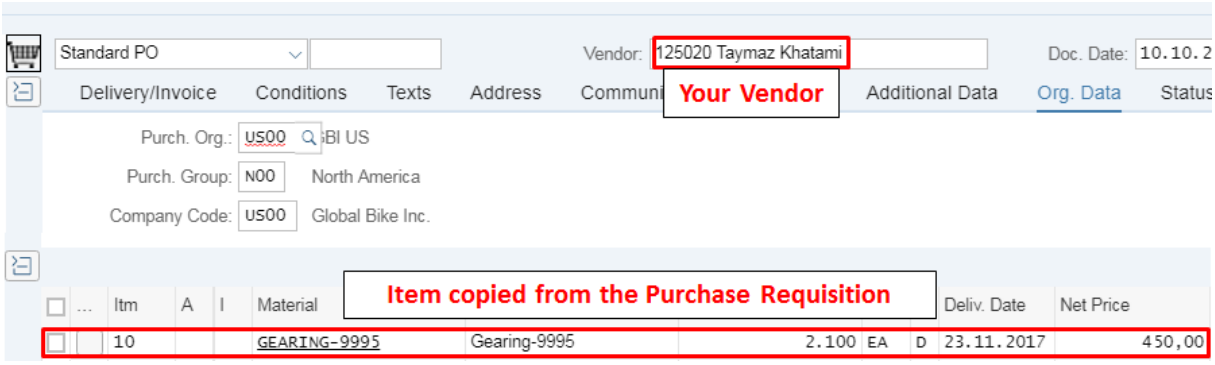


Figure 167: Create Purchase Order (3): SAP-System-Screenshot

10. *Save* the purchase order and skip a possible message regarding occurred notifications by saving. List the number on your data sheet.

Standard Purchase Order Gearing:

11. Update the list by clicking the Refresh symbol. The purchase requisition (Pur.Req.) is converted to a purchase order delivery schedule line (POItem). Close the current view.

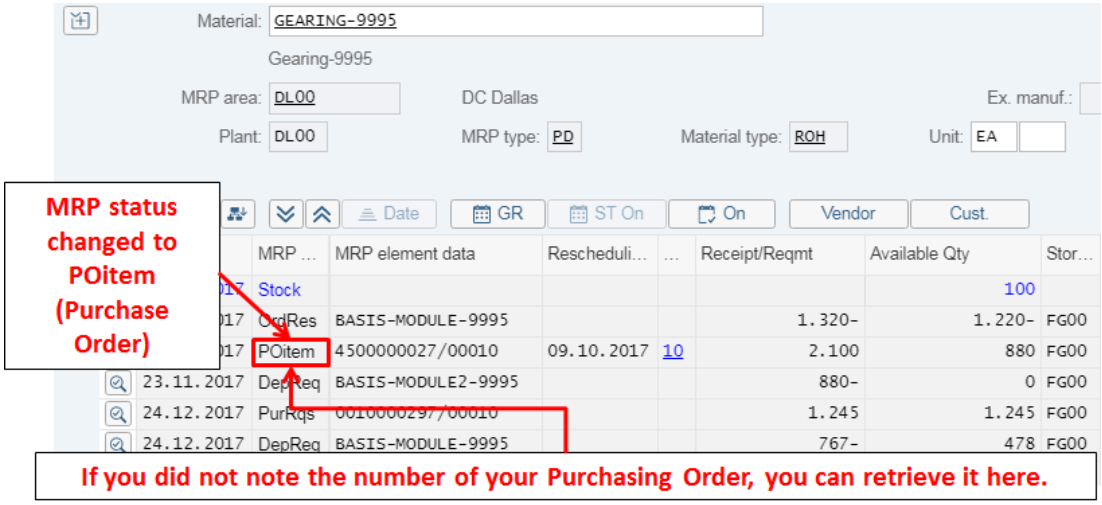


Figure 168: Purchase Order in Stock/Requirements List: SAP-System-Screenshot

12. Repeat steps 1 - 11 for the other materials. List the respective numbers on the data sheet.

Standard Purchase Order Wheel:
Standard Purchase Order Carb-Frame:

If you did everything correctly, you should have the following two purchase orders in your Stock/Requirements List (compare with figure). As you might have noticed, you still have 0 (zero) quantities in the available quantity fields!

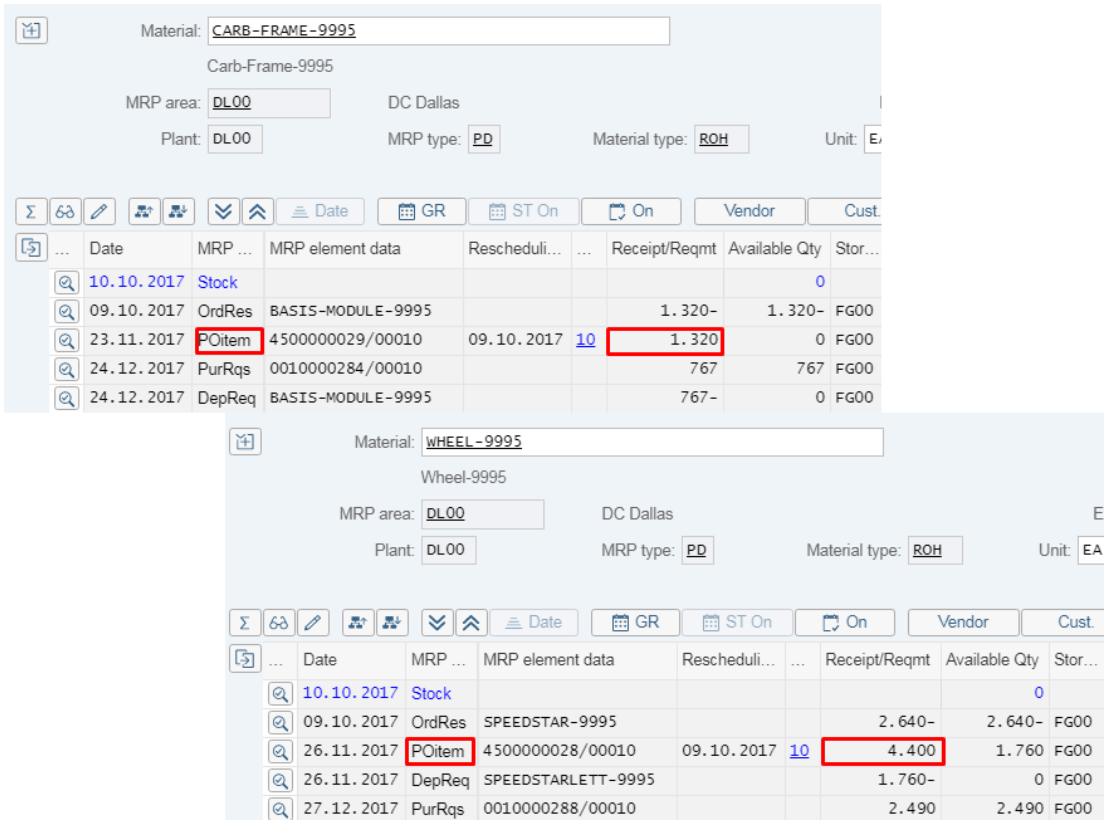


Figure 169: Purchase Orders in Stock/Requirements List: SAP-System-Screenshot

All components required for the production of the Basis-Module are ordered. Next, you need to wait until the vendor **delivers** the materials.

3.5.2.2 Post Goods Receipt

To simplify the case study, the vendor delivers the ordered goods on the same day. Post the goods receipt regarding the three created purchase orders.

Enter goods receipt for purchase order

Within the tile group **Script 2 – Design-to-Operate** select the app ***Post Goods Movement***.

1. On the upper part of the screen, select **Goods Receipt** from the left drop-down menu and select **Purchase Order** from the right drop down menu.
2. Enter your order number for the first purchase order (Gearing-xyyy) in the field on the right hand side of the drop-down menu. Press *Enter*.

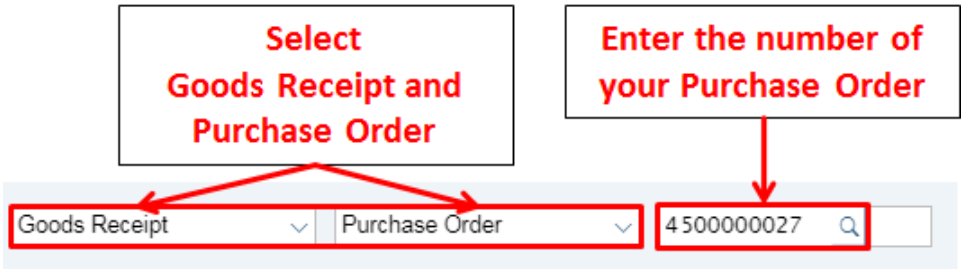


Figure 170: Post Goods Receipt (1): SAP-System-Screenshot

3. The system proposes goods receipt quantities according to the purchase order. Enter ***** in the **Delivery Note** field. Select the ***Item OK*** field (therefore, scroll down) on the lower part of the screen to mark the goods receipt document as checked. ***Save (Post)***.

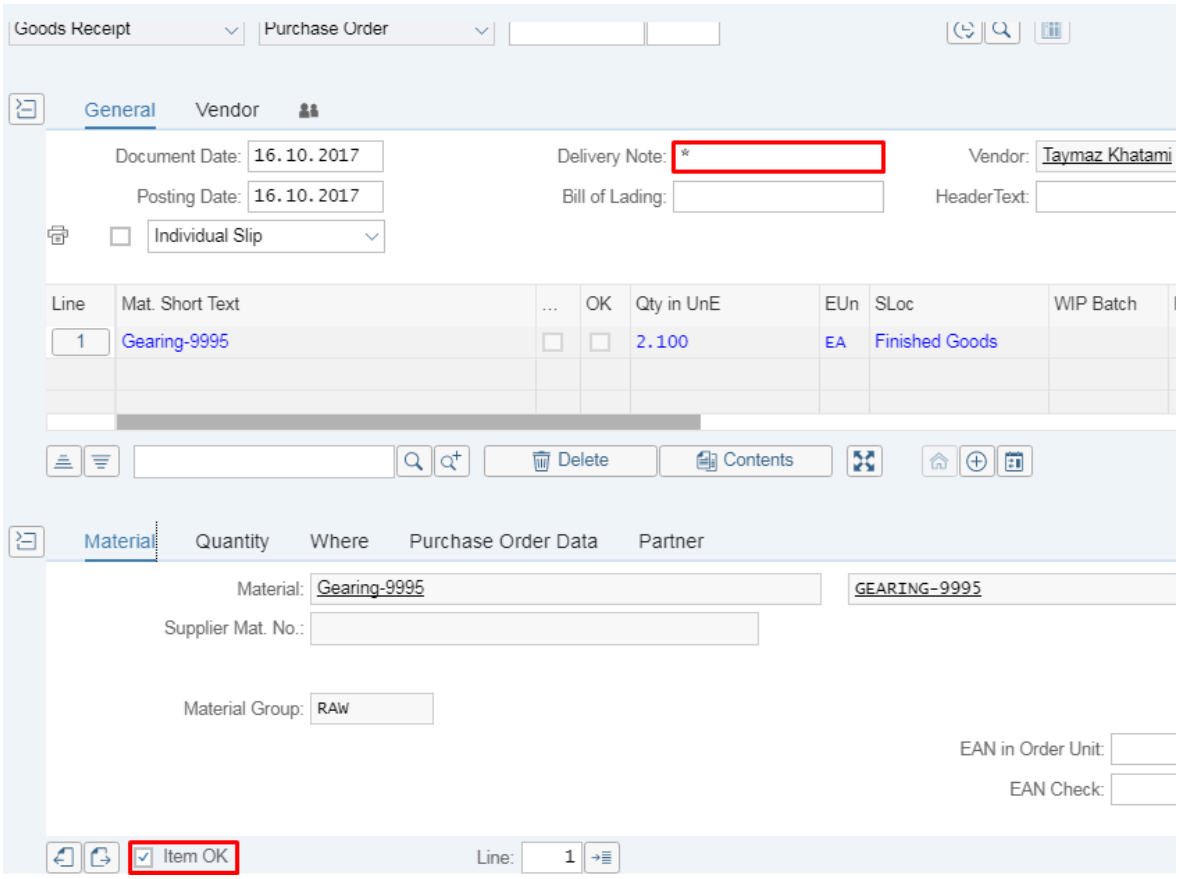


Figure 171: Post Goods Receipt (2): SAP-System-Screenshot

4. List the document number goods receipt.

Document 1 for Gearing:

5. Carry out the steps 1-4 for the other materials.

Document 2 for Wheel:
Document 3 for Carb-Frame:

3.5.2.3 Reporting: Stock/Requirements List

Now that the materials are available from the warehouse, we can remove from stock and post goods issues for production purposes. Before doing so, check the MRP status of your materials. Call up within the tile group **Script 2 – Design-to-Operate** the app ***Monitor Stock / Requirements List*** and look at the goods you just received (gearing, wheel, carb-frame). You can see that the quantities received are listed in the first line of the **Available Quantity** column.

