



Integrated Business Processes with SAP ERP

Script 4: Manufacturing Execution in SAP ERP

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1 Manufacturing Execution in SAP ERP

This unit aims at giving you an understanding of the manufacturing execution in the SAP ERP system.

After this unit, you will be able to:

- Describe the different procedures of discrete, repetitive, and process manufacturing.
- Explain the organizational levels used by manufacturing execution.
- Identify the master data used by manufacturing.
- Perform manufacturing execution tasks.
- Explain the basic steps for the manufacturing of a product with production orders.
- Create a production order, perform inventory transactions, and confirm production.
- Describe the settlement process of an order.
- Name the major interfaces with other SAP ERP components (MM, CO, FI, SD).
- Review the production performance using information systems and controlling reports.

Scenario for the Case Study

In the practical section of this unit, you will at first focus on maintaining master data for the work center at which your bicycles are manufactured. After that, you will modify the task list for the production of the Speedstar.

Along with this, you will create a product cost calculation for your bicycles to ensure a proper calculation of production costs. This step is an anticipation of the controlling unit and therefore marked purple in the following figure.

The major part of this unit is concerned with manufacturing execution. In this part, you will create the Speedstar, complete tasks for production, and create a report in the order information system.

The following figure shows the entire process, which you will complete independently in the SAP ERP system in the practical chapters of this unit. The process step “purchase order of components” is initiated by the production department (material planning, MD04), however, the subsequent process steps are carried out by the purchasing department (MM, materials management).

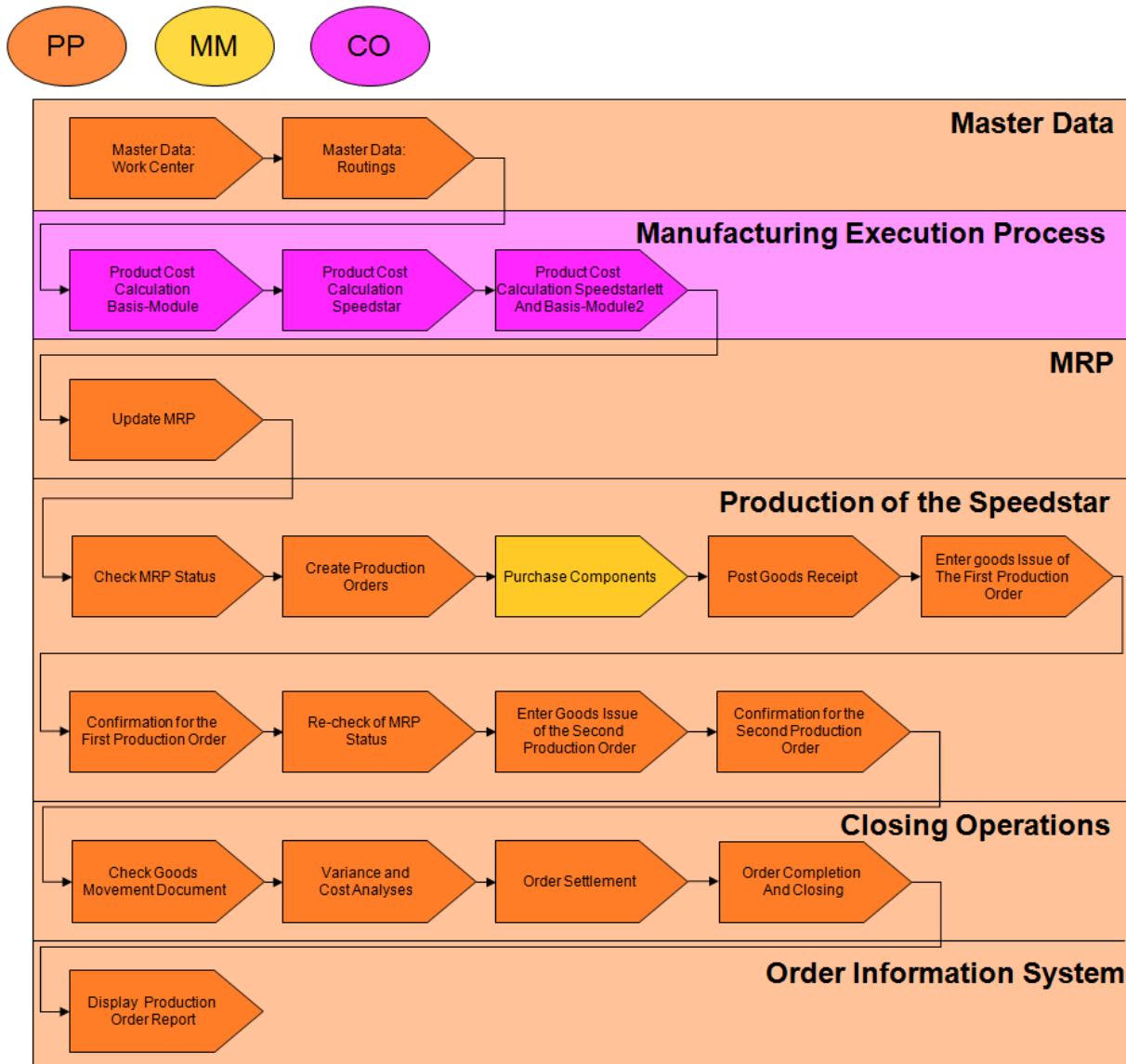


Figure 1: Process Overview: Manufacturing Execution

2 Organizational Levels and Master Data of Manufacturing Execution

In this section, you will get an overview of the organizational levels and master data relevant for manufacturing execution in SAP ERP.

2.1 Theory: Organizational Levels of Manufacturing Execution



You are already familiar with the organizational levels relevant to manufacturing execution, since they are the same as for the material planning application. Thus, you will only find a brief summary in this section.

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

A **client** contains all organizational units of a company.

A **company code** is an independent accounting unit. On company code level, the financial statements required by law are created.

A **plant** is an organizational element within a company. Within a plant, goods are produced, services are rendered, or goods are made available for distribution. A plant can be either a manufacturing facility or a warehouse distribution center. A plant is *the core organizational unit of logistics* and, thus, of manufacturing execution as well.

A **storage location** is an organizational unit *within* a plant. A storage location refers to the location in a plant where materials are stored. Usually, a plant contains multiple storage locations.

The SAP manufacturing execution business process uses the following organizational levels:

- Client



- Company Code



- Plant



- Storage location



Figure 2: Organizational Levels of Manufacturing

2.2 Theory: Master Data of Manufacturing Execution



In manufacturing execution, the following master data are particularly important:

Theory

Material Master Data:

A material to be produced must feature the **procurement type *in-house production (X or E)*** in the material master record to use it in manufacturing. The flag **X** means that both in-house production and external procurement are allowed.

BOM:

The **bills of materials** are ***single-level BOMs***. The applicable BOM is chosen in the production process (production order) using a ***special selection procedure***.

Routings:

The routings are **normal routings**. A ***special selection procedure*** chooses the valid routing.

Work centers:

Work centers or resources are assigned to operations in the routing.

Production resources/tools:

Production resources and tools are assigned to operations in the routing.

Documents (managed in the document management system) can be linked with and displayed in the production order.

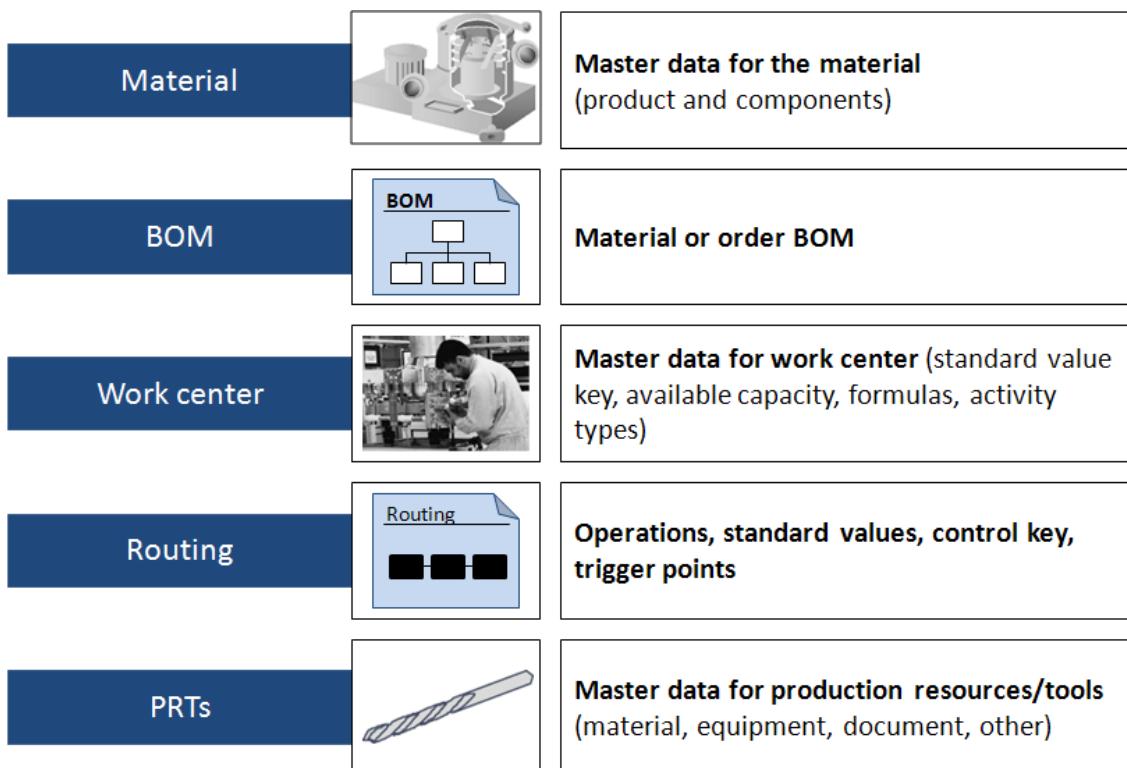


Figure 3: Master Data of Manufacturing Execution

You are already familiar with some of these master data from the procurement and material planning teaching units. Consequently, you can see the integrative aspect of the SAP ERP system. In the following, these master data are listed here as well. Use this as an opportunity to refresh your knowledge.

2.2.1 Material Master: Primary Views

The material master file is a companies' central source for depositing and accessing **material-related data**. All **logistical applications** of the SAP ERP system employ material master files for their processes. The following functional areas are some sub-areas of logistics in SAP ERP:

- SAP MM – Material Management (Procurement and Material Planning are sub-areas of SAP MM)
- SAP SD – Sales and Distribution
- SAP PP – Production Planning
- SAP PM – Plant Maintenance

You can learn this from the **SAP Easy Access Menu** as well (all functional areas assigned to **logistics**).

You already learned from the introduction of the **views** that the material master uses different views for the different functional areas (MRP 1-4, work scheduling, costing, accounting and so on). Data stored in the material master can be used by all departments in common, e.g. purchasing, inventory management, MRP, invoice verification, etc.

The views **MRP (Planning → MRP Views)** and **work scheduling (Control)** must be maintained by production.

Basic data as well as data from **financial accounting**, **quality management**, **forecasting**, **purchasing** and **classification** are used by different **manufacturing planning and execution processes**; however, they are **primarily** maintained by the particular departments (and thus, applications).

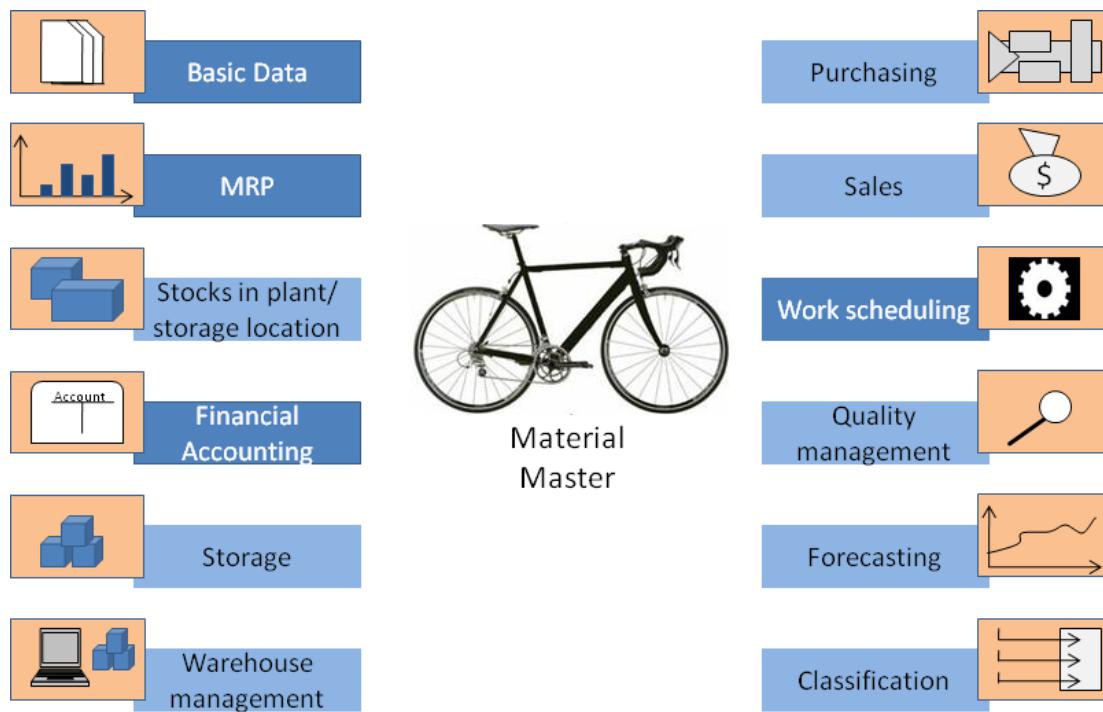


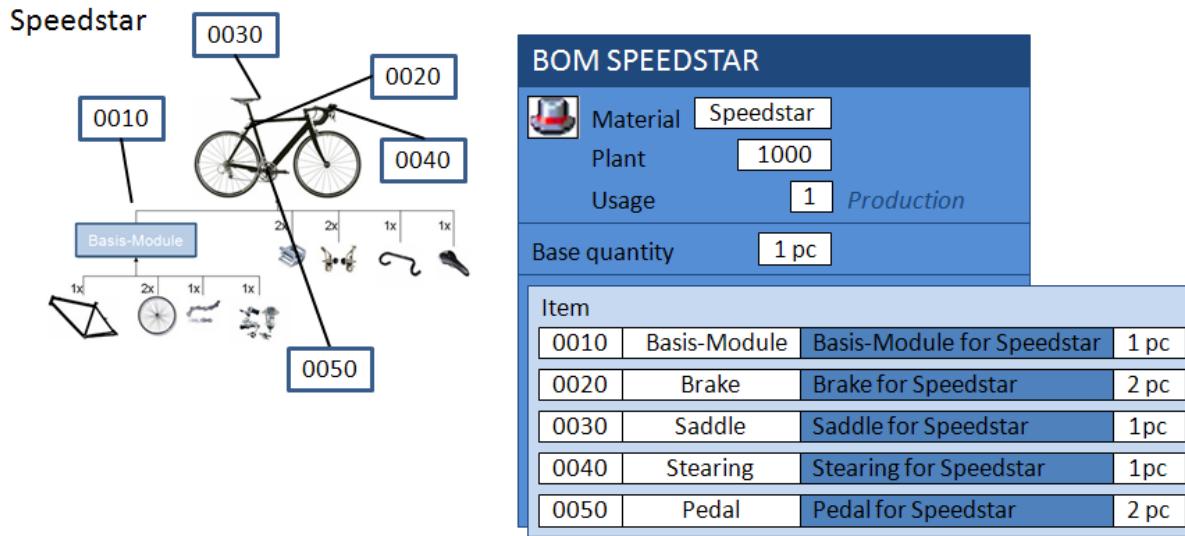
Figure 4: Primary Views in the Material Master

2.2.2 BOMs

The **bill of materials** is a composition of all materials used for the production of a particular product. It contains assemblies (materials produced from different materials themselves) or components. BOM are used in **MRP**, **production**, **procurement**, and for **product costing**.

A BOM consists of a **BOM header** and **BOM items**. The **base quantity** in the header determines to which quantity of the finished product the production items refer.

BOMs in the SAP ERP system are **single-level**. Thus, only the first step of the materials used for the production of a good are listed in the BOM. However, assemblies (containing components or assemblies..., etc.) can also be listed on a BOM, resulting in a multi-level production. Besides **stock items** that are used for the production of the finished product, a BOM can contain **documents or text items**.



- Bills of material are single-level
- Items of a bill of material can themselves contain a further bill of material

Figure 5: BOM Speedstar

BOM structure

The **header** of a BOM contains all settings valid for the entire BOM. **BOM usage** determines, for example, for which **business applications** a BOM can be used.

Using the **status** of a BOM, you can control whether a BOM is active for a particular application (e.g., MRP).

In addition to **simple BOMs**, there are also so-called **multiple BOMs** consisting of multiple **BOM alternatives**. The different BOM alternatives can be valid e.g. for distinct lot-size areas of production processes.

BOM **items** are necessary for the production of the finished product.

The **item category** states which **kind of item** it is about:

- **Stock items** are managed in the warehouse and used in production.
- In contrast to that, **non-stock items** are assigned directly to a manufacturing order (not via the warehouse, e.g., consumable materials (cf. previous chapter)).
- **Variable-size items** contain variable-size data (e.g., a steel plate of a particular surface).
- Finally, **Document items** contain a supplemental document that describes manufacturing (e.g., a construction diagram).

The particular items can feature multiple settings themselves as well with respect to the certain item.

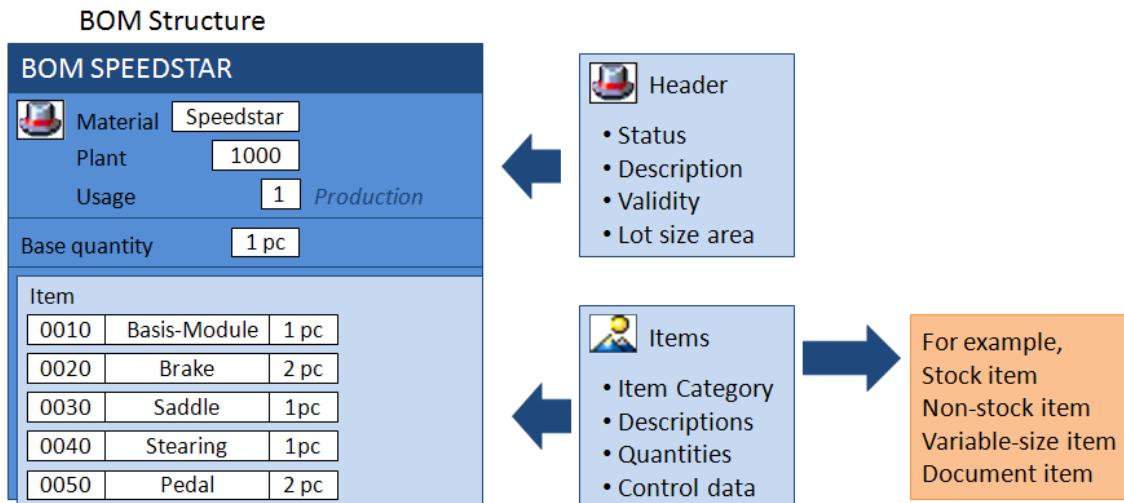


Figure 6: BOM Structure

2.2.3 Work Center (Resource) Data

In SAP ERP operations like welding, assembling or any kind of activities are carried out at a work center. In the SAP system work centers are business objects that can represent the following real world work centers, for example:

- machines, machine groups
- production lines
- assembly work centers
- employees, groups of employees

Together with bills of material and routings, work centers belong to the most important master data in the production planning.

Resource-related data of a work center are managed on multiple screens in the work center master data. Data in work centers is used for scheduling, costing, capacity planning, and simplifying operation maintenance. The following figure displays the central questions regarding planning production processes on a work center.

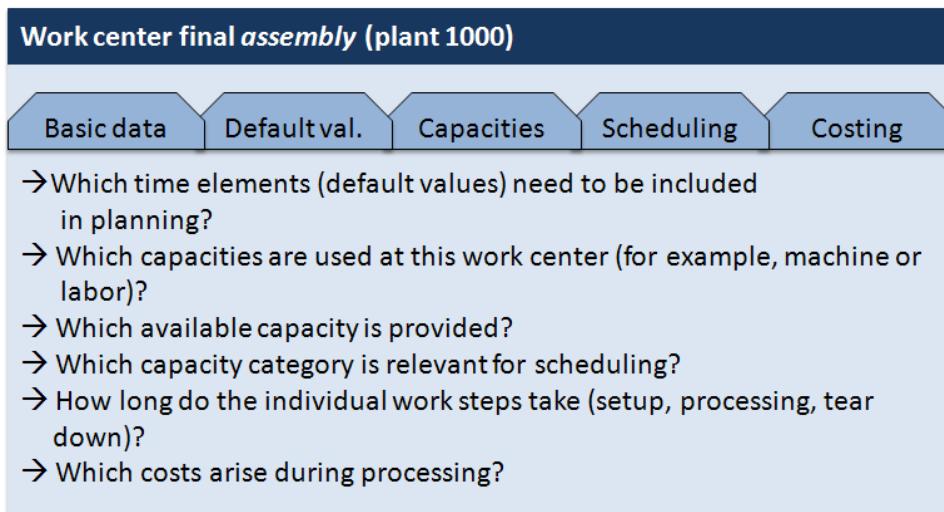


Figure 7: Work Center

Operations defined in a routing take place at work centers of a plant. That is, a work center specifies where production ultimately takes place. A work center is generally a specific geographical location in the plant, for example, a specific machine or department in a plant. Generally, work centers are used in routings. They may also be used in networks, inspection plans (Quality Management) or in maintenance routings.

The data of the work center is assigned according to thematic views:

- **Basic data:** On the **basic data** screen, a **person** or a **group of persons** responsible for maintaining the master data of this resource is defined. The definition of the **task list usage** also includes the specification of the **task list types** (e.g., routing, rate routing, master recipe, equipment task list, or inspection plan) in which the resource can be used and whether the resource can be used in orders (production orders).
- **Default values:** You can assign standard values for operations in routings, rate routings, master recipes, or production/process orders that are supposed to be executed at this resource by specifying a **standard value key**. A **standard value** is a planned value used to carry out an operation. For example, you entered for setup time an execution of 15 minutes for operation 10 at work center 1420. Consequently, these standard values are used in **costing**, **scheduling**, and **capacity requirements planning** to calculate costs, execution times, and capacity requirements. You can also enter default **values** for an operation at a work center. Thereby, the system copies data maintained in the routing, rate routing, master recipe or production/process order, or references these data.
- **Capacities:** The available **capacities of resources** are the basis for **scheduling** process orders. Furthermore, they are required for **capacity planning** and **shop floor control**.
- **Scheduling:** For **calculating the execution** of an operation during **process 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.

- **Costing:** By assigning a **cost center** to a work center, the link between the resource and **cost accounting (SAP CO)** is established. Thus, the processing of product and order costing is enabled and a connection between SAP CO and SAP PP established. You can define the specific resource output by assigning **activity types** that are assigned to a cost center or to the resource.

2.2.4 Routings

Routings contain the work steps required to carry out production. These include the relevant operations, the sequence in which they occur and the work centers at which these operations are to be executed. Each operation in a routing is assigned to a work center.

The definition of **routings** is carried out via so-called **routing groups** and **group counters**. Furthermore, a routing contains a reference to the **material** whose production it describes. A material can have multiple routings based upon lot-size, production equipment, etc. Therefore, in addition to the so-called **standard sequence**, a routing can contain **parallel sequences** or **alternative sequences**.

The standard sequence is the normal routing and contains a number of process steps (welding at work center X, mounting at work center Y, etc.) that are required for the production of the product.

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 particular sales order for a product regarding the operations required for the production process.

Alongside the **standard values** a routing also contains time elements (e.g., 15 minutes for machine X), which are relevant for scheduling operations. Please note that each step of a routing features a particular base quantity, which refers to these time elements.

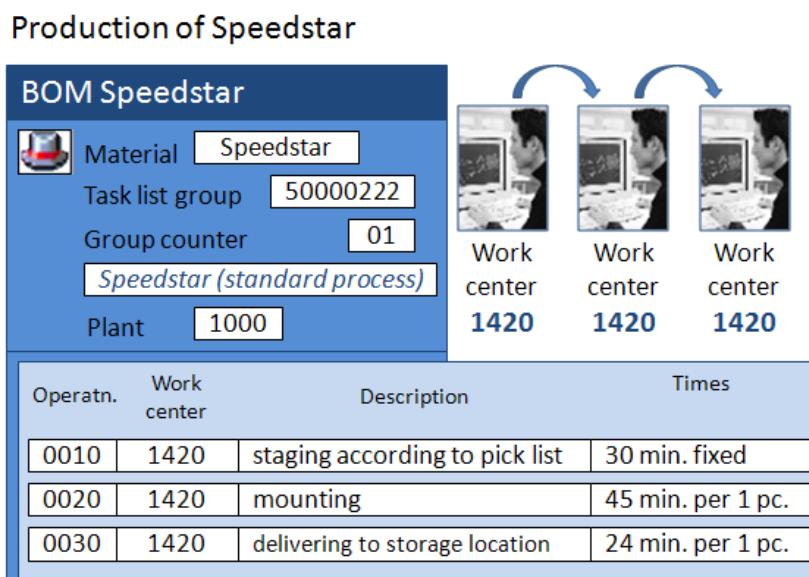


Figure 8: Routing Speedstar

2.2.4.1 Routings and Work Centers

A **work center** is assigned to an operation within a routing. 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, personnel 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, processing, and tear down of an operation at a work center. Thereby, those process steps are executed for which a formula is stored (e.g., tear down of an operation might not be necessary).

If multiple **capacities** (e.g., personnel capacities, machine capacities) are stored, the **scheduling basis** determines which capacity is relevant to a particular scheduling.

Scheduling via Routing and Work Center

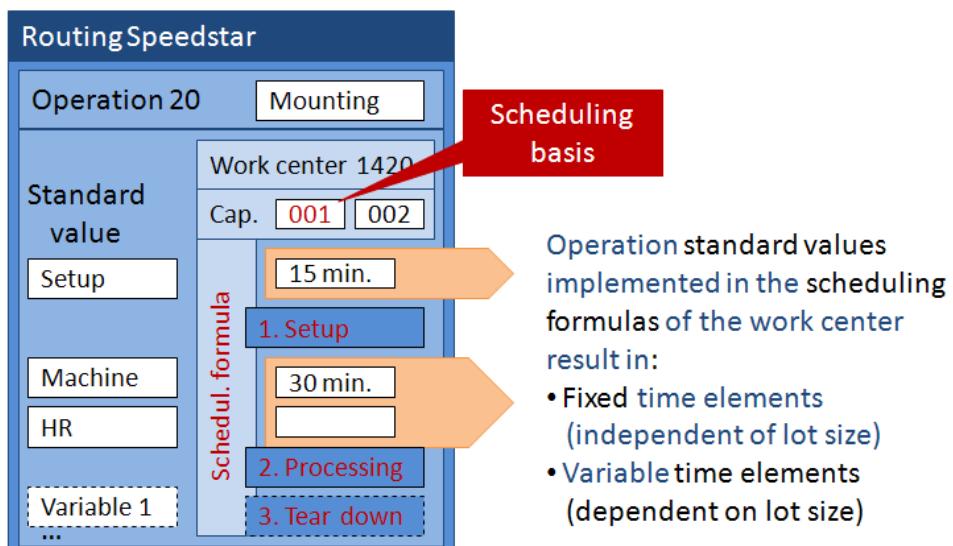


Figure 9: Routings and Work Centers

2.2.4.2 Routings and BOMs

The production of a particular product is described using a **routing** and a **BOM**. The BOM components can be assigned to a particular operation in the routing. The procurement of these components will then be planned 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/tools** in the routing. Production resources/tools are location-independent facilities required for production, e.g. a measuring instrument or a support.

Component Assignment in Routing

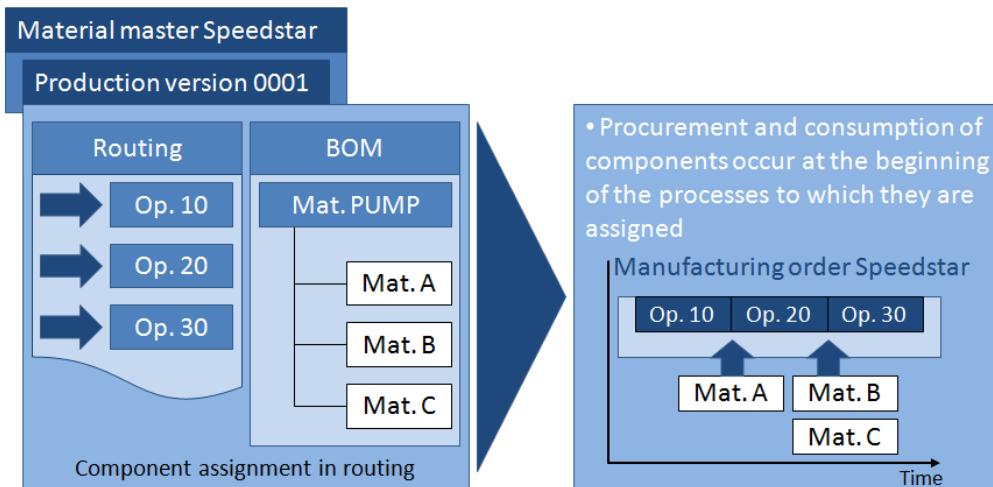


Figure 10: Routings and BOMs

The following figure displays master data in **process industries** and is only shown for informational purposes.

As previously mentioned, master data for discrete manufacturing is used when the controlling of production is mapped with **production orders**. For this purpose a production order uses routings, work centers and BOMs.

In case of production with process manufacturing (PP-PI) other master data is required. At this point, you need a master recipe (instead of the routing) and resources (instead of work centers) for the **process order**.

But consider that discrete manufacturing master data can logically be transferred to the range of concepts in the process industry. Thereby, the master recipe is actually a special routing that was enhanced with process industry-specific functions. Furthermore, in Production Planning-Process Industries (PP-PI), production versions are usually used, so that the corresponding BOMs are assigned directly to a recipe. You can therefore maintain the BOM directly from the recipe.