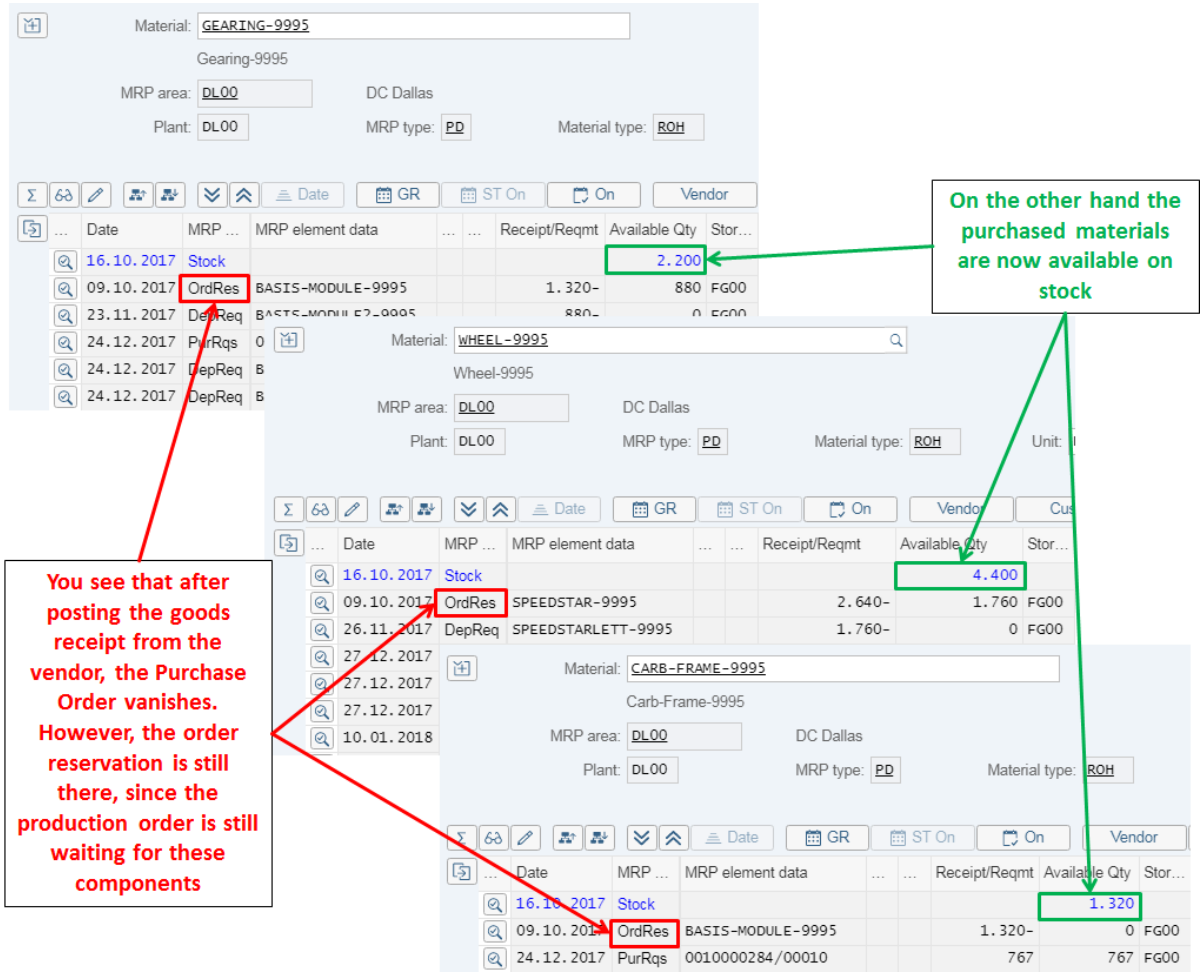


Figure 172: Available Quantities after Goods Receipt: SAP-System-Screenshot

3.5.3 Shop Floor Control

Now that all preliminary steps (creating product structure, costing, carrying out MRP) are completed as well as the required components having been ordered and received in the storage location, the production of the Speedstar will be processed.

In this section, the simplified production of the Speedstar is carried out. In order to carry out the production the production department accomplishes the following steps:

- goods issue of components to the production orders
- confirmation of production orders
- goods receipts of finished products in the storage location

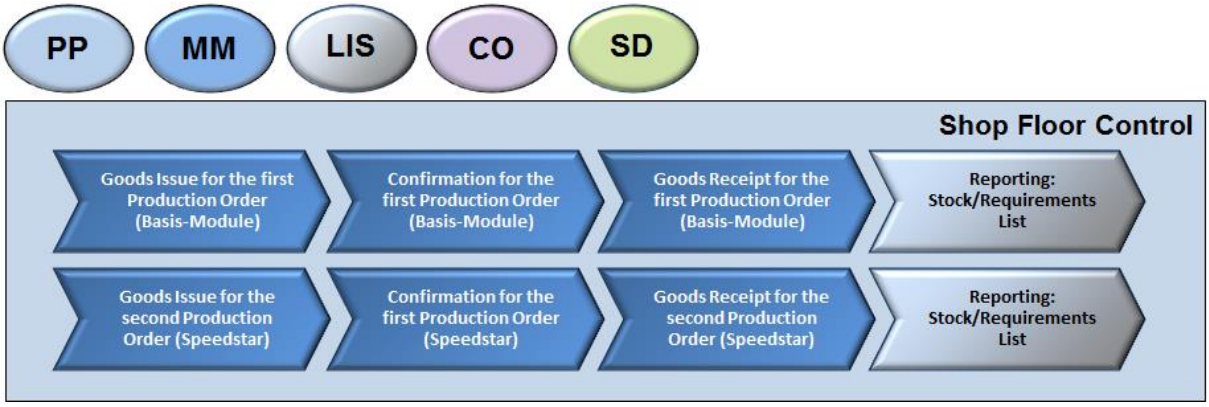


Figure 173: Process Overview: Shop Floor Control

3.5.3.1 Goods Issue for the first Production Order

Next, post the goods issue for the production order of the Basis-Module. This is to make materials required for the production of the Basis-Module available to the production center (work centers). Therefore, within the tile group **Script 2 – Design-to-Operate** select the app ***Post Goods Movement***.

1. On the upper part of the screen, select **Goods Issue** from the left drop-down menu and select **Order** from the right drop down menu.
2. Enter your order number for the ***first production order (Basis-Module-xyyy)*** in the field on the right hand side of the drop-down menu. Press *Enter*.

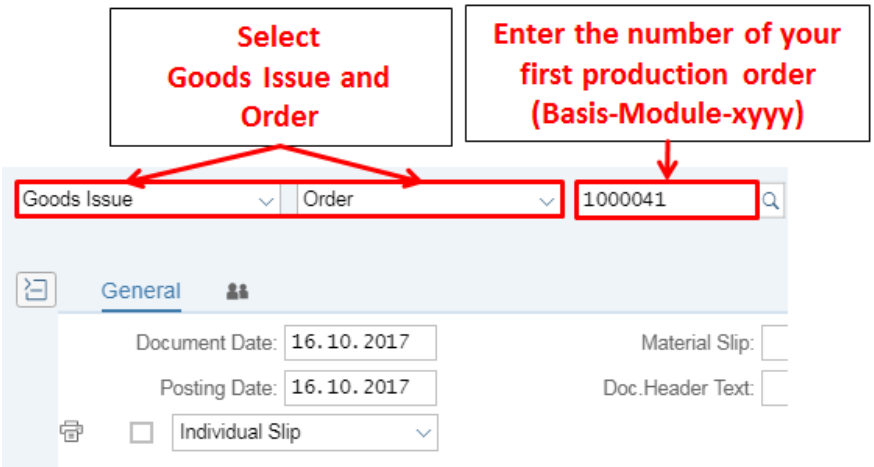


Figure 174: Post Goods Issue (1): SAP-System-Screenshot

3. The system proposes the two correct material positions. Enter ***** in the **Material Slip** field. Furthermore, within the ***second row***, select the ***OK*** field and in the lower area, select the ***Item OK*** field (therefore, scroll down).

The order of items does not matter for further processing. Independent of the material, check the second row.