Similarly, resources largely correspond to the routings. All of the relationships displayed so far for master data in discrete manufacturing are therefore also valid in PP-PI. Material requirements planning (MRP), for example, is completely identical for PP and PP-PI.

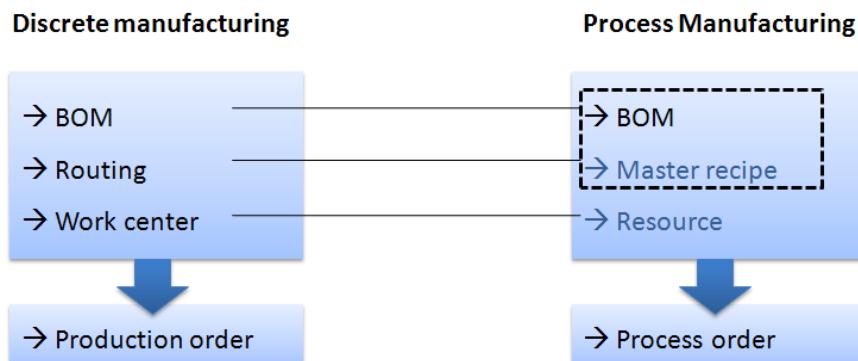


Figure 11: Master Data in the Process Industry

2.3 Practice: Master Data of Manufacturing Execution



The operations for the production of the Speedstar are carried out at **work center 1420**. 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.



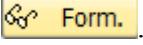
Figure 12: Process Overview: Maintaining Master Data

2.3.1 Master Data: Work Center

Firstly, display the master data for **work center 1420**. Therefore, call up the following transaction:

Logistics → Production → Master Data → Work Centers → Work Center → Display (CR03)

1. Enter plant **1000** and work center **1420**.
2. Confirm by pressing **Enter**.
3. You are now in the master data record of work center 1420. Answer the following questions and list the answers on your data sheet:
 - Which **five tabs** are displayed for the work center?
 - The **work center category** is a key which 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 **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?
 - Go to the **capacities tab**. Here you determine what type of capacities (labor, machine, person etc.) and how many capacity (working hours, machine hours, personnel hours) the work center has and how the capacities are calculated and allo-

cated (divers formulas). You can take a look at formulas by clicking in one of the formula fields (e.g., Processing formula) and then pressing  Form.

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 ( Capacity) 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)?

2.3.2 Master Data: Routing

After you got an overview of work center **1420**, take a closer look at the routing for the Speedstar. Therefore, call up the following transaction:

Logistics → Production → Master Data → Routings → Routings → Standard Routings → Change (CA02)

1. Enter material **Speedstar-xxyy** and plant **1000**.
2. Choose the **header data symbol** ().
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 **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 are 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 can specify for a routing that it is only valid for lot sizes between 10 and 100

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** 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 (Operations). You can now see the operations that you already maintained yourself. Select the first operation (0010) and choose **detail → operation** from the menu.

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.

Which are the **base quantity** and the **unit of measure** for this operation?

Which are the **standard value** and the **measurement unit** of the personnel time required for the base quantity?

By default, components of a BOM are assigned to the first operation of a routing. However, your goal is that except for the Basis-Module, all of the other four components are not made available until final assembly. Therefore, you need to assign the four components (pedal, breaks, handlebar and saddle) to operation 20. For this reason, you need to switch to the **general data screen for component assignment** (CompAlloc).

1. Select the four rows with the entries pedal, breaks, handlebar, and saddle and choose **new assignment**.

Routing Change: Material Component Overview

New Assignment Reassign BOM Task list Operation

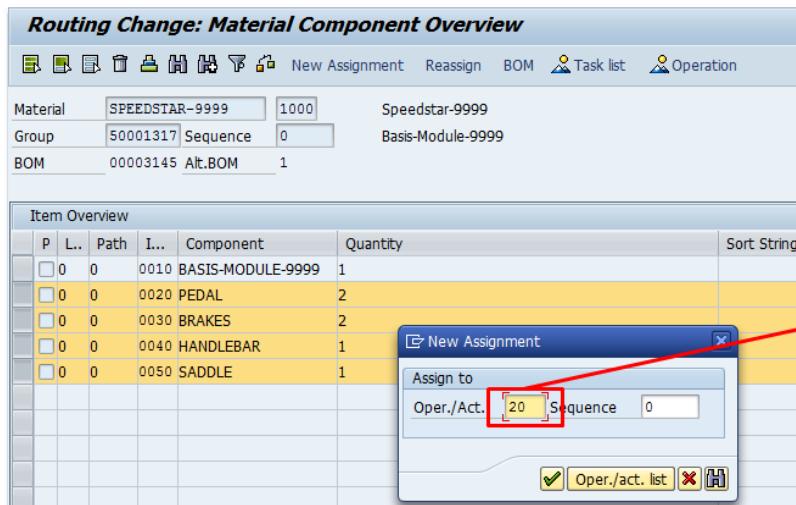
Material	Group	BOM	Description
SPEEDSTAR-9999	50001317	00003145 Alt.BOM	Speedstar-9999 Basis-Module-9999
0010 BASIS-MODULE-9999			1
0020 PEDAL			2
0030 BRAKES			2
0040 HANDLEBAR			1
0050 SADDLE			1

Select all four materials and press this button

You want to make these materials available for production not before every other step of the production process is finished

Figure 13: Change Routing (1): SAP-System-Screenshot

2. In the next dialog, enter the number of the second activity (**20**) into the **activity** field and press **Enter**.



Operation or Activity
0010 is setting up the machines, Activity 0020 is the final assembly. Thus, you enter 20 as Activity to which the materials should be assigned to.

Figure 14: Change Routing (2): SAP-System-Screenshot

3. You can see that the operation number in the operation column changes.

The screenshot shows the same SAP interface after saving the changes. The 'Item Overview' table now has the 'Oper.' column filled with '0020'. The 'Seq.' column remains at 0. A red box highlights the '0020' entry in the 'Oper.' column for the PEDAL component.

P	L..	Path	I...	Component	Quantity	Sort String	U.	I.	Ba...	O...	Seq.
	0	0	0010	BASIS-MODULE-9999	1		PC	L			
	0	0	0020	PEDAL	2		PC	L	<input type="checkbox"/>	0020	0
	0	0	0030	BRAKES	2		PC	L	<input type="checkbox"/>	0020	0
	0	0	0040	HANDLEBAR	1		PC	L	<input type="checkbox"/>	0020	0
	0	0	0050	SADDLE	1		PC	L	<input type="checkbox"/>	0020	0

Figure 15: Change Routing (3): SAP-System-Screenshot

4. Save your routing.

2.4 Elucidation



What have we learned so far?

You got acquainted with the organizational levels and master data of manufacturing execution. Except of the work centers and the relationships between work centers, routings and BOMs, all other information in this chapter came as a repetition.

2.4.1 Organizational Levels of Manufacturing Execution

In production planning and manufacturing, the following organizational units are relevant:

- **client**
- **company code**
- **plant** (central organizational unit of logistics and manufacturing execution)
- **storage location**

2.4.2 Master Data of Manufacturing Execution

In manufacturing execution, the following master data are particularly important:

- **Material Master Data**
- **BOM**
- **Routings**
- **Work centers or resources**
- **Production resources and tools**
- **Documents**

2.4.2.1 Material Master: Primary Views

- The views **MRP (MRP 1 to 4)** and **work scheduling** must be maintained by and for production.
- Basic data as well as data from **financial accounting, quality management, forecasting, purchasing and classification** are used by different **manufacturing planning and execution processes**; however, they are **primarily** maintained by the particular departments (and thus, applications).

2.4.2.2 BOMs

A **bill of materials** contains all the components that are necessary for producing a finished or semi-finished good.

BOMs are used in:

- **MRP:** When planning material requirements for a finished good, you must know what components it contains, since you must plan those, too.
- **Production:** Producing a finished good is only possible if you know what components it is composed of.
- **Procurement:** Purchasing requirements for finished goods components are derived using BOM.

- **Product costing:** When you calculate the production costs for a finished good in controlling application, you need to know what components it contains.

Bills of Materials Structure

- BOMs consist of a Header (general, base quantity, BOM usage, etc.) and item data (components, item category, quantity, etc.)
- **Status** of a BOM (key which describes the current processing status of the BOM)
- **single-level** BOM; multi-level production is accomplished through multiple single-level BOMs
- Simple BOMs have only one alternative BOM, whereas **multiple BOMs** consisting of multiple **BOM alternatives**.

2.4.2.3 Work Center (Resource) Data

Activities that are accomplished in a company are carried out in work centers in SAP ERP. Work centers can represent the following real work centers, for example:

- machines, machine groups
- production lines
- assembly work centers
- employees, groups of employees

Together with bills of material and routings, work centers belong to the most important master data in the production planning.

The master data of a work center contains the following tabs, which provide **resource-related data** of a work center:

- **Basic data**
 - o name and description for the work center
 - o **Person or a group of persons** responsible for maintaining the master data of this resource is defined.
 - o **Task list usage:** Key to control in which type of task list you can use the work center or more generally operating resources like work centers or production resources/tools.
 - o **Standard value key:** Key defining and giving 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.
 - o A **standard value** is a planned value used to carry out an operation. For example, you entered for setup time an execution of 15 minutes for operation 10 at work center 1420. Consequently, these standard values are used in **costing**, **scheduling** and **capacity requirements planning** to calculate costs, execution times and capacity requirements.
- **Default values**

- You can also enter default **values** for an operation at a work center. Thereby, the system copies data maintained in those 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 1420 the control key is PP01 (in-house production), thus, routing activities that use work center 1420 are assigned "in-house 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.)

- **Capacities**

- This tab determines 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 given capacity on a work center and uses this data for scheduling the production processes.

- **Scheduling**

- Scheduling also uses the capacities and the same formulas to calculate the time schedule for production processes.
- The available **capacities of resources** are the basis for **scheduling** process orders. Furthermore, they are required for **capacity planning** and **shop floor control**.
- For **calculating the execution** of an operation during **process 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.

- **Costing**

- Information on this tab is closely integrated with SAP CO (account management)
- You assigning a **cost center** to a work center. This establishes the link between the resource (SAP PP) and **cost accounting (SAP CO)**.
- 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 SAP ERP as costing types. In case of activities (e.g., assembling) **activity types** (e.g., activity type 1421 in your routing = wage hours) are defined. Activity types are then assigned to costing types to determine the "price" of this activity.
 - Example: The activity type 1421 costs you 100 € 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 50 € of costs on the work center. These costs are transferred to the assigned cost center and accounted in SAP CO.
- **HR Assignment**
- HR Assignment is not a tab in the work center master data but special data view.
 - You can assign employees, positions, qualifications and other objects from the SAP HR application to a work center.

2.4.2.4 Routings

Routings determine the required work steps relevant for production, concerning operations, their sequence and the work centers in charge. The definition of **routings** is carried out via so-called **routing groups**. That is, all routings belonging to one particular material are grouped together. Each routing in a group receives its individual **group counter**.

Routings features:

- routing is created **material-specific**
- **Standard sequences**
- **Parallel sequences**
- **Alternative sequences**
- **Standard values**
- Routings can be transferred as **production process models (PPM)** to SAP **Advanced Planning and Optimization (APO)**.

2.4.2.5 Routings and Work Centers

- A **work center** is assigned to an operation (activity in the routing).
- **Standard value key** that is defined in the work center determines which time elements (standard values) are considered in the planning process (e.g., setup time, machine time, personnel time).
- The **scheduling formulas** stored in the work centers define the duration of operations regarding time elements in the **routing**.
- **Formulas** are available for setup, processing, and tear down of an operation at a work center. Only those process steps are executed for which a formula is stored.
- If several **capacities** (e.g., personnel capacities, machine capacities) are stored, the **scheduling basis** determines which capacity is relevant to a particular scheduling.

2.4.2.6 Routings and BOMs

- BOM components (materials) can be assigned to a particular operation in the routing.

- If there is no specific allocation to an operation, BOM components are assigned to the **first** operation of the routing.
- Besides BOM components, you can also assign ***production resources/tools*** in the routing.
- Production resources/tools are location-independent facilities required for production, e.g. a measuring instrument or a support.

3 Production Order Process

In this section the processing of production orders, especially for the make-to-order production order, and the elements of this process are described. Furthermore, the integration aspect with other SAP applications is discussed.

3.1 Theory: Production Order Processing



Theory

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.

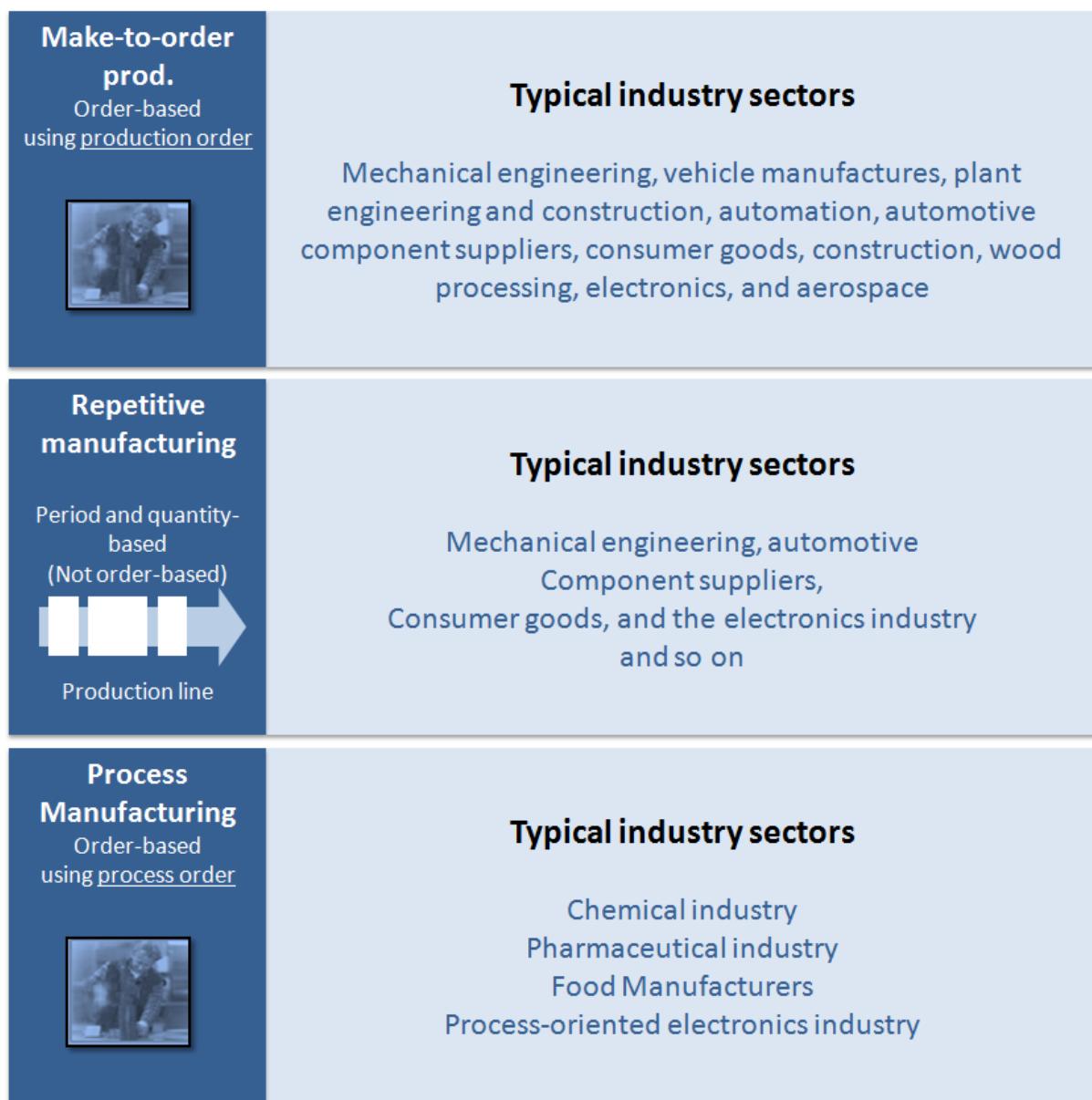


Figure 16: Production types in SAP ERP (1)

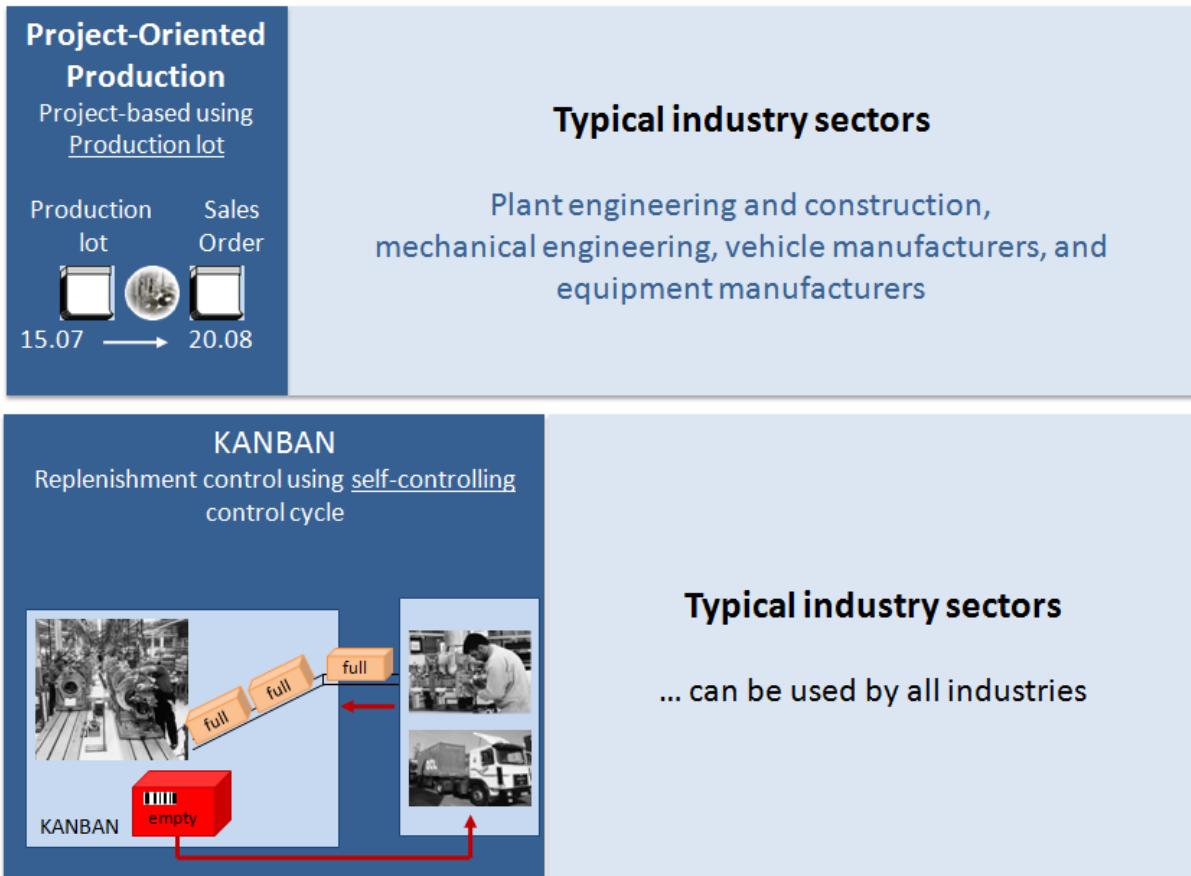


Figure 17: Production types in SAP ERP (2)

We will now focus on make-to-order production (discrete manufacturing).

3.1.1 Processing Production Orders

A production order is processed through several process steps (**activities**) during production. The following figure displays those process steps. Important steps for order-related production are order creation, scheduling, release, printing papers, material withdrawal, execution, confirmation, goods receipt, and settlement. These functions are integrated with other areas in your 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 SAP system allows you to run many of these processes **automatically** or in **background**. Thus, only few steps require manual intervention, leading to a reduction of complexity reduction for the operations manager.

Usually, **WIP-determination (work in process), variance calculation and settlement** are recurring tasks of **Cost Object Controlling (COC)** and, thus, are processed in the background. You can use the **quality management (QM)** tools **during the production process** and for the **goods receipt**. Various interfaces for **process integration** are available for **downloading** orders and **uploading** process messages.

The figure shows the processing steps of a production order, starting at the order request and ending with the archiving. Not all process steps are mandatory. A **number of settings** available in Customizing allow you to perform each step in order processing successfully.

The operations marked with (1) can be run automatically due to Customizing settings. The operations marked with (2) can be executed via **background processing**.

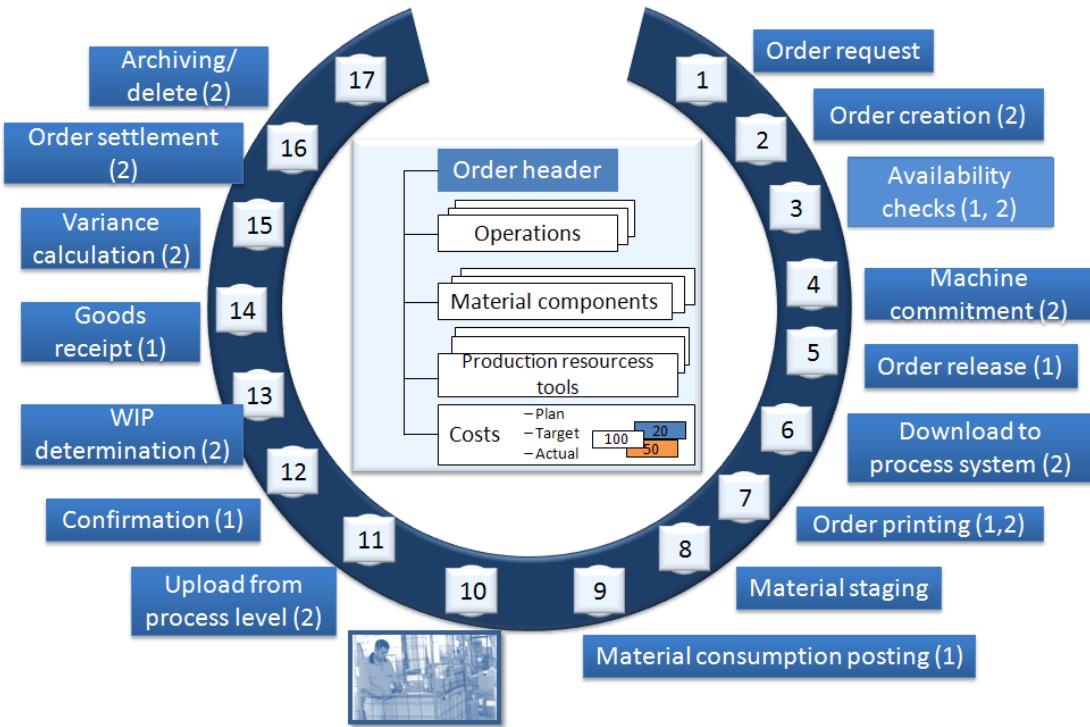


Figure 18: Processing Production Orders

3.1.2 Elements of a Production Order

The following figure displays the order structure of a production order in SAP ERP.

The standard sequence of a production order must contain **at least one operation** (routing activity). If there is no operation present, the system automatically creates one. **Sub-operations** are allowed within an operation. You can add **material components**, **production resources/tools** and **trigger points** to an operation.

You can create **multiple (parallel) operation sequences**. Parallel sequences are used if operations of a production order need to be executed at the same time at different work centers or machines.

You can choose from different **alternative sequences**. Alternative sequences are used if a product needs to be produced according to order requirements (e.g., make-to-stock production or individual order).

Costs are determined at **operation level** and then transferred to **order head level**. A settlement rule is only created for order-related COC.

Production orders can be linked to documents (texts, specifications, order descriptions, etc.) in the **document management system (DMS)**.

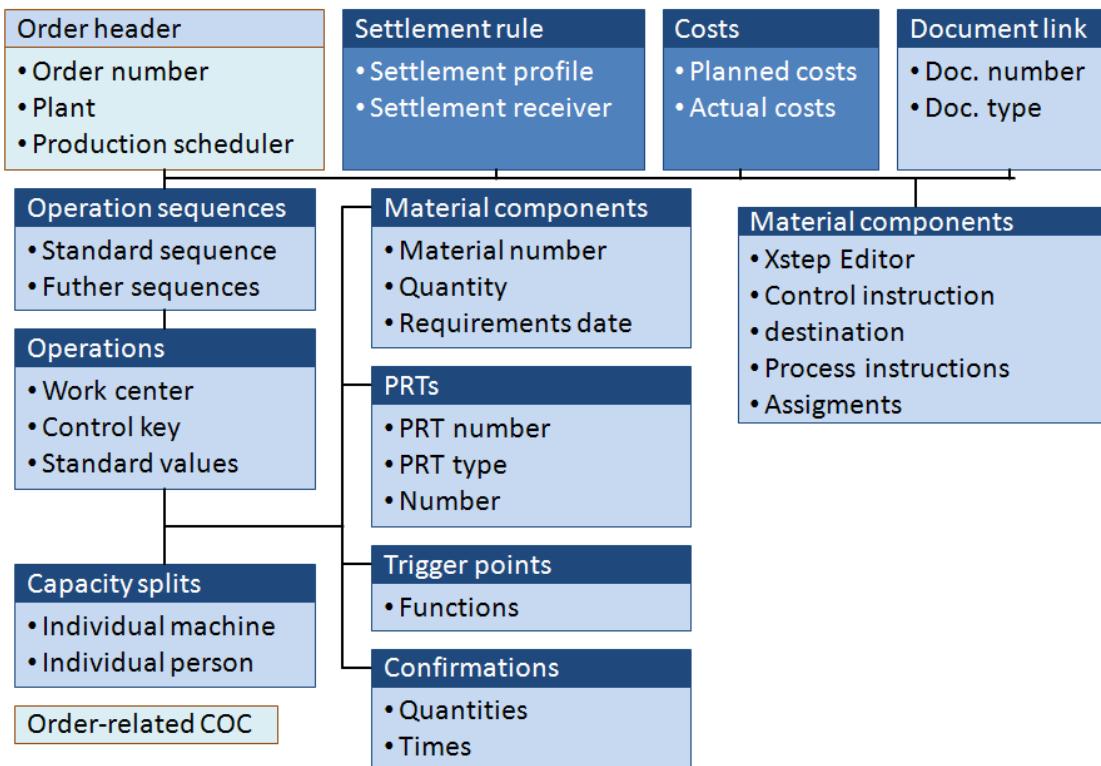


Figure 19: Elements of a Production Order

3.1.3 Order Release Functions

The **order release** is the basis of manufacturing execution. Only if a production order has the status **released**, subsequent processes, such as printing order documents, material withdrawal are possible. Thus, subsequent processes are managed using the status. When releasing an order, the according **status** is set. At the time of order release, the status of an order is created (CRTD). When an order is released, the status is released (REL).

Depending on the status of an order, certain subsequent processes are possible. For example, there cannot be a goods receipt posting to production for a not released order.

You can configure the ERP system and the respective order type (in our case studies order type PP01) to automatically run an **availability check**. There is no automatic availability check for order type PP01.

In the SAP ERP system, you can release either one single operation or multiple operations or several orders simultaneously. Additionally, you can use the **mass release** function for operations and orders.

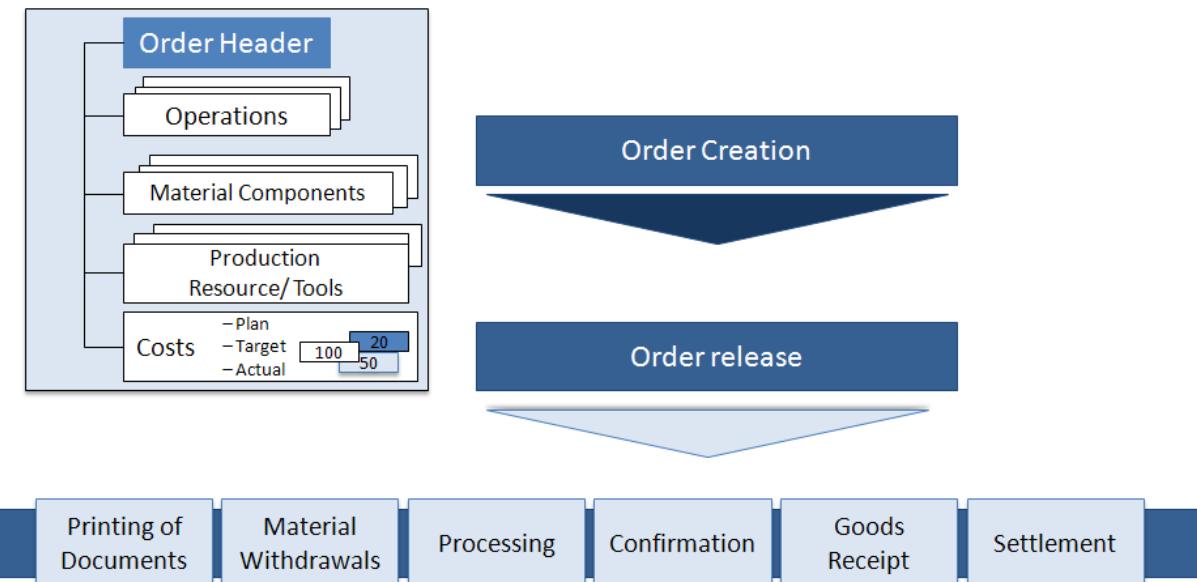


Figure 20: Order Release Functions

3.1.4 Goods Issue Posting

A further milestone in production order processing is goods issue posting for the required components. When consuming a material during the production order process, a **goods issue posting** (GI) is executed.

The following steps are executed for a **goods issue posting** for the components of the production order:

- **Stock and consumption fields** are updated at the respective storage location.
- Materials reserved by a production order are reduced (**reduction of reservations** in case of planned withdrawal). In case of unplanned material withdrawal, only the costs of the materials are updated on the production order.
- The production order is updated and the **actual costs** are determined. In Customizing, you use a **plant-specific or company-code-specific valuation variant** to define the **valuation of material consumption**.
- **Material documents, accounting documents and controlling documents (cost accounting)** are created:
 - The **material document** gives information about goods movements from a materials management (stock) point of view.
 - 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.
 - The **controlling document** represents the actual costs posted to the production order.
 - You can branch from the display of the material document to display other relevant information regarding accounting and cost accounting.
- If desired, you can print a **goods issue document**.