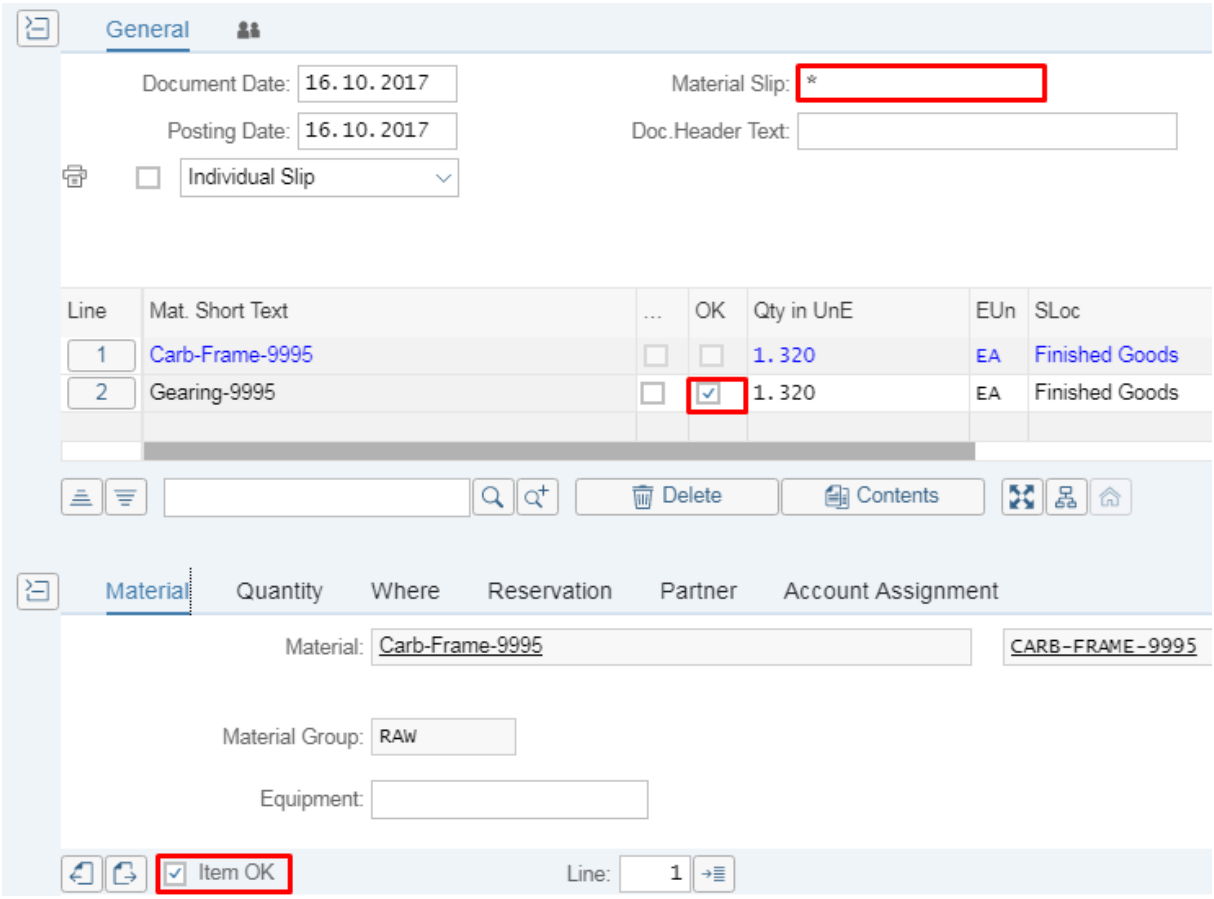


Figure 175: Post Goods Issue (2): SAP-System-Screenshot

4. ***Save (Post)*** and list the document number. Press Exit.

Document (Basis-Module):

3.5.3.2 Confirmation for the first Production Order (Basis-Module)

Your next task is to **confirm** the production orders for the Basis-Module.

Confirmation:

Order confirmation is part of order monitoring, documenting the status of operations and sub-operations. The SAP system differentiates between partial confirmation and final confirmation.

A confirmation clarifies

- at which work center an operation was carried out
- who carried out the operation
- which quantity was produced in an operation
- the size of the standard values required for the actual operation

Confirm the Production Order

We assume that the employer at ***work center ASYS1000*** worked quickly and finished the Basis-Module. Of course, this is not very realistic, but otherwise we would have to wait three months to continue our case study. After the completion of production, the manufacturing execution manager created a confirmation regarding the completion of the production order.
Therefore, within the tile group **Script 2 – Design-to-Operate** select the app ***Confirmation for Production Order***.

1. In the **Order** field, enter ***the number of the production order for the Basis-Module.*** Press *Enter*. Select the confirmation type ***Final Confirmation***.

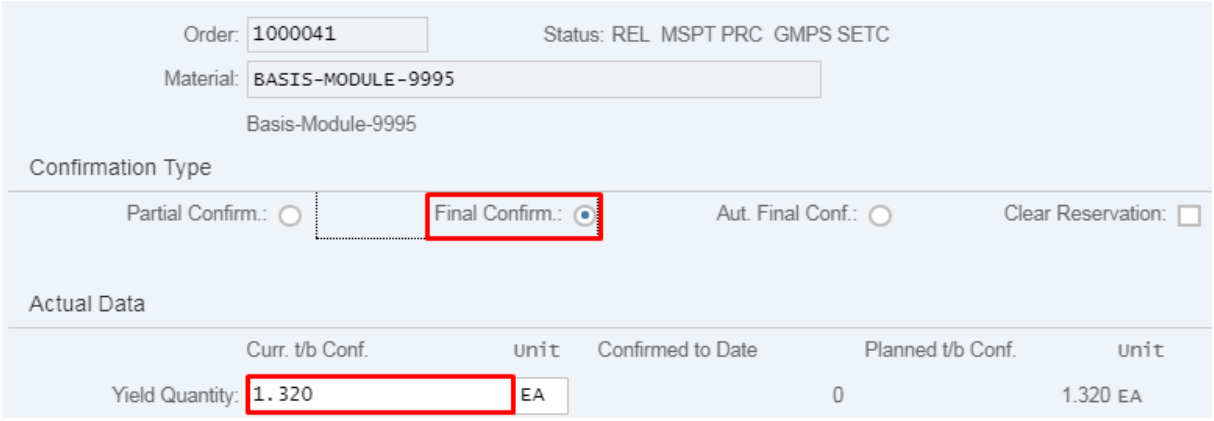


Figure 176: Confirm Production Order: SAP-System-Screenshot

2. ***Save***.
3. The system issues a notification that the confirmation was saved.

3.5.3.3 Goods Receipt for the first Production Order (Basis-Module)

Once completed the Production order, you post the good receipt for your production order in your storage location. The goods receipt transfers the finished products from the Work place to the storage location of the Plant. Therefore, within the tile group **Script 2 – Design-to-Operate** select the app ***Post Goods Movement***.

1. On the upper part of the screen, select **Goods Receipt** from the left drop-down menu and select **Order** from the right drop down menu.
2. Enter your order number for the ***first production order (Basis-Module-xyyy)*** in the field on the right hand side of the drop-down menu. Press *Enter*.
3. The system proposes the correct material position. Within the **Delivery Note** field, enter *****. Furthermore, select the ***Item OK*** field (therefore, scroll down) on the lower part of the screen to mark the goods receipt document as checked.

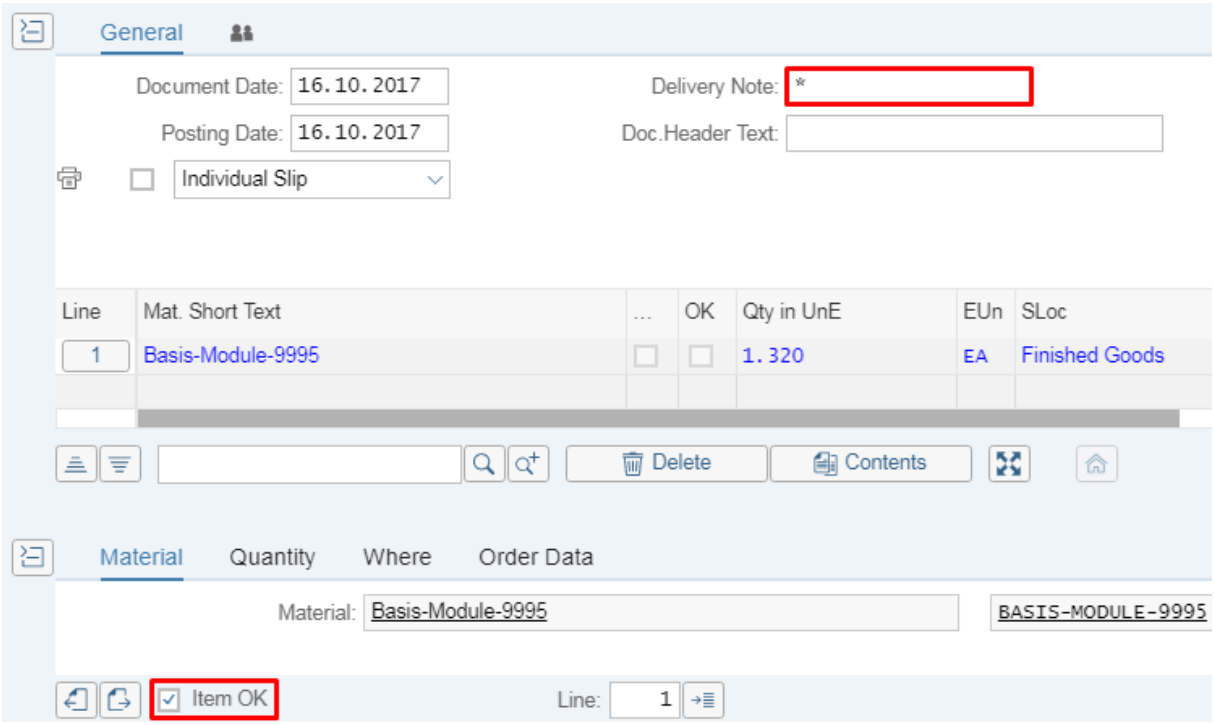


Figure 177: Goods Receipt for the First Production Order: SAP-System-Screenshot

4. ***Save (Post)*** the goods receipt and note the material document number in your data sheet. Press ***Exit***.

Material Document Number (Goods Receipt) Basis-Module:

3.5.3.4 Reporting: Stock/Requirements List

Check the Stock/Requirements List again. Therefore, within the tile group ***Script 2 – Design-to-Operate*** select the app ***Monitor Stock / Requirements List***.

1. Enter **material** ***Basis-Module-xyyy*** and **plant** ***Dallas (DL00)***. Press *Enter*.
2. Once again, you can see the available quantity and the demand created by the production order for the Speedstar (Order Reservation). The demand should equal the available quantity.
3. Check the available quantities for wheel, gearing, and carb-frame as well. You should see that only the components for the production of the Speedstarlett are still available. The spare ones were already used for the Basis-Module of the Speedstar.

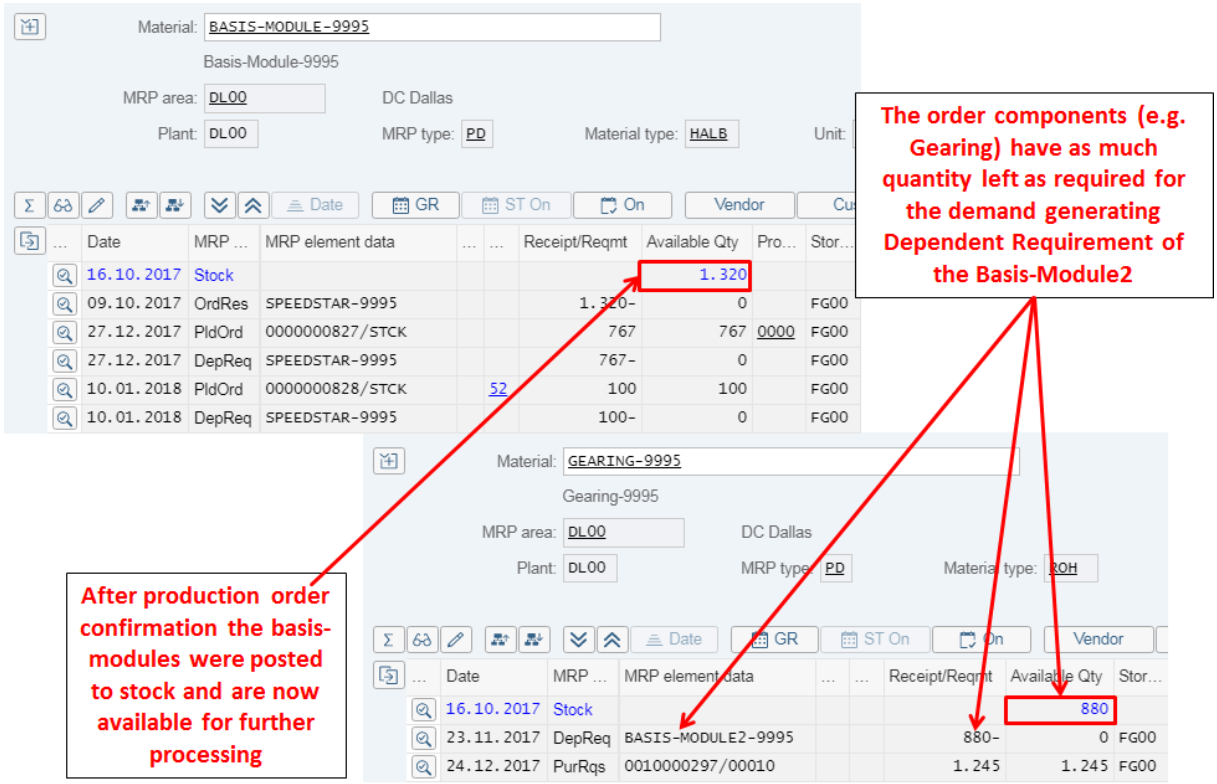


Figure 178: Check Storage Status: SAP-System-Screenshot

3.5.3.5 Goods Issue for the second Production Order (Speedstar)

Now that the semi-finished product is available in storage FG00, we can produce the finished product Speedstar. Again, we commence with making the materials (wheel and Basis-Module) available for production. Once again, the system will carry this out automatically. Please note that you are a member of manufacturing here who is not familiar with the materials management processes (and who does not need to be familiar with them). The only thing you need to know is the second order number for the Speedstar. The rest is copied by the SAP system. Therefore, within the tile group **Script 2 – Design-to-Operate** select the app ***Post Goods Movement***.

1. On the upper part of the screen, select **Goods Issue** from the left drop-down menu and select **Order** from the right drop down menu.
2. Enter your order number for the ***second production order (Speedstar-xyyy)*** in the field on the right hand side of the drop-down menu. Press *Enter*.

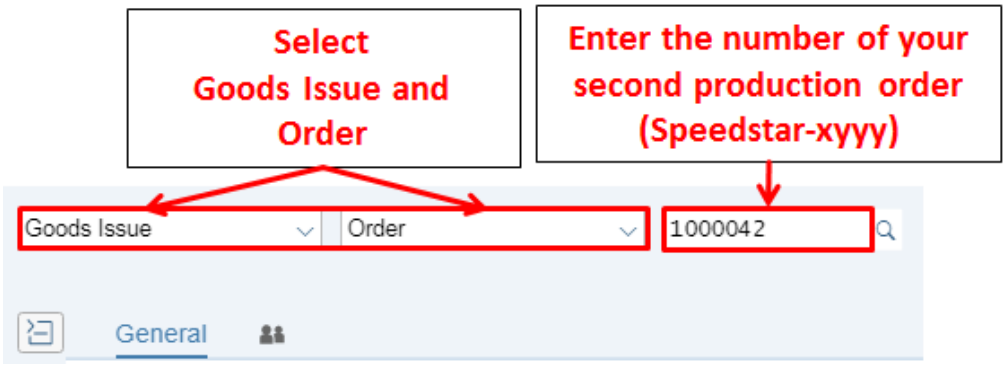


Figure 179: Post Goods Issue to Production Order 2 (1): SAP-System-Screenshot

3. The system proposes the two correct material positions. The system proposes the two correct material positions. Enter ***** in the **Material Slip** field.
4. During production, 200 wheels were damaged. Thus, a higher demand is the case. Independently **add (!) 200** to the demand for wheels (here: 2840 units).

In case the wheel is displayed within the first row, click on 2 *to edit the first row.*

5. Furthermore, within the ***second row***, select the ***OK*** field (if necessary, click on 1 to edit the second row) and in the lower area, select the ***Item OK*** field (therefore, scroll down).

The system does not know that there are 200 additional wheels required and will only propose the quantities required according to BOM/production order. The information concerning the 200 additional wheels needs to be entered manually by the manufacturing execution manager (that's ***you****!).*

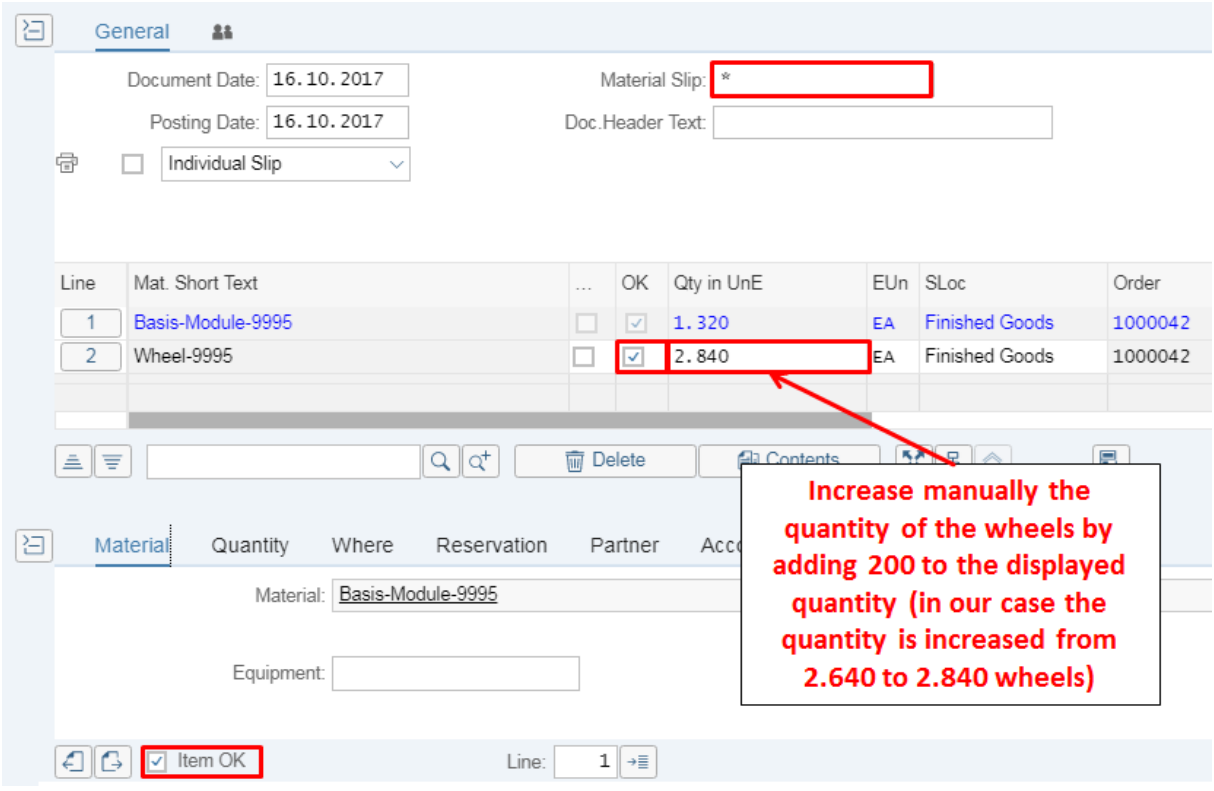


Figure 180: Goods Issue to Production Order 2 (2): SAP-System-Screenshot

6. ***Save (Post)*** and list the document number. Press ***Exit***.

Document (Speedstar):

3.5.3.6 Confirmation for the second Production Order (Speedstar)

Since all materials for production are available, you can carry out production. We assume again that production is completed quickly; thus, our task is merely to enter the confirmation.

1. Within the tile group **Script 2 – Design-to-Operate** select the app ***Confirmation for Production Order***.
2. In the **Order** field, enter ***the number of the second production order (Speedstar)***. Press *Enter*.
3. Select the confirmation type ***Final Confirmation***.
4. ***Save***.
5. The system issues a notification that the confirmation was saved. Press ***Exit***.

3.5.3.7 Goods Receipt for the second Production Order

Once completed the Production order, you post the good receipt for your production order in your storage location to transfer the finished products from the Work place to the storage location of the Plant. Therefore, within the tile group **Script 2 – Design-to-Operate** select the app ***Post Goods Movement***.

1. On the upper part of the screen, select **Goods Receipt** from the left drop-down menu and select **Order** from the right drop down menu.
2. Enter your order number for the ***second production order (Speedstar-xyyy)*** in the field on the right hand side of the drop-down menu. Press *Enter*.
3. The system proposes the correct material position. Within the **Delivery Note** field, enter *******. Furthermore, select the ***Item OK*** field (therefore, scroll down) on the lower part of the screen to mark the goods receipt document as checked.