The goods issue posting is controlled by using **movement type** (261), to which each posting refers. This procedure can be carried out both manually and automatically.

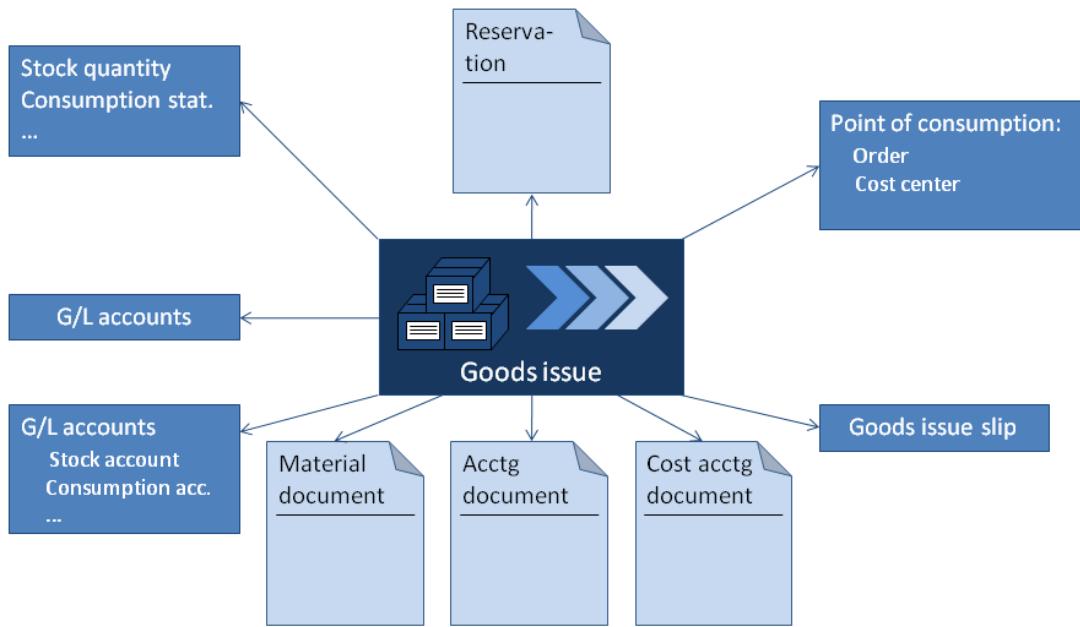


Figure 21: Production Order: Goods Issue Posting

3.1.5 Production Order Confirmation

The next step after posting the goods issue to the production order is the confirmation of the production order. The confirmation is used for the consumption of internal activities. That is, you capture activities consumed by the production process with a confirmation and post the costs etc. of the production process on the production order. Thus, confirmations are an important basis for **entering internal activities** performed for the order, **for checking the progress** of an order and subsequent capacity requirements planning. For this reason, exact **real-time confirmations** are of particular **importance**.

A confirmation causes **various** additional **functions** to be executed, which are displayed in the following figure. For instance,

- the employees' working hours are updated in the HR (Human Resource) module of SAP ERP,
- a sales order, which might have initiated the production order is updated,
- the capacity requirements of the order for work centers are reduced,
- for the goods movement to storage location a material document is created for the produced material,
- and actual costs are updated on the production order.

There are several procedures to confirm a production order in SAP ERP. You can enter the confirmation manually or upload confirmations from PDC systems using the PP-PDC interface.

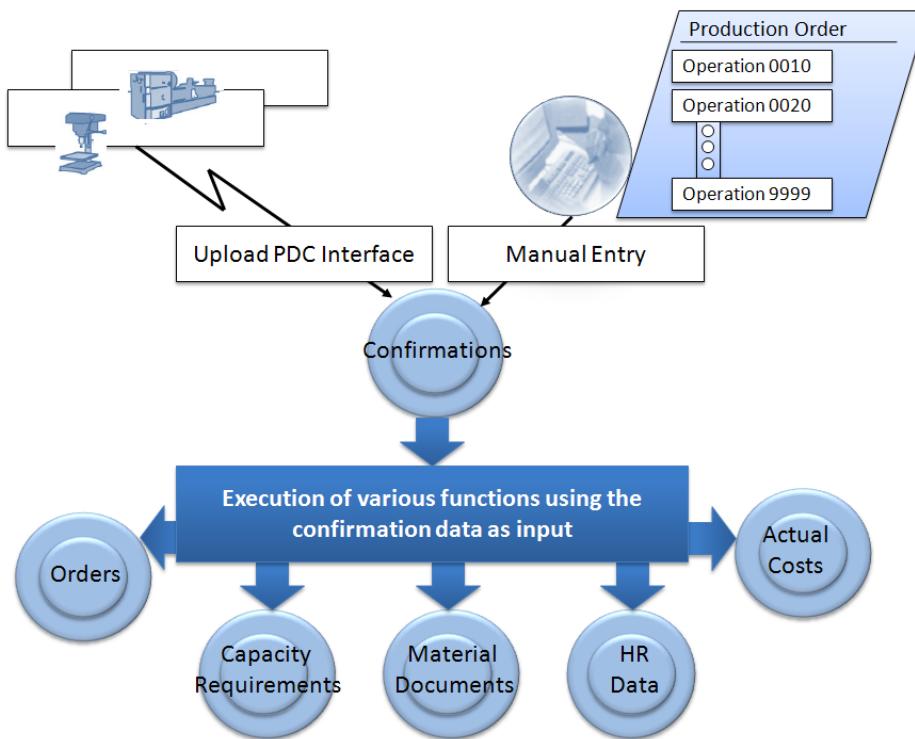


Figure 22: Confirmation Procedures

After the production order is confirmed, follow-on functions are performed. Thereby, the confirmed quantity of the product produced, the status **CNF** (confirmed), and the actual costs of the production process are written in the production order.

A production orders routing may contain multiple operations, which can be confirmed individually. When an individual operation, which contains processing of materials, is confirmed, an automatic goods issue is posted on the basis of the quantity that has been assigned the material components (backflush). These material components must be prepared for backflush posting and also be provided for using at the work center.

When the last operation of the routing is confirmed (or for the operation where this posting is defined in the control key), an automatic goods receipt is posted. Depending on the request, the goods receipt posting for the materials produced can be either attached to the order confirmation or carried out separately.

The reduction of capacities on the employed work center is carried out either in proportion to the quantity or activity consumed.

If a scrap or rework quantity is confirmed, a quality notification can be generated automatically (as of ECC 6.0 EhP3).

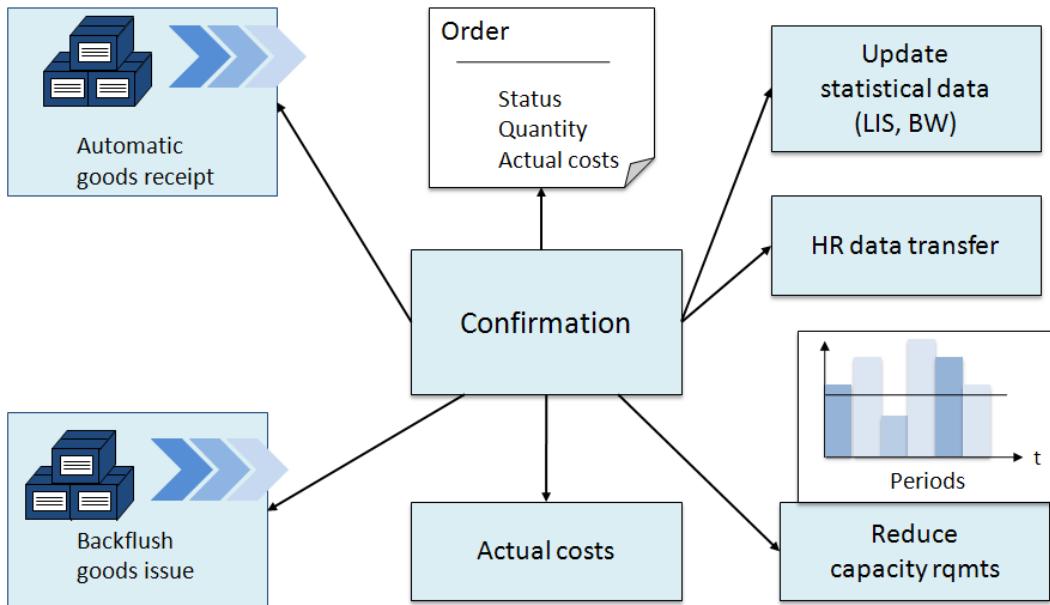


Figure 23: Effects of a Confirmation

3.1.6 Goods Receipt Posting

A **goods receipt posting** is carried out to realize a **stock receipt** for a product produced with a **production order**.

The following functions are executed when a goods receipt is posted:

- **Material documents, accounting documents and controlling documents (cost accounting)** are created.
 - The **material document** gives information about goods movements from a materials management (stock/warehouse) point of view.
 - 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.
- If required, you can print a **goods issue document**.
- The delivered quantity is updated in the production order.
- The receipt is evaluated.
- Depending on the settlement rule, a credit to order is carried out (see chapter 3.1.7).
- The plant activity is updated.

The goods receipt posting is controlled using **movement type** (101), to which each posting refers. This procedure can be carried out both manually and automatically.

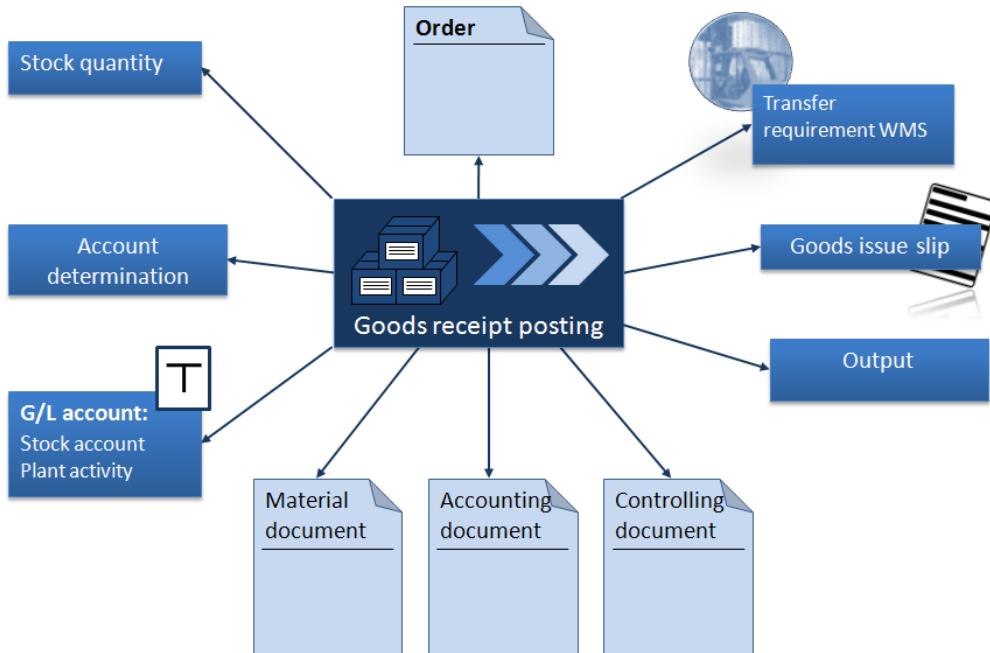


Figure 24: Production Order: Goods Receipt Posting

3.1.7 Integration of Management Accounting

The following two figures display the integration between production orders and SAP CO (Controlling). The first figure shows the steps for variance determination and settlement of a production order. The second figure displays the effect of the production order processing steps. That is, it shows what effects material withdrawal, confirmations, and goods receipts have on a production order from a FI and CO point of view.

The logistics sub-area **Production Planning (SAP PP)** is very closely integrated with Management Accounting (SAP CO). Bills of material and routings created in SAP PP or SAP MM can be used for product cost calculation in Management Accounting. Furthermore, production orders in SAP PP are **cost units** that are used for purposes of documentation and controlling the production costs. That is, production orders are cost collectors and, thus, accumulate all costs (material, activities, etc.) occur during the production of a product.

One 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. These costs are stored as planned costs in the production order.
- After releasing the production order costs are initially incurred by material withdrawals. The raw materials inventory (that has been supplied before) 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 these 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** of the product or the **settlement** of the production order effects an increase in the inventories of finished products, whereby unusual internal cost fluctuations 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.

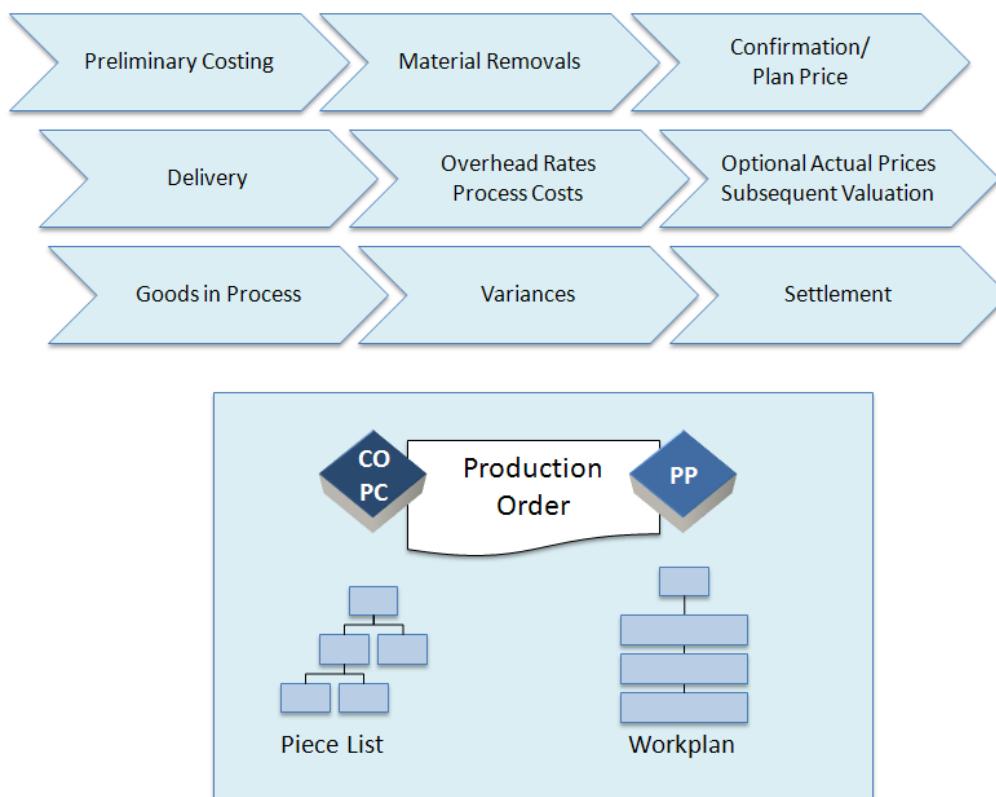


Figure 25: Manufacturing Processing with Management Accounting

The variant of **cost object controlling** (COC) 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**.

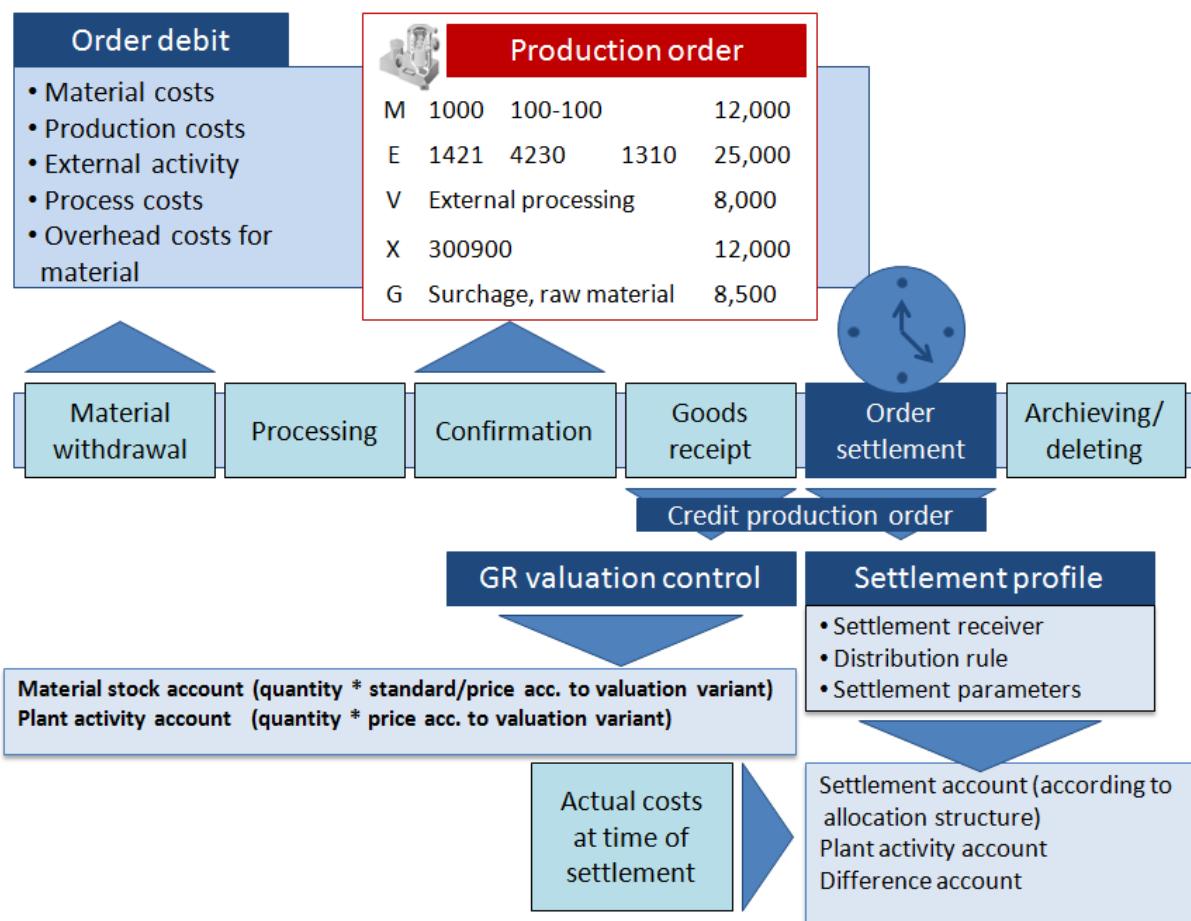


Figure 26: Cost Debit/Credit (Order-Related COC)

3.1.8 Information Systems for Production Order Management

There are several **information systems** and flexible evaluation options for production orders. They differ in their **utilization of the order database (directly/indirectly)** and in their **results**. In the SAP Easy Access menu, you can find them following the path

Logistics → Production → Shop Floor Control → Information System

The following figure displays the available information systems in SAP PP. Systems marked with (1) are layout-controlled (profile-controlled up to Release 5.0). You can set up layouts (and profiles) in the application (information system) itself.

If you use the Enterprise Portal, you can access with the role of the production scheduler to process and track production orders and other objects (inspection lots, quality notifications, malfunction reports, and maintenance orders).

In addition to the evaluation options displayed, there are the following options in the SAP PP-IS

- **Capacity evaluations**
- **Event Manager (SCM)**
- **Alert Monitor (APO)**
- **Batch where-used list**
- **Evaluation of digital signatures** and other lists.

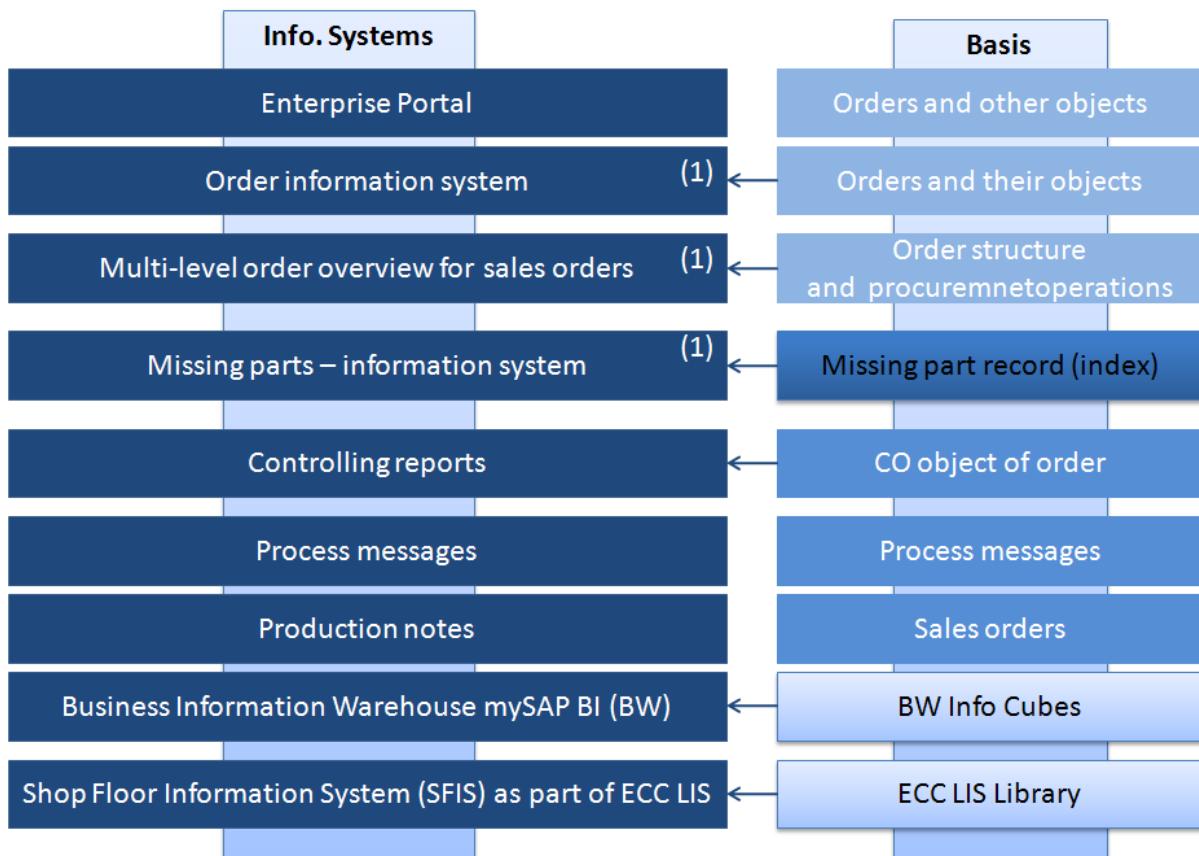


Figure 27: Information Systems for Order Management

3.2 Practice: Manufacturing Execution Process



Practice

In units 1 (procurement) and 2 (material planning), you created all required master data (material master records, routings, BOMs) 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 costing**.

3.2.1 Product Cost Calculation

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.

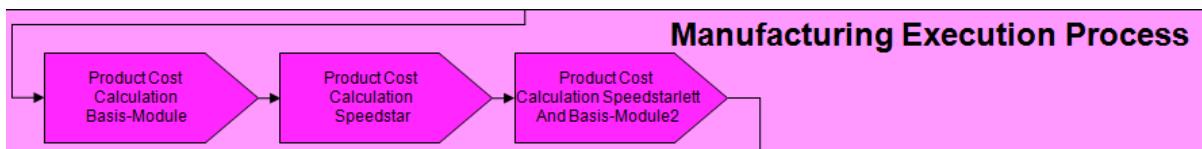


Figure 28: Process Overview: Product Costing



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 IDES AG, determined in cost-center accounting. The calculation is the basis of determining

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

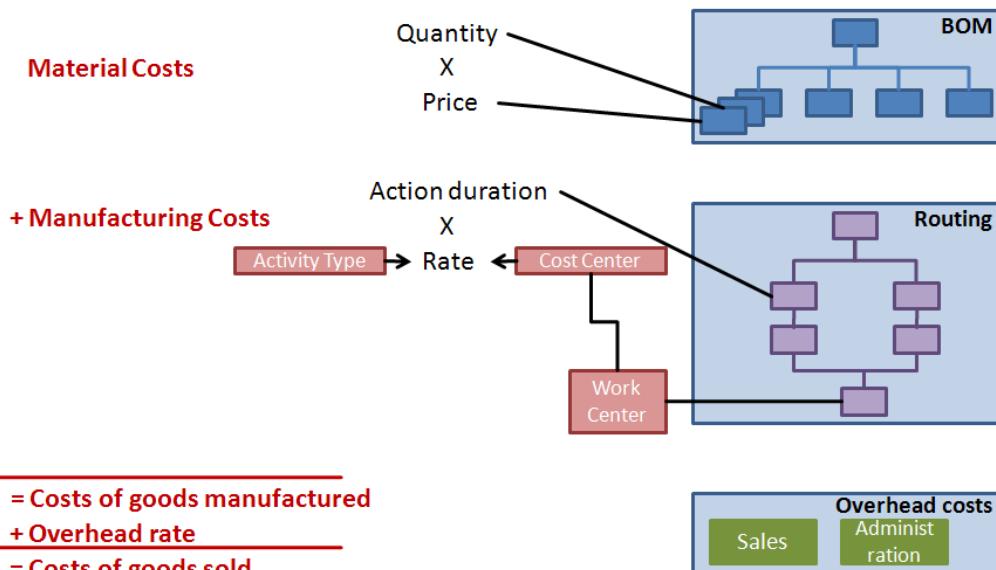


Figure 29: Product Costing



Please bear in mind that processing product cost calculation is a task of **controlling** and for that matter this step is a look ahead at this point. Product cost calculation will be discussed in teaching unit 9 in greater detail. Still, you will carry out product cost calculation at this point to make sure that the cost calculation for production orders is carried out properly, i. e., not with the standard prices from the material master. You can see a core integration aspect of the SAP ERP system at this point since production could not proceed without these controlling functions and vice versa.

3.2.1.1 Product Cost Calculation: Basis-Module

Firstly, carry out a product cost calculation for the semi-finished product **Basis-Module-xxyy**, since this is required for the product cost calculation of the Speedstar. Choose the following transaction:

Accounting → Controlling → Product Cost Controlling → Product Cost Planning → Material Costing → Cost Estimate with Quantity Structure → Create (CK11N)

1. In the **create cost estimate for material** dialog, enter the following data:

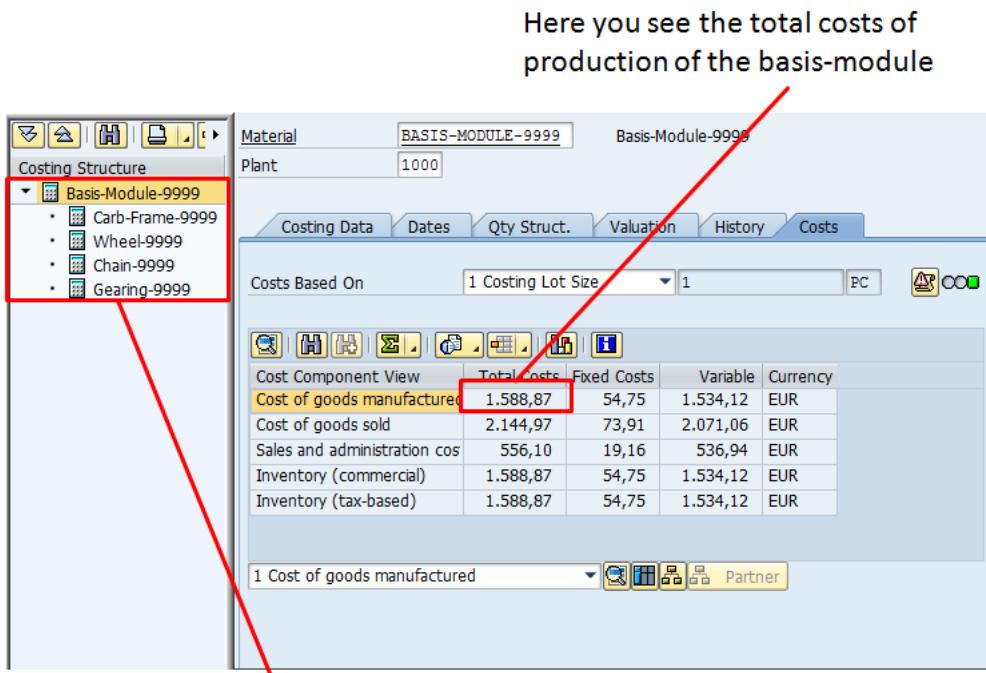
- Material	Basis-Module-xxyy
- Plant	1000
- Costing variant	PPC1 (standard costing Mat)
- Costing version	1 (TP PrCtr)
- Costing lot size	1
- Confirm with <i>Enter</i> .	
2. The system automatically goes to the next tab. Set the following date:

- Costing date from	current date
- Confirm with <i>Enter</i> .	

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 Euro are usual).



Here you see the costing structure of the basis-module. It should be equivalent to the BOM structure

Figure 30: 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 **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 in case of different numbers:

Caution

- 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 with the teaching unit 2.
- 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 with the teaching unit 2.

Rows indicated with „E“ refer to in-house production. Those rows hold costs caused by operations in the routing of the basis-module

Rows are read as follows (first row):
Work center 4210 allocates activity types 1420 and 1422 for 30 min. This activity costs 7,23 €

Item	T. Resource	Cost Element	Total Value	Fixed Value	COCr	Quantity	U. In
1	E 4210	1420 1422	625000	7,23	EUR	0,500	H
2	E 4210	1420	020000	0,00	EUR	0	H
3	E 4210	1420 1421	619000	0,00	EUR	0	H
4	M 1000 CARB-FRAME-9999		400000	750,00	0,00 EUR	1	PC
5	M 1000 WHEEL-9999		400000	200,00	0,00 EUR	2	PC
6	M 1000 CHAIN-9999		400000	75,00	0,00 EUR	1	PC
7	M 1000 GEARING-9999		410000	500,00	0,00 EUR	1	PC
8	E 4210	1420 1421	619000	0,00	EUR	0	H
9	E 4210	1420 1420	620000	5,00	4,08 EUR	0,250	H
10	E 4210	1420 1421	619000	33,68	28,33 EUR	0,750	H
11	E 4210	1420 1421	619000	0,00	0,00 EUR	0	H
12	E 4210	1420	620000	0,00	0,00 EUR	0	H
13	E 4210	1420 1421	619000	17,96	15,11 EUR	0,400	H
14	G 4130 655300		655300	0,00	0,00 EUR		
15	G 4130 655400		655400	0,00	0,00 EUR		
			1588,87	54,75	EUR		

Rows indicated with „M“ refer to the Materials in the BOM. Here the prices from the info records are taken into account

Figure 1: Product Cost Calculation: Itemization Basis-Module: SAP-System-Screenshot

In case of large variances, please contact your tutor.