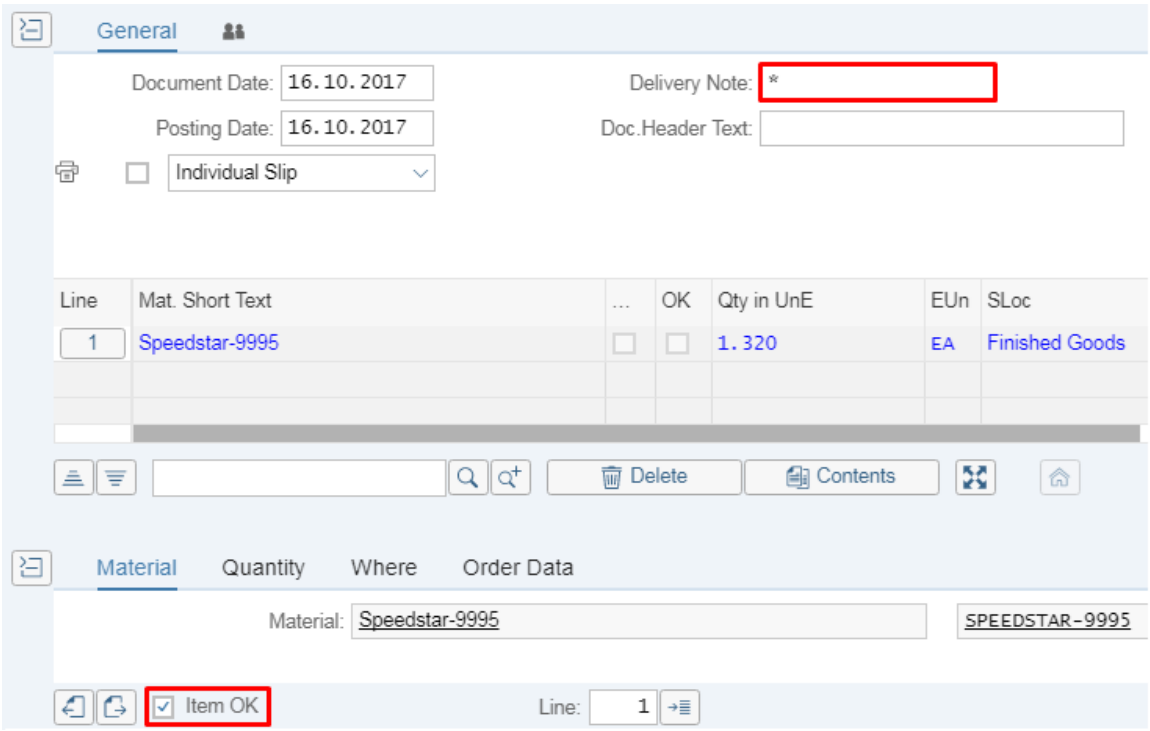


Figure 181: Goods Receipt for the second Production Order: SAP-System-Screenshot

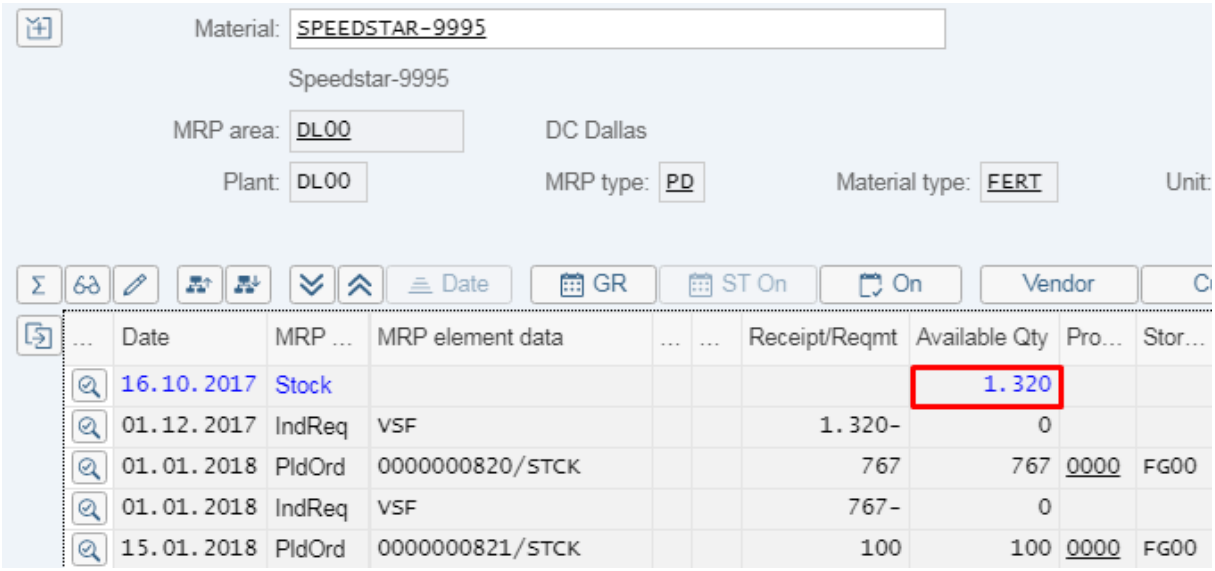
3. ***Save (Post)*** the goods receipt and note the material document number in your data sheet. Press ***Exit***.

Material Document Number (Goods Receipt) Speedstar:

3.5.3.8 Reporting: Stock/Requirements List

Check the Stock/Requirements List again. Therefore, within the tile group **Script 2 – Design-to-Operate** select the app ***Monitor Stock / Requirements List***.

1. Enter **material** ***Speedstar-xyyy*** and **plant** ***Dallas (DL00)***. Press ***Enter***.
2. Once again, you can see the available quantity and the demand created by planning independent requirements (Ind.Req.). The demand should equal the available quantity.



...	Date	MRP ...	MRP element data	...	...	Receipt/Reqmt	Available Qty	Pro...	Stor...
	16.10.2017	Stock					1.320		
	01.12.2017	IndReq	VSF			1.320-	0		
	01.01.2018	PldOrd	0000000820/STCK			767	767	0000	FG00
	01.01.2018	IndReq	VSF			767-	0		
	15.01.2018	PldOrd	0000000821/STCK			100	100	0000	FG00

Figure 182: Available Quantity of Speedstars: SAP-System-Screenshot

Thus, production of the Speedstar is completed. The production of the Speedstarlett will be carried out in the Order-to-Cash case study.

3.5.4 Closing Operations

You will now carry out closing operations for production. In the following figure, you can see the steps you need to complete. Closing operations include the settlement of all costs and work-in-process left on a production order. After the settlement is done and the order is balanced out (that is, there are no more costs on the production order), a period-end closing can be performed.

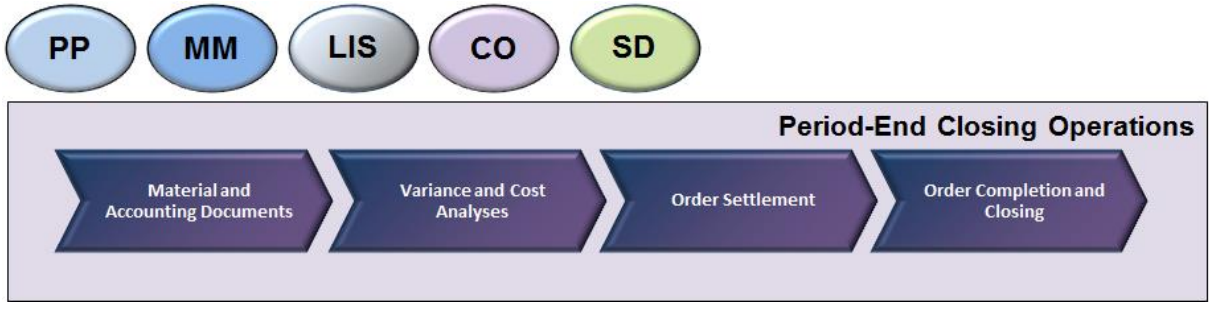


Figure 183: Process Overview: Period-End Closing Operations

3.5.4.1 Variance and Cost Analyses

During production, variances to the plan (product cost calculation) occurred. In addition, 200 extra wheels were consumed in comparison to the plan. In the next steps, you will clarify these variances.

3.5.4.1.1 Variance Calculation

Due to the displayed cost analysis, you want to gain additional information about the production-related variances, which occurred for this production order. **Variance calculation** determines the causes for variances concerning target values for **debit and credit postings** of an order by structuring variances in **variance categories**. Variance categories are stored together with the order in form of **statistic information** and can thus be made available for later valuations and consolidations. In the following, you will calculate the variances for the production order for the current period. Therefore, within the tile group **Script 2 – Design-to-Operate** select the app ***Variance Calculation***.

1. In case you need to enter the controlling area, enter **NA00** and press *Enter*.
2. Enter the following data:
   - **Order** — ***order number for the Speedstar***
   - **Period** — ***current period*** (current month)
   - **Fiscal year** — ***current year***
   - **Selected Target Cost Version** — ***select***
   - **Test run** — ***deselect***
   - **Detail list** — ***select***
   - Click *Execute*.
3. In the **variance calculation list**, select the ***order number*** and select **Cost Elements** to display variances according to cost elements.

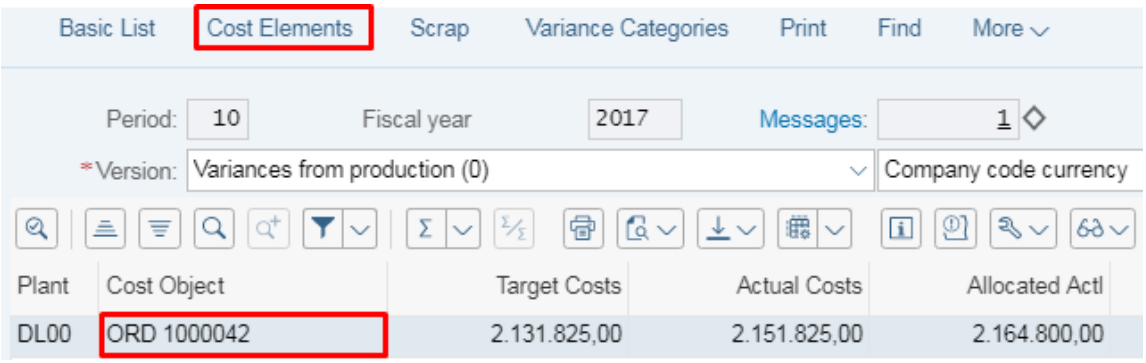


Figure 184: Variance calculation (1): SAP-System-Screenshot

4. Look at the row containing your *wheel-xyyy*. What is the value in the **Variance** field?! Why there is a variance in opposite to the Basis-Module?! List the answers on your **data sheet**.

Variance Wheel-xyyy:

3.5.4.1.2 Input Variance for Production Order

Within the tile group **Script 2 – Design-to-Operate** select the app ***Display Production Order***.

1. Enter the production order number of the ***second order (Speedstar)*** and confirm.

2. You can see that 1320 units of the Speedstar were delivered, i.e., delivered to the storage. The confirmed finished date is today, as opposed to the calculated date.
3. Select the component overview. Therefore, select Components. Select the row containing your **wheel** and choose ***More → Component → Component Details***. You can see that ***Requirement quantity*** and ***Withdrawal quantity*** vary by 200 units.
4. Go back ( ) and select Operations.
5. Select the row with **operation 10** and choose ***More → Operation → Operation Details*** from the menu. Select the **Quantities/Activities** tab (you need to scroll to the right using the small arrow until you see the tab). You can see that 1320 units are in stock and, thus, there is no variance regarding the final quantity.

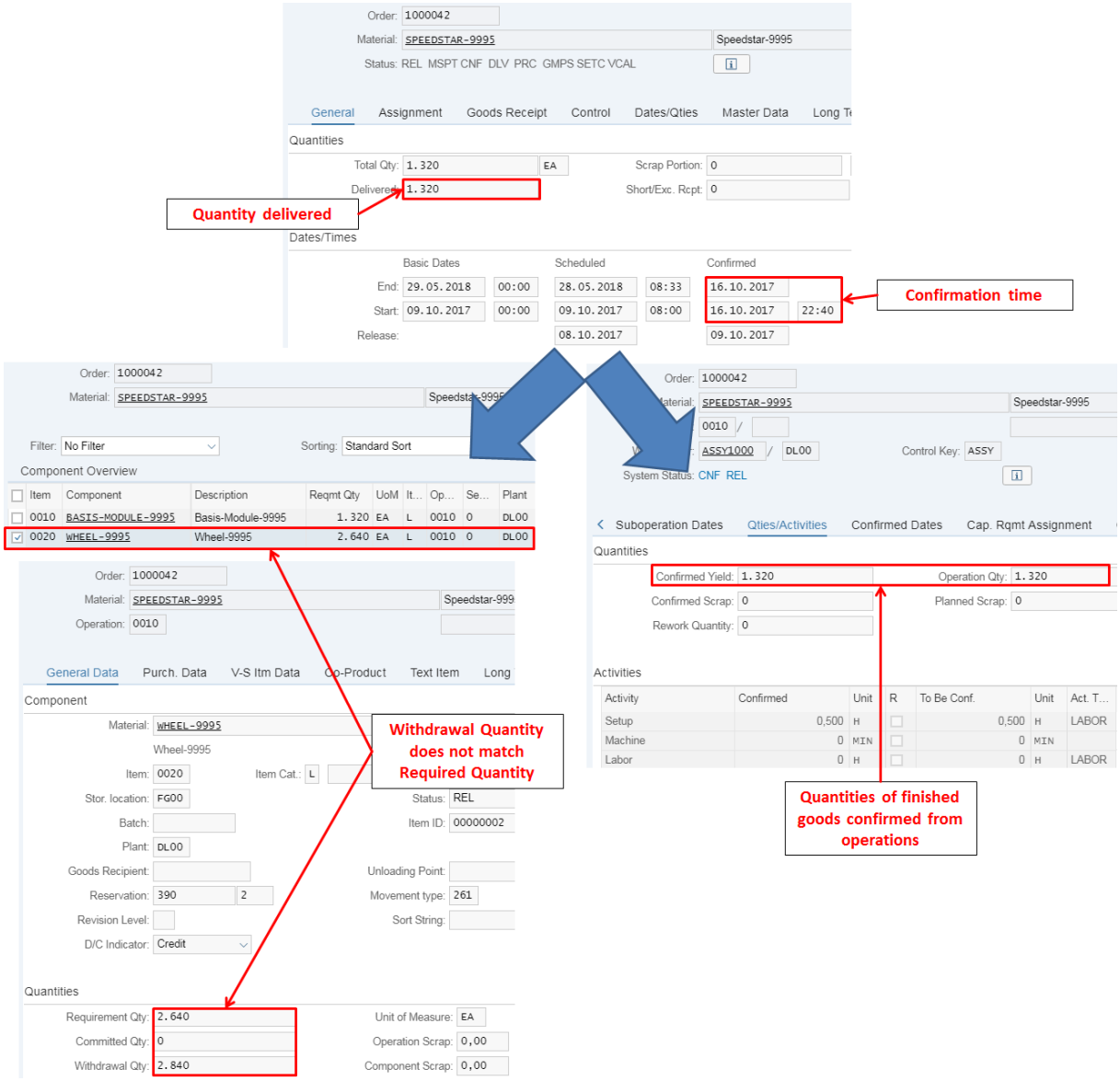


Figure 185: Quantities Delivered, Required and Withdraw: SAP-System-Screenshot

6. Go back to the initial screen of your production order (**Production order Display: Header)**.

3.5.4.1.3 Detailed Production Cost Analysis

Check the **actual costs** posted to your production order. Check whether the actual costs were posted based on **goods issue** and **confirmations** to your order. For the final delivery of the Speedstar, a **credit posting** should have been carried out.

1. Choose ***More → Goto → Costs → Analysis*** from the menu to display the cost analysis for the production order.
2. You can see that your production order was **debited** with the cost categories **confirmations** (personnel costs) and **goods issues** (goods issue from storage). The offsetting entry features the cost category **goods receipt** (finished product to stock). This cost category **credits** your production order.
3. Additionally, you can see that the cost analysis shows a **variance** regarding **actual and planned costs**, which is basically due to the additionally consumed wheels.

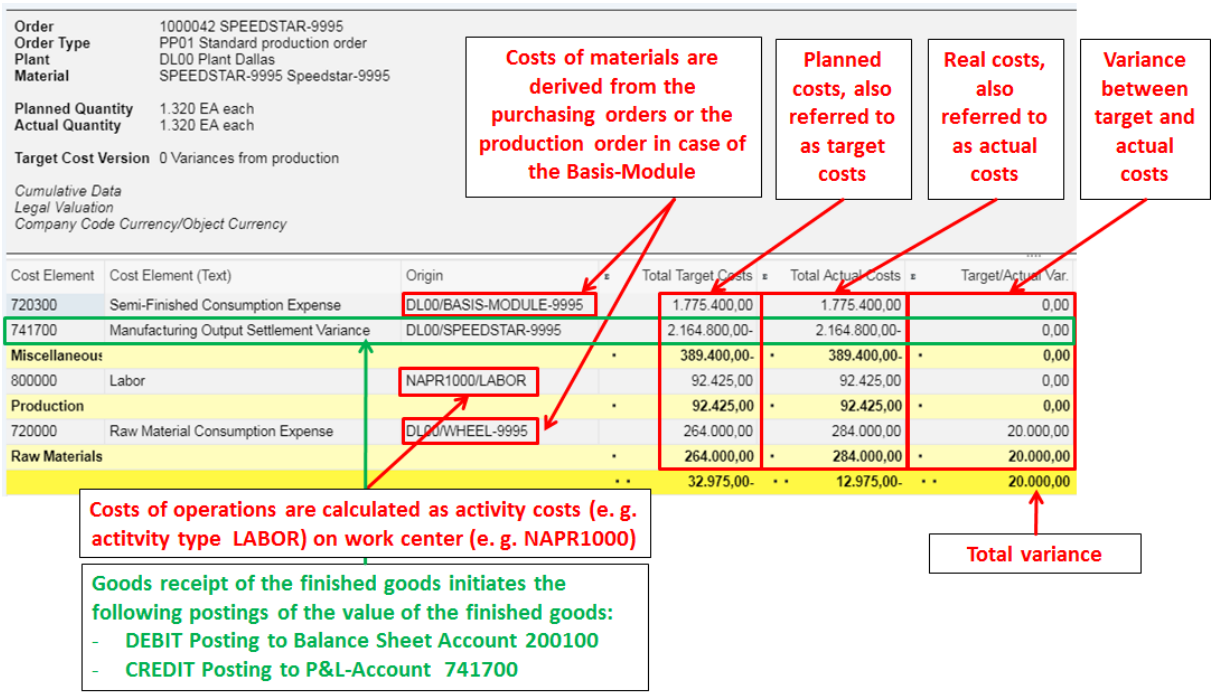


Figure 186: Cost Analysis for Production Order: SAP-System-Screenshot

NOTE

Under certain circumstances the display of your columns differs from the figure above. In this case adjust the display of the columns by changing the layout ( ). Move the respective columns to the Displayed Columns area and confirm. Usually newly added columns are displayed on the right of the available table. You can change the position of the column by marking the column header and moving it with your mouse.

The result of this cost analysis shows some interesting aspects:

Target Costs

The column *Total Target Costs* contains the **calculated** costs of the production process according to the steps performed in the production process. The target costs depict what the production process **should have** cost:

1. Costs of Goods Issue Posting:
   - **1.775.400** USD depict the value of the Basis-Modules taken from the storage location is used. The value on stock for the Basis-Modules is derived from the product cost calculation for this material: 1320 PC * **1345** USD = 1.775.400 USD.
   - **264.000** USD is the value of the other component used in the production of the Speedstar, namely the Wheels. Here the material price is used: 2640 PC * **100** USD = 264.000 USD.
2. Costs of Order Confirmation:
   - **92.425** USD depicts the costs of the activities (activity type LABOR) performed by workforces on work center ASSY1000. The following figure displays the routing of the Speedstar, which contains the activities performed on ASSY1000 for each operation:
     - Setup of machines: 30 minutes of activity type LABOR
     - Labor time: 84 minutes of activity type LABOR
   - On the lower part of the screen the integration of Production (SAP PP) with Controlling (SAP CO) is illustrated. The work center ASSY1000 is assigned to cost center NAPR1000. On this cost center, the activity type LABOR is planned and cost 50 USD per unit (hour of work performed).

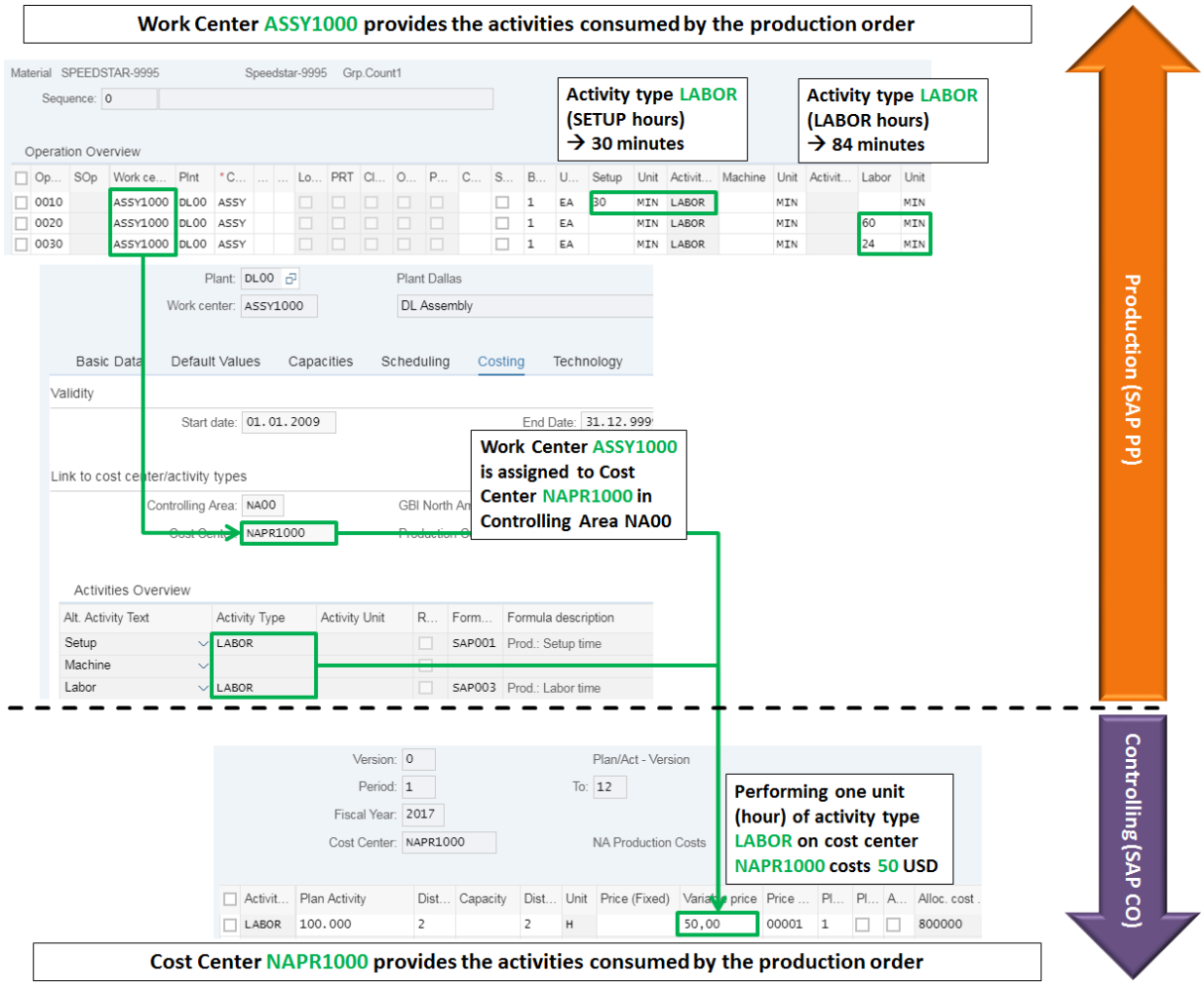


Figure 187: Activity Costs: Integration between SAP PP and SAP CO: SAP-System-Screenshot

- Thus, producing 1320 Speedstars sums up to 92.425 of activity costs as follows:
  - 30 minutes of setup for the machines = 0,5*1*50 = 25 USD
  - 84 minutes per produced Speedstar = 1,4*1320*50 = 92400 USD

  Note that the setup of machines takes place only once for the entire lot (of 1320). There is no need to change machine settings if the production process does not change, which is the case when the same item is produced 1320 times in a row.

3. Costs of Goods Receipt:
   - When the production process is completed and the finished goods are moved to the storage location a posting is made (Goods Receipt posting) that
     - increases stock **quantity**: a material document is created that documents the increase of Speedstars on stock by 1320
     - increases stock **value**: an accounting document is created that documents the increase of value on stock by the value of 1320 Speedstars – account 200100 (D) vs. account 741700 (C).
   - The value generated through the production process (in the production order analysis) is **2.164.800 USD**. This refers to the value of the materials produced with this production order according to the product cost calculation that you ran earlier in this teaching unit. The cost estimation price for the Speedstar is **1640 USD**. Thus, 1320 Speedstars freshly added to the stock increase the value of finished goods on stock by 1640 USD * 1320 PC = 2.164.800 USD.
   - As a result of the production process, a value Variance is generated: **32.975 USD**
     - Target Costs of the production: 1.775.400 + 264.000 + 92.425 = 2.131.825
     - Value increase on stock: 2.164.800

This variance is due to an inaccuracy in the product cost calculation:

- Generally, it is impossible for a company to know the exact lot sizes of future production processes in cases where production orders are released based on order situations. In many cases average lot sizes are used for the product cost calculations.
- In our case we used lot size 1 for the product cost calculation. This means that the setup time of 30 minutes (or 25 USD) is calculated for each Speedstar produced.
- In the production order, the setup time is only calculated one time as it is not necessary to setup the machines multiple times for the same production activities.
- The result is that the material value posted in Financial Accounting according to the material value from the production cost calculation is
  (1615*1320) + (25*__1320__) = 2.131.800 + 33.000 = 2.164.800
  Whereas the real costs for the production process are
  (1615*1320) + (25*__1__) = 2.131.800 + 25 = 2.131.825

All in all, this means that the production process is actually more cost efficiently than calculated in the product cost calculation.