- Save your calculation (or **CRTL-s**). In the next dialogue, choose itemization and log and confirm with *Enter*. The calculation is now saved. Leave the dialogue with or **SHIFT-F3**.

Price update: Before the cost estimation is set active as the current price, you must first mark the standard price in the material master and set the new estimate as future price. By using price updates, you can transfer the results of the product costing in the material master record. Update consists of two steps: marking and releasing.

- Therefore, call up the following transaction:

Accounting → Controlling → Product Cost Controlling → Product Cost Planning → Material costing → price update (transaction code: CK24)

- Enter the following data:

- **Posting period** *current month*(e. g. 8 for August)
- **Company Code** *1000*
- **Plant** *1000*
- **Material** *Basis-Module-xxyy*
- **With list output** *select*
- **Test run** *deselect*
- Execute the marking with the button (**execute**) or by pressing **F8**.

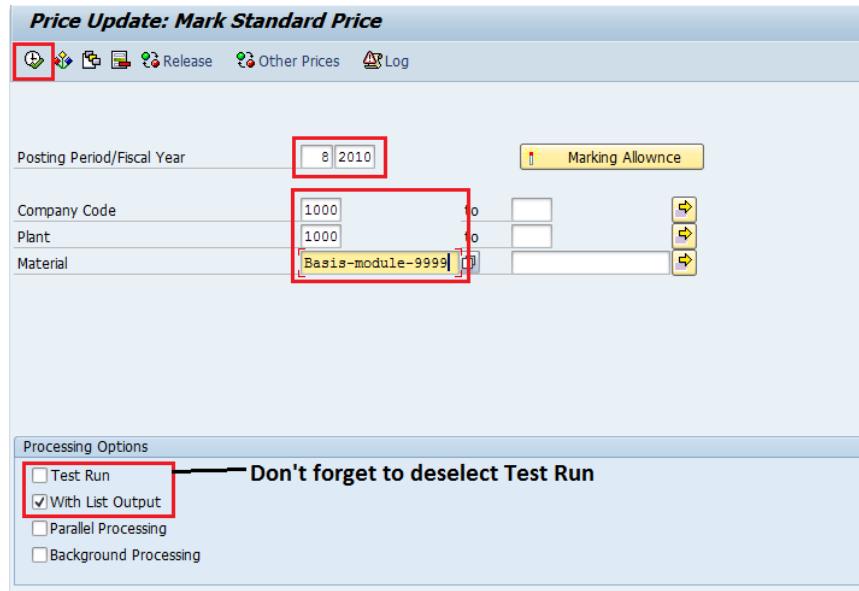


Figure 31: Mark Standard Price: SAP-System-Screenshot



In case the marking and posting is not allowed for the current period (i.e., you are the first one to carry out this operation in a month), you might receive the message in the status bar that you need to change your selection criteria or check your marking allowance. In this case, go back to the price update screen.

Select the marking allowance button (). Enter the current month as posting period. Select company code 1000 (IDES AG) with double-click. Select the costing variant **standard costing** and save your selection. The note “marking allowance issued” appears and you can go back to the price update screen to carry out step 4 again.

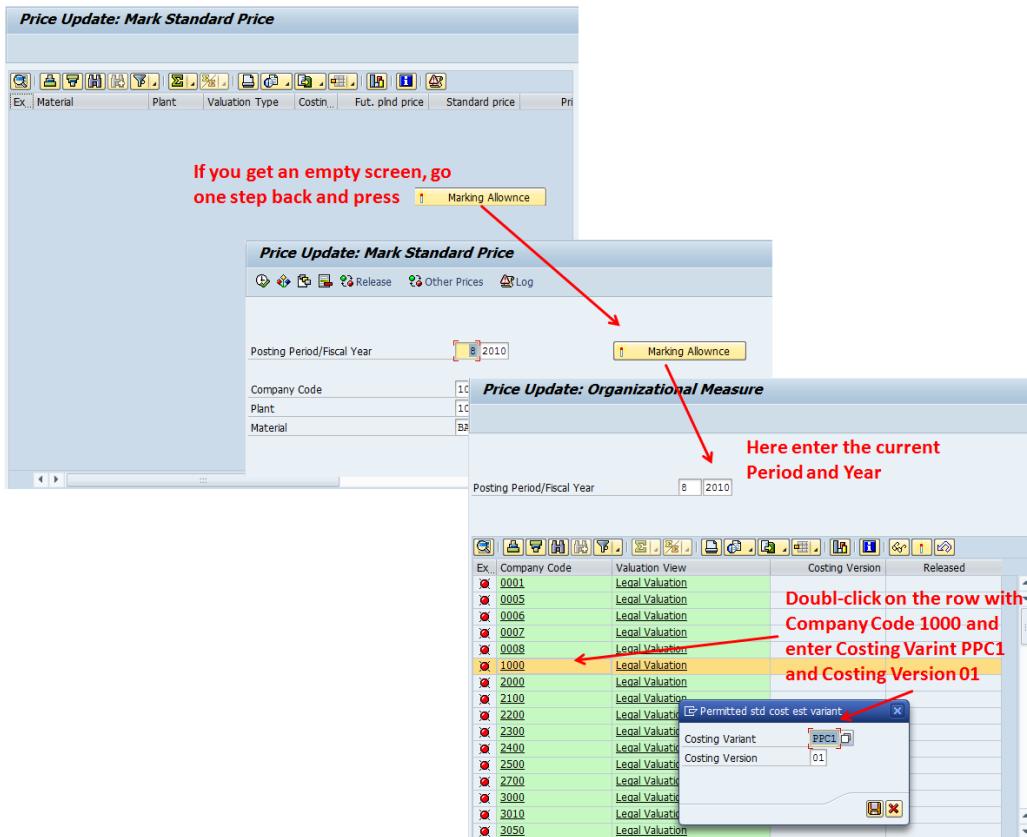


Figure 32: Setting Marking Allowance: SAP-System-Screenshot

6. When successfully completed, the following text is displayed: **of 1 materials, 1 cost estimates were updated successfully.** Leave the dialogue.

Price Update: Mark Standard Price							
	Ex... Material	Plant	Valuation Type	Costin...	Fut. plnd price	Standard price	Pr...
	BASIS-MODULE-9999	1000		VO	1.588,87	2.000,00	

Figure 33: 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, choose the following transaction:

Logistics → Materials Management → Material Master → Material → Display → Display Current (MM03)

1. Enter your material (**Basis-Module-xxxx**) and press *Enter*.
2. Select the **Costing 2** view and confirm the dialogue.
3. Enter **plant Hamburg (1000)**. Go to the next screen.

- In the **costing column planned price**, you can see the marking of the planned future price.

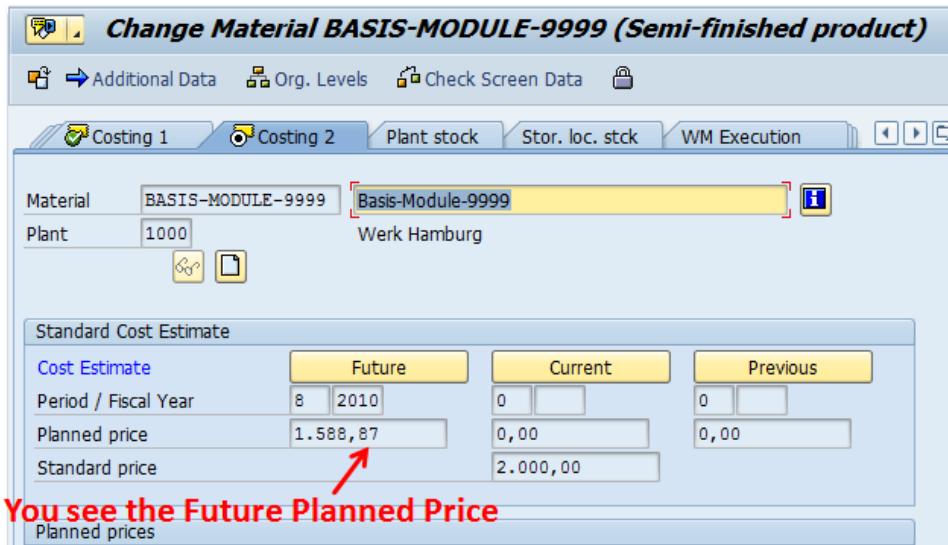


Figure 34: Future Planned Price updated in Material Master: SAP-System-Screenshot

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

Accounting → Controlling → Product Cost-Controlling Product Cost Planning → Material Costing → Price Update (CK24)

- Click the button.
- Enter the following data:
 - Posting period** *current month*(e. g. 8 for August)
 - Company Code** *1000*
 - Plant** *1000*
 - Material** *Basis-Module-xxyy*
 - With list output** *select*
 - Test run** *deselect*
- Execute the marking with the button (**execute**) or by pressing **F8**. 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".

Price Update: Release Standard Price							
Ex...	Material	Plant	Valuation Type	Costin...	Standard price	Price Unit	Currency
	BASIS-MODULE-9999	1000		FR	1.588,87	1	EUR

Figure 35: Released Standard Price: SAP-System-Screenshot

Take a closer look at the result of the release. Therefore, call again:

Logistics → Materials Management → Material Master → Material → Display → Display Current (MM03)

1. Enter your **material** (Basis-Module-xxxx) and select the **Costing 2** view. Continue with **Enter**.
2. Enter **plant Hamburg (1000)**. 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 400 € less than the previously entered 2000 €.

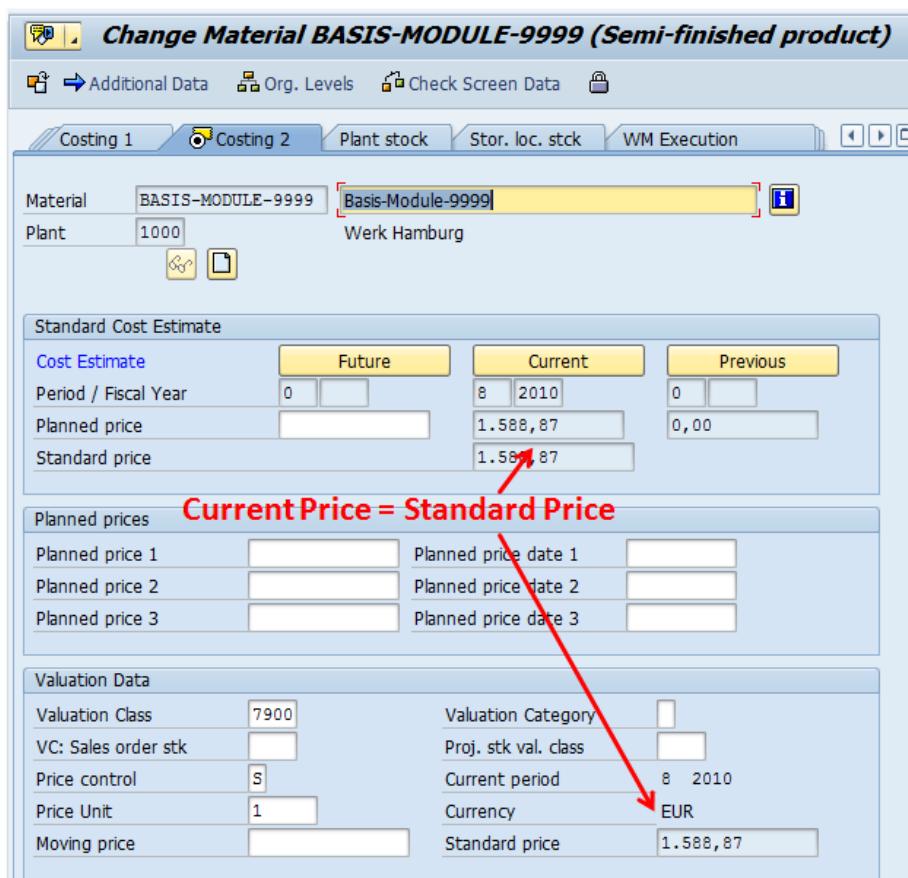


Figure 36: Result of the Price Update for the Basis-Module: SAP-System-Screenshot

3.2.1.2 Product Cost Calculation: Speedstar

Now, we need to carry out the same procedure for our finished product Speedstar. Therefore, call up the following transaction:

Accounting → Controlling → Product Cost Controlling → Product Cost Planning → Material Costing → Cost Estimate with Quantity Structure → Create (CK11N)

1. In the **create cost estimate for material** dialog, enter the following data:

- **Material** *Speedstar-xxyy*
- **Plant** *1000*
- **Costing variant** *PPC1 (standard costing Mat)*
- **Costing version** *1 (TP PrCtr)*
- **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 Euro are usual).

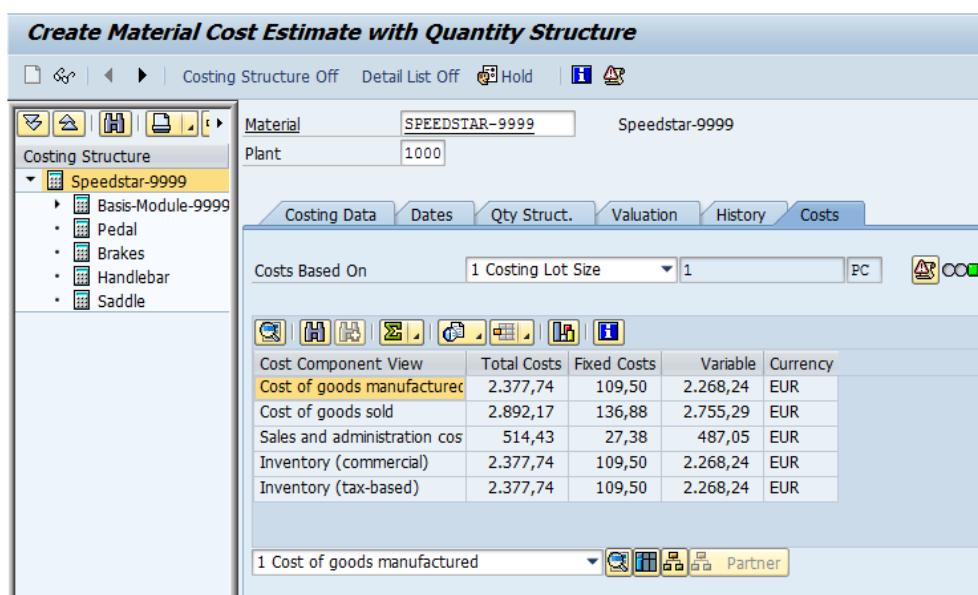


Figure 37: Product Cost Calculation Speedstar: SAP-System-Screenshot

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

Item...	I Resource	Cost Eleme	Σ	Total Value	Σ	Fixed Value	COCr	Quantity	Un
1	E 4210 1420 1422	625000		7,23		7,23	EUR	0,500	H
2	E 4210 1420 1420	620000		0,00		0,00	EUR	0	H
3	E 4210 1420 1421	619000		0,00		0,00	EUR	0	H
4	M 1000 BASIS-MODULE-9999	890000		1.588,87		54,75	EUR	1	PC
5	E 4210 1420 1421	619000		0,00		0,00	EUR	0	H
6	E 4210 1420 1420	620000		5,00		4,08	EUR	0,250	H
7	E 4210 1420 1421	619000		33,68		28,33	EUR	0,750	H
8	M 1000 PEDAL	400000		150,00		0,00	EUR	2	PC
9	M 1000 BRAKES	400000		300,00		0,00	EUR	2	PC
10	M 1000 HANDLEBAR	400000		125,00		0,00	EUR	1	PC
11	M 1000 SADDLE	400000		150,00		0,00	EUR	1	PC
12	E 4210 1420 1421	619000		0,00		0,00	EUR	0	H
13	E 4210 1420 1420	620000		0,00		0,00	EUR	0	H
14	E 4210 1420 1421	619000		17,96		15,11	EUR	0,400	H
15	G 4130 655300	655300		0,00		0,00	EUR		
16	G 4130 655400	655400		0,00		0,00	EUR		
						2.377,74		109,50	EUR

Figure 38: Product Cost Calculation: Itemization Speedstar: SAP-System-Screenshot

In case of large variances, please contact your tutor.