Actual Costs

The column *Total Actual Costs* contains the **real** costs of the production process that actually occurred when the production process steps were performed.

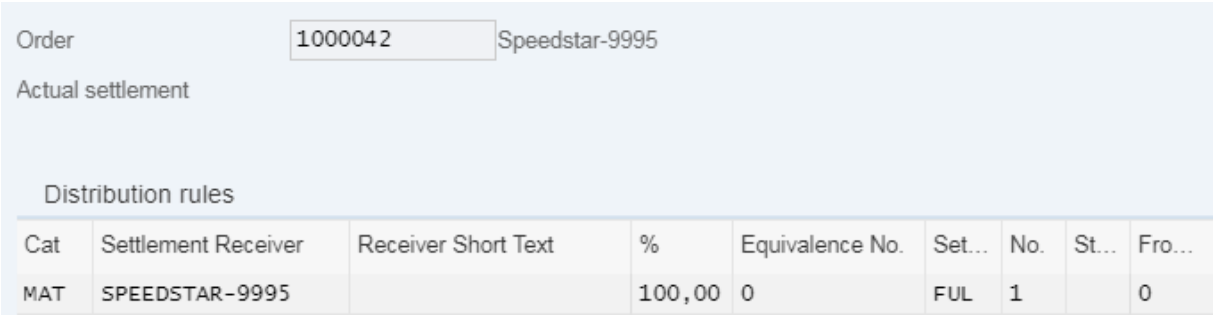
1. The actual costs in our case do not differ much from the calculated target costs. The only difference is the position Goods Issue for the Wheels. As you may recall, due to problems in the production process, 200 Wheels were damaged. This caused extra costs of 20.000 USD.
2. As a result, the actual total variance is reduced to **12.975 USD**, which is the calculated variance of 32.975 USD (due to the inaccuracy in calculation) minus the real extra costs of 20.000 USD.
3. This total variance of **12.975 USD** is left on the order and must be settled to balance the order out (balance must be zero before you can close a production order technically and in terms of accounting).

3.5.4.1.4 Settlement Rule

Now let us take a look at the settlement rule applied in the production order.

1. Go back to the first screen of ***Production order Display: Header***. Select ***More → Header → Settlement Rule*** from the menu.
2. Here you see how variances and work-in-process are settled in this production order. As it is common for in-house production, those costs are settled using the material that is produced as costing object. Hence, the settlement rule is **MAT**. The 100% indicate that 100% of the costs are settled to the produced material (Speedstar). There are two ways this settlement is accomplished, depending on the price control parameter in the material master:
   - Price control parameter **V**: If V is set in the Speedstar's material master, the 12.975 USD would decrease the average price of the material in stock.
     Example: You have 10 Speedstars on stock with a total value of 16400 USD. Now you produce 1 Speedstar costing you 2000 USD (Variance = 2000 - 1640 = 360). The average price moves to 1672,72 USD each ((16400+2000)/11 = 1672,72) compared to the original price of 1640 each.

   - Price control parameter **S**: This parameter is set in the material master of Speedstar. In that case the variance is posted (Debit) to the P&L account 741700 (Manufacturing Output Sett Var) after settlement process. The offset posting (Credit) is made to the account 760100 (Production Variances).


Order 1000042 Speedstar-9995

Actual settlement

Distribution rules

Cat	Settlement Receiver	Receiver Short Text	%	Equivalence No.	Set...	No.	St...	Fro...
MAT	SPEEDSTAR-9995		100,00	0	FUL	1		0

Figure 188: Settlement Rule: SAP-System-Screenshot

3. Now, leave current view.

3.5.4.2 Order Settlement

To complete the production order, you need to settle the order. Settle your order to allocate the **order balance**. When an order is settled, the balance is posted according to the posting rule (settlement rule) to balance sheet accounts or to price difference accounts. Check whether the balance of the order after settlement equals zero. Settle your order automatically using processing type **automatic** in one posting run. After order settlement, the system displays an extensive list. Check the **sender/receiver information** in this list.

Within the tile group **Script 2 – Design-to-Operate** select the app ***Actual Settlement***.

1. If necessary, enter ***NA00*** as **Controlling *Area***. Then, enter the following data:
   - **Order** ***order number of the Speedstar***
   - **Settlement Period** ***current period***
   - **Fiscal Year** ***current year***
   - **Processing type** ***Automatic***
   - **Test run** ***Deselect***
   - Select ***Execute*** and skip any warning message.
2. Select detail list Detail lists to display the settlement.
3. The **production order** is the cost sender and the material **Speedstar** is the receiver. Details regarding settlement can be displayed using the **sender** and **receiver** buttons.

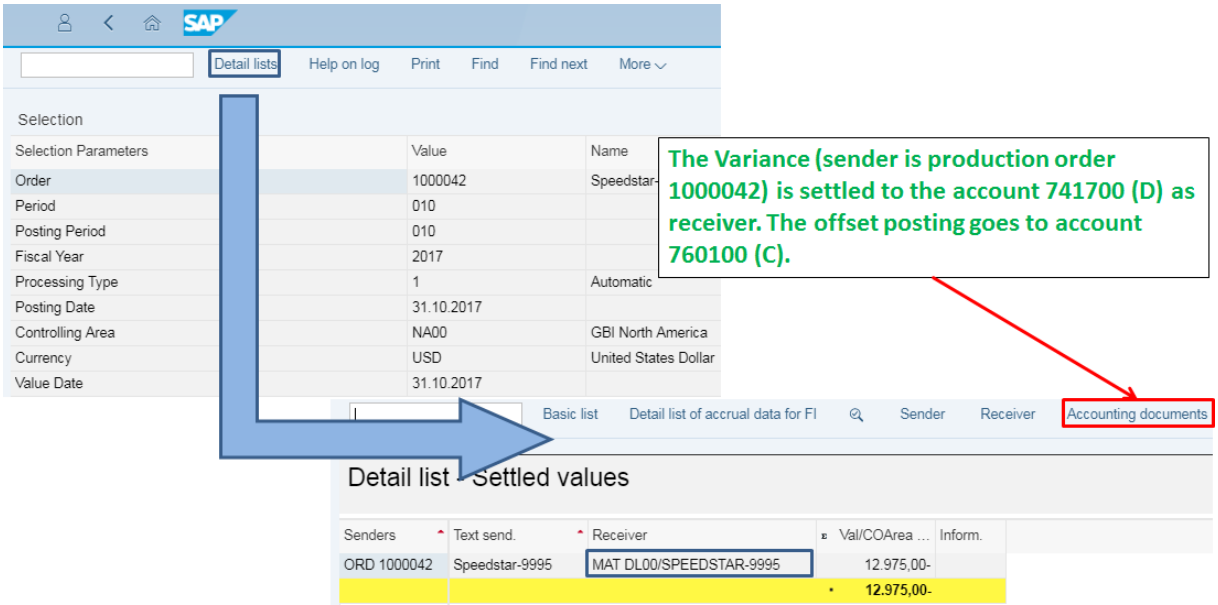


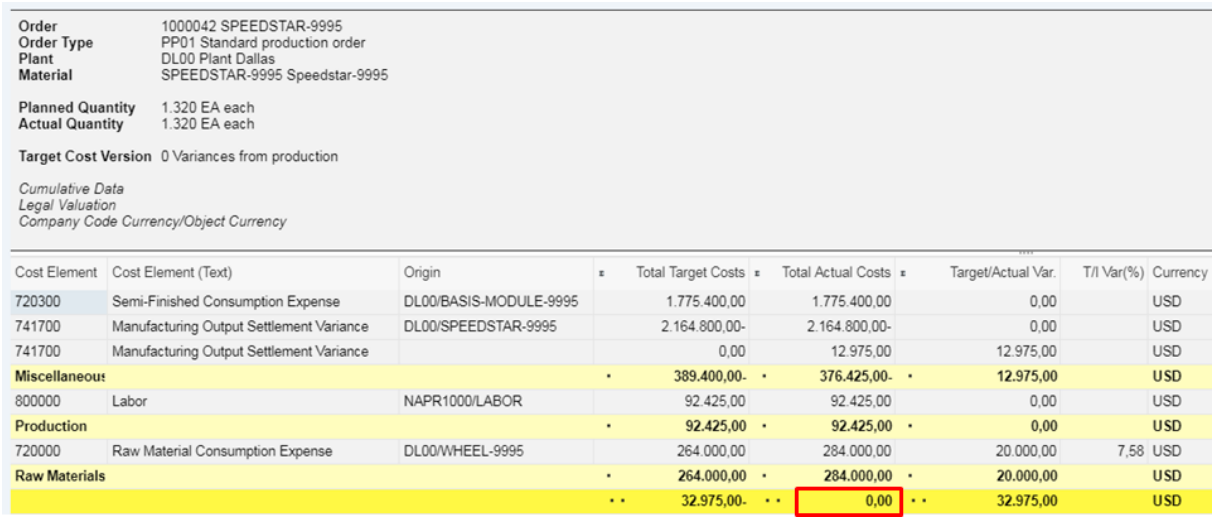
Figure 189: Order Settlement: SAP-System-Screenshot

4. Thus, variances between actual and target costs are settled and assigned to the accounts introduced above:
   - The variance is posted (Debit) to the P&L account **741700** (Manufacturing Output Sett Var) after settlement process. The offset posting (Credit) is made to the account **760100** (Production Variances).
   - You can also see the variance settlement posting and the particular account in the following chapter or by pressing the Accounting documents button in the figure above and then double-click on the Accounting Document displayed in the pop-up screen.

3.5.4.3 Order Completion and Closing

Now, check the cost analysis again. After making sure that the variance is settled you can complete the order technically and close it from accounting point of view. Therefore, within the tile group **Script 2 – Design-to-Operate** select the app ***Change Production Order***.

1. Enter the production order number of the ***second order (Speedstar)*** and confirm with *Enter*.
2. Select ***More → Goto → Costs → Analysis.*** You see that the variance of the actual costs column is 0.



Order	1000042 SPEEDSTAR-9995
Order Type	PP01 Standard production order
Plant	DL00 Plant Dallas
Material	SPEEDSTAR-9995 Speedstar-9995
Planned Quantity	1.320 EA each
Actual Quantity	1.320 EA each
Target Cost Version	0 Variances from production

Cumulative Data
Legal Valuation
Company Code Currency/Object Currency

Cost Element	Cost Element (Text)	Origin	Total Target Costs	Total Actual Costs	Target/Actual Var.	T/I Var(%)	Currency
720300	Semi-Finished Consumption Expense	DL00/BASIS-MODULE-9995	1.775.400,00	1.775.400,00	0,00		USD
741700	Manufacturing Output Settlement Variance	DL00/SPEEDSTAR-9995	2.164.800,00-	2.164.800,00-	0,00		USD
741700	Manufacturing Output Settlement Variance		0,00	12.975,00	12.975,00		USD
Miscellaneous			**389.400,00-**	**376.425,00-**	**12.975,00**		**USD**
800000	Labor	NAPR1000/LABOR	92.425,00	92.425,00	0,00		USD
Production			**92.425,00**	**92.425,00**	**0,00**		**USD**
720000	Raw Material Consumption Expense	DL00/WHEEL-9995	264.000,00	284.000,00	20.000,00	7,58	USD
Raw Materials			**264.000,00**	**284.000,00**	**20.000,00**		**USD**
			32.975,00-	**0,00**	**32.975,00**		**USD**

Figure 190: Production Order Balanced out: SAP-System-Screenshot

Now complete the order technically and close it.

Technical completion means ending a production order from a logistical viewpoint. This function is usually used if the execution of an order has to be stopped prematurely or if the order could not be executed in the required manner and open requirements for the order (reservations, capacities) should be deleted. The following actions are executed if an order is set to *Technically complete*.

- The order is not relevant for MRP planning.
- Reservations are deleted.
- Capacity requirements are deleted.
- Purchase requisitions for external operations or non-stock materials are deleted.
- The order and its operations receive the system status Technically Completed (TECO).

The **Closed** (CLSD) status has been introduced in the production order. It has the following characteristics:

- No more costs can be posted to the order, that is, confirmations and goods movements are no longer permitted for the order.
- The order can no longer be changed. Exceptions to this are revoking the CLSD status and setting the deletion flag.
- All actions relating to the status.
- Technically completed (TECO) are executed.

Prerequisites for setting the CLSD status are:

- The order must have the status **Released** (REL) or **Technically completed** (TECO).
- **The order balance must be 0**.
- There can be no open purchase requisitions, purchase orders or commitments.
- There can be no future change records from confirmation processes.

3. Turn back to the *Production order Change: Header* screen and select ***More → Functions → Restrict Processing → Complete Technically*** from the menu.
4. Now select ***More → Functions → Restrict Processing → Close***
5. The status of your order changes accordingly. *Save* the order and leave the view.

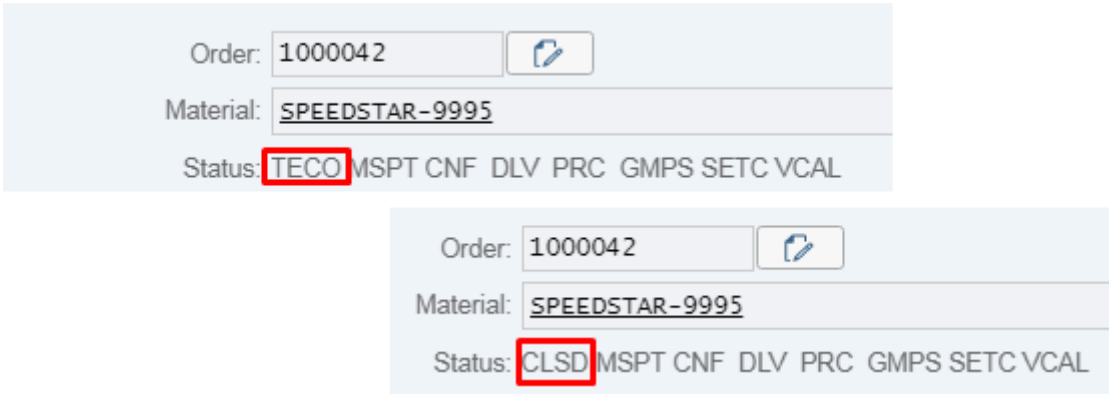


Figure 191: Technical Completion and Closing: SAP-System-Screenshot

3.5.5 Order Information System

You want to display a document containing all production orders for material ***Speedstar-xyyy*** in ***plant DL00***. You further want to customize the **report layout** according to your personal requirements. Correspondingly, the ***material description*** column should be next to the ***material*** column. In addition, you need the **total purchase order quantity** for all **production orders**. Since this is a report that you will use frequently, you do not want to change the layout for each run. Therefore, you will **save** the report layout after implementing your changes.

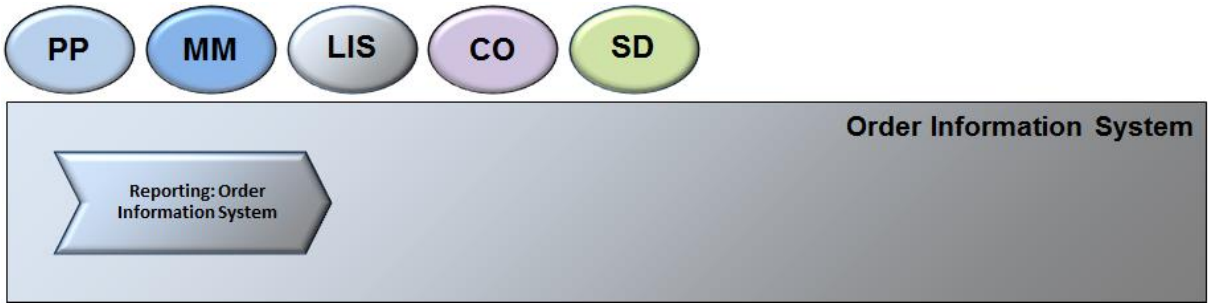


Figure 192: Process Overview: Order Information System

Within the tile group **Script 2 – Design-to-Operate** select the app ***Monitor Production / Planned Orders***.

1. On the *Production Order Information Systems* screen, enter the following data:
   - **List** ***Order Headers***

- **Layout** *000000000001 Standard Layout*
- **Planned Orders** *select*
- **Material** *Speedstar-xyyy*
- **Production plant** *DL00*
- Choose ***Execute***

2. In the report output, you need to activate all **standard ALV functions**. Select **Standard ALV Functions On (** **)**.

Consider, that the following figure including the values may differ from your data dependent from your previous results.

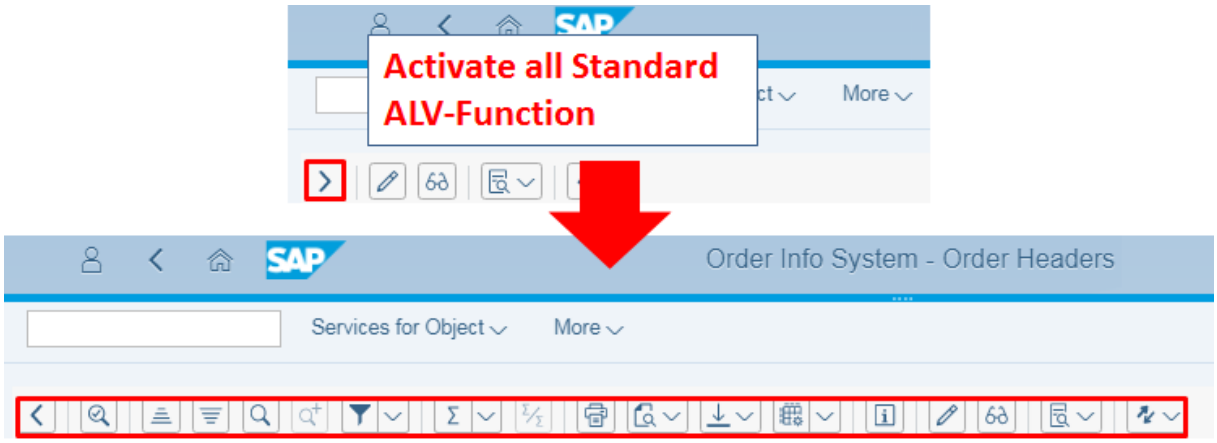


Figure 193: Production Order Information System: SAP-System-Screenshot

3. In the report, pull the ***Material*** field right next to the ***material description*** field (if necessary, scroll to the right).
4. To add a total amount, select the **Target quantity** column by clicking the column header and select **Total** Σ.
5. To save the **report layout,** select **Choose Layout** and then **Save Layout**.

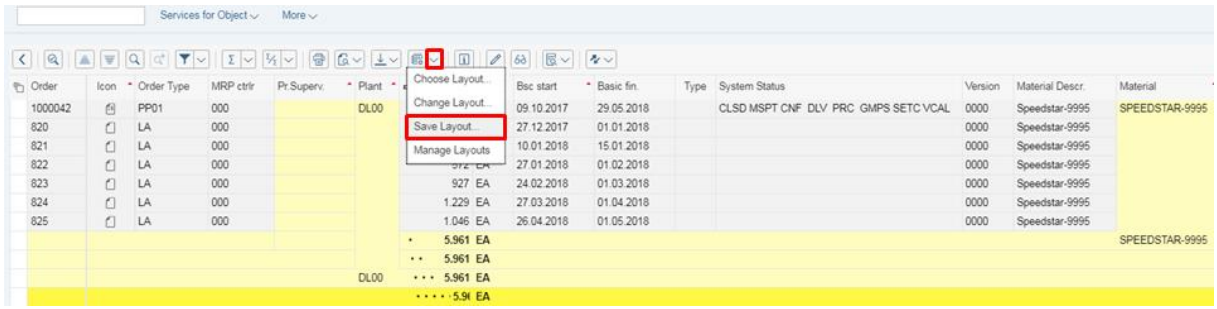


Figure 194: Save Layout: SAP-System-Screenshot

6. Enter the following data:
   - **Save layout** *Manu-xyyy*
   - **Name** *Manufacturing xyyy Layout*

- **User-specific** ***select***
- **Default Setting** ***deselect***
- Choose ***Continue***.

7. Close the report.
8. Run the report again and choose **your report layout** from the layout field. Run the report again using the same selection criteria. Close the report.

Data Sheet

*Congratulations! You completed the **Design-to-Operate Business Process** case study.*

The subsequent case studies are based on the results of this case study. In case your data differs from the description in the script, please contact your tutor prior to processing another case study.

Finally, please **submit the carefully completed data sheet** to your tutor (use support email address) for the case study ***Design-to-Operate Business Process***.

Please comply with the naming rules. Non-compliant data sheets will not be accepted; i.e. re-name the document that you downloaded from this course's download area as follows:

02-Design-to-Operate-xyyy-zzz-lastname.doc

Thereby, you need to replace **xyyy** with your user number **without** the "***WIP***" and without the hyphen (WIPx-yyy) and replace zzz with the number of the client you are working on.

Example:
Your name is **Max Mustermann,** you are working on **client 901**, and your **user number is** WIP**9-999**. Then, name the document as follows:

02-Design-to-Operate-**9999-901-Mustermann**.doc

List of Literature

The content of this teaching unit is partially based on the following references:

Akhtar, J.; Murray, M. (2018): Materials Management with SAP S/4HANA – Business Processes and Configuration. SAP PRESS.

Akhtar, J. (2013): Production Planning and Control with SAP ERP. Galileo Press.

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Chikkappaiah, K. (2017): MRP Innovations with SAP S/4HANA. https://blogs.sap.com/2017/05/22/mrp-innovations-with-sap-s4hana/

Dickersbach, J. T..; Keller, G. (2014): Produktionsplanung und -steuerung mit SAP PP. Galileo Press.

Jordan, J. (2011): Product Cost Controlling with SAP. Galileo Press.

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SAP White Paper (2016): Simplification List for SAP S/4HANA 1610 Initial Shipment Stack. Document Version: 1.0 – 2016-10-31