- Save your calculation (or **CRTL-s**). In the next dialogue, choose **itemization** and **log** and confirm with *Enter*. The calculation is now saved. Leave the dialogue with or **SHIFT-F3**.

Price update: Before the cost estimation is set active as the current price, you must first mark the standard price in the material master and set the new estimate as future price. 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:

Accounting → Controlling → Product Cost Controlling → Product Cost Planning → Material costing → price update (transaction code: CK24)

- Enter the following data:

- Posting period	current month (e.g., 8 for August)
- Company Code	1000
- Plant	1000
- Material	Speedstar -xxyy
- With list output	select
- Test run	deselect
- Execute the marking with the button (execute) or by pressing F8 .	
- When successfully completed, the following text is displayed: **of 1 materials, 1 cost estimates were updated successfully**. Leave the dialogue.

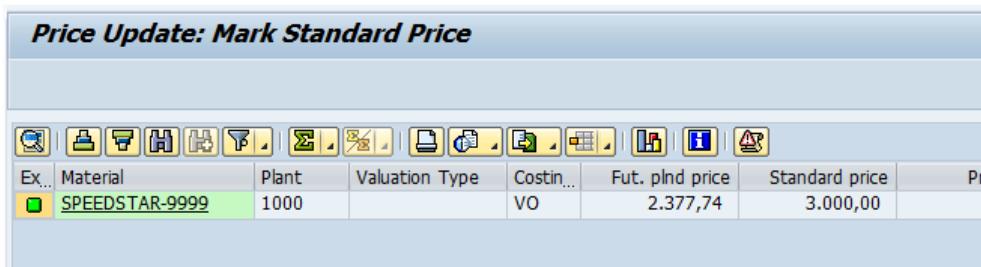


Figure 39: Future Planned Price: SAP-System-Screenshot

You can see the result of the marking in the material master of Speedstar. Look at the material master. Therefore, choose the following transaction:

Logistics → Materials Management → Material Master → Material → Display → Display Current (MM03)

1. Enter your material (**Speedstar-xxyy**) and press **Enter**.
2. Select the **Costing 2** view and confirm the dialogue.
3. Enter **plant Hamburg (1000)**. 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:

Accounting → Controlling → Product Cost-Controlling Product Cost Planning → Material Costing → Price Update (CK24)

1. Click the Release button.
2. Enter the following data:

- Posting period	current month (e.g., 8 for August)
- Company Code	1000
- Plant	1000
- Material	Speedstar-xxyy
- With list output	select
- Test run	deselect
3. Execute the marking with the button (**execute**) or by pressing **F8**. 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".
4. Take a closer look at the result of the release. Therefore, call again:

Logistics → Materials Management → Material Master → Material → Display → Display Current (MM03)

5. Enter your **material (Speedstar-xxyy)** and select the **Costing 2** view. Continue with **Enter**.
6. Enter **plant Hamburg (1000)**. Go to the next screen.

7. 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 600 € less than the previously entered 3.000 €.

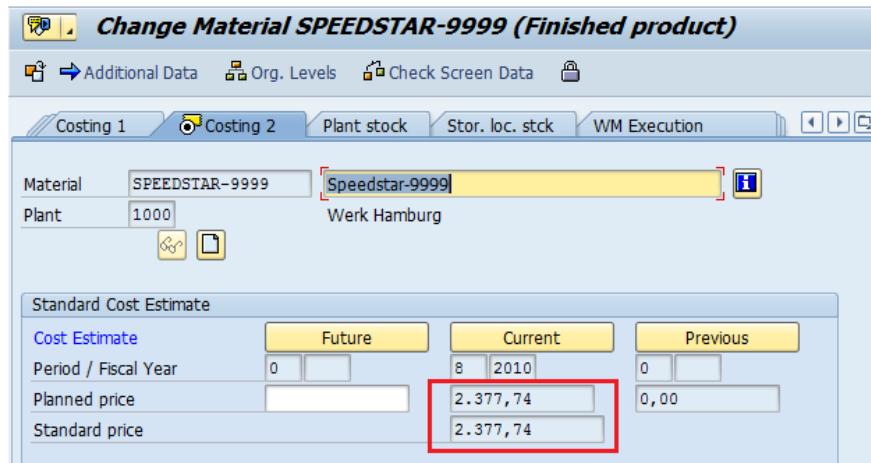


Figure 40: Result of the Price Update for Speedstar: SAP-System-Screenshot

3.2.1.3 Product Cost Calculation: Basis-Module2 and Speedstarlett

Carry out independently the product cost calculation firstly for Basis-Module 2 and then for the Speedstarlett in **exactly the same manner** as before. You have to complete the following steps:

1. Costing for Basis-Module2-xxyy: CK11n
2. Price update for Basis-Module2-xxyy: CK24
3. Releasing () the planned price for Basis-Module2-xxyy: CK24
4. Costing for Speedstarlett-xxyy: CK11n
5. Price update for Speedstarlett -xxyy: CK24
6. Releasing () the planned price for Speedstarlett -xxyy: CK24



Caution

In case you receive large variances in the total costs of goods manufactured field after completing costing (CK11n) to the values 1088 and 1877 € 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 in CK11n.

After completing step 1 you should get the following results:

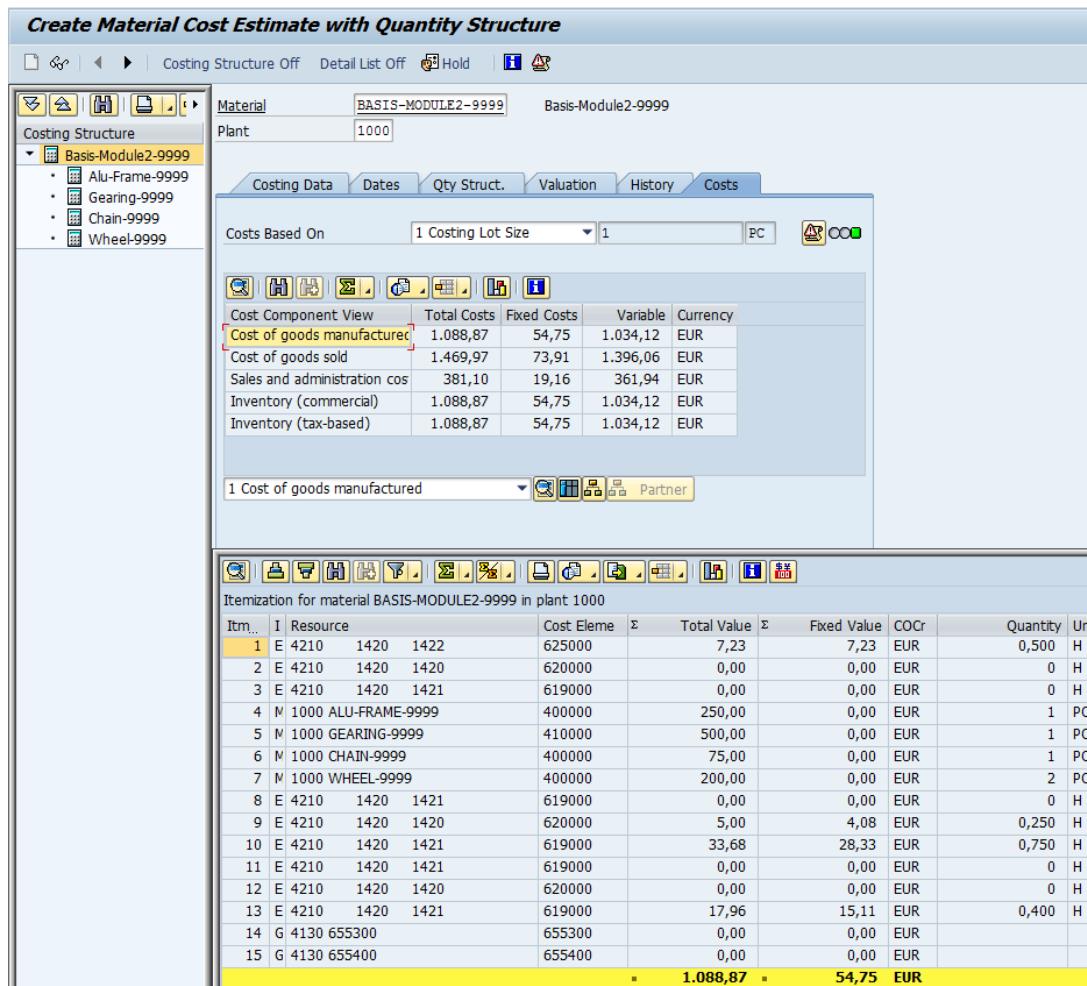


Figure 2: Estimate Basis-Module2: SAP-System-Screenshot

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

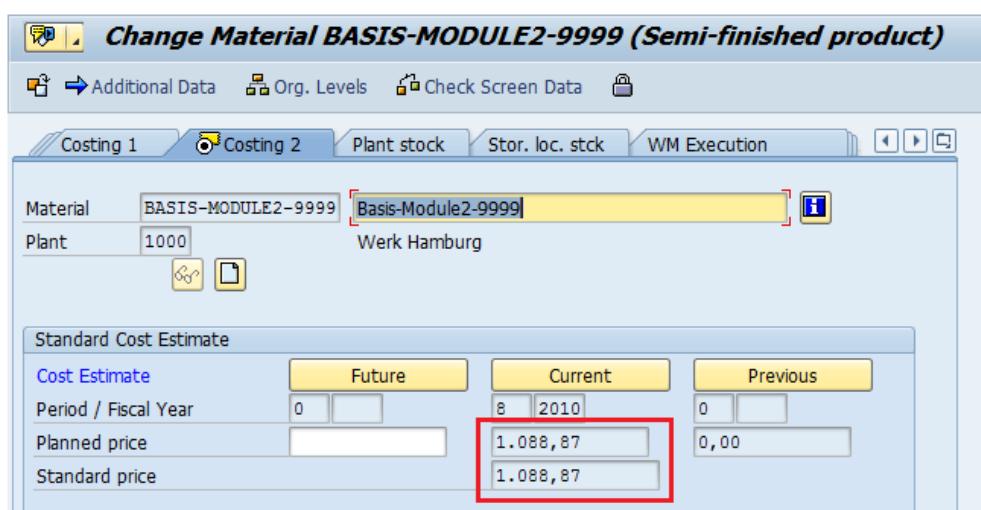


Figure 41: Standard Price Basis-Module2: SAP-System-Screenshot

After completing step 4 you should get the following results:

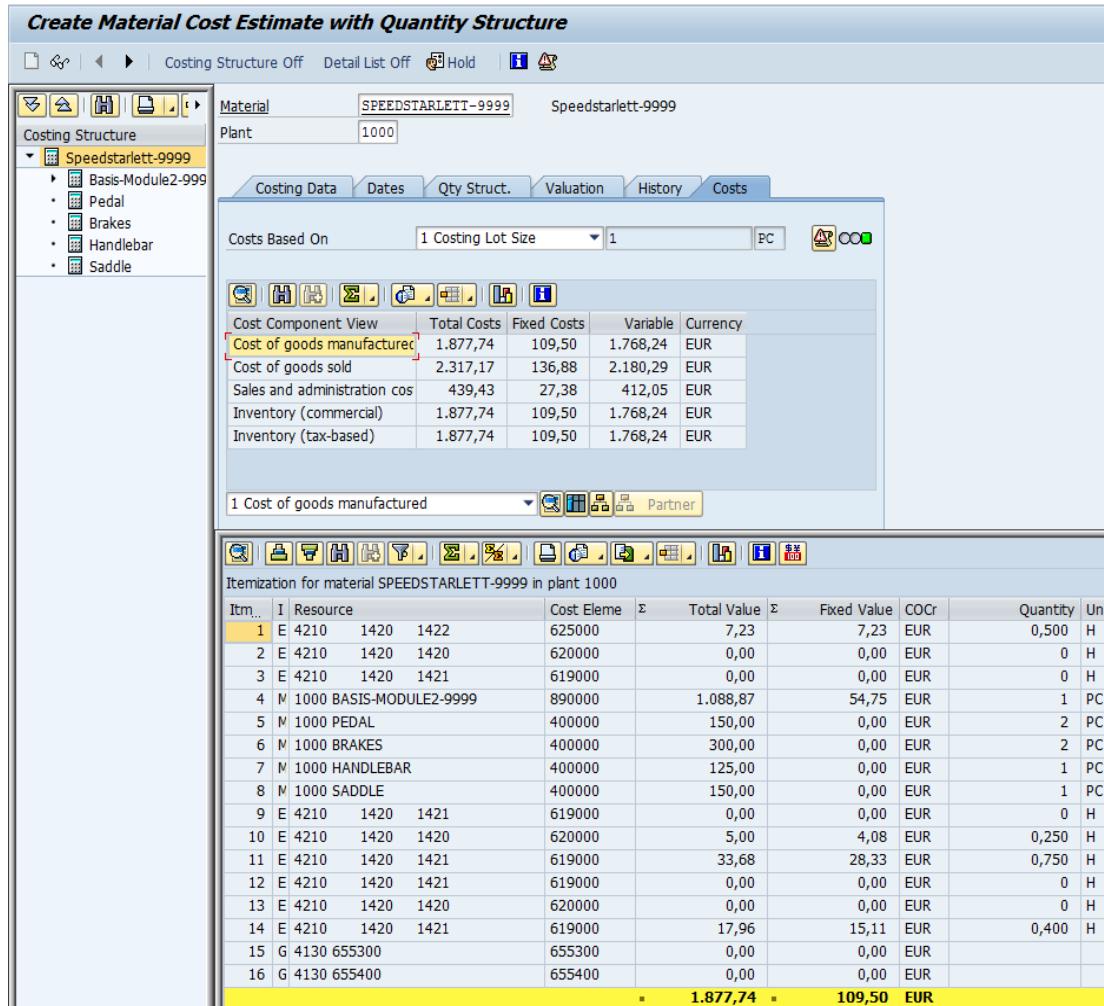


Figure 42: Estimate Speedstarlett: SAP-System-Screenshot

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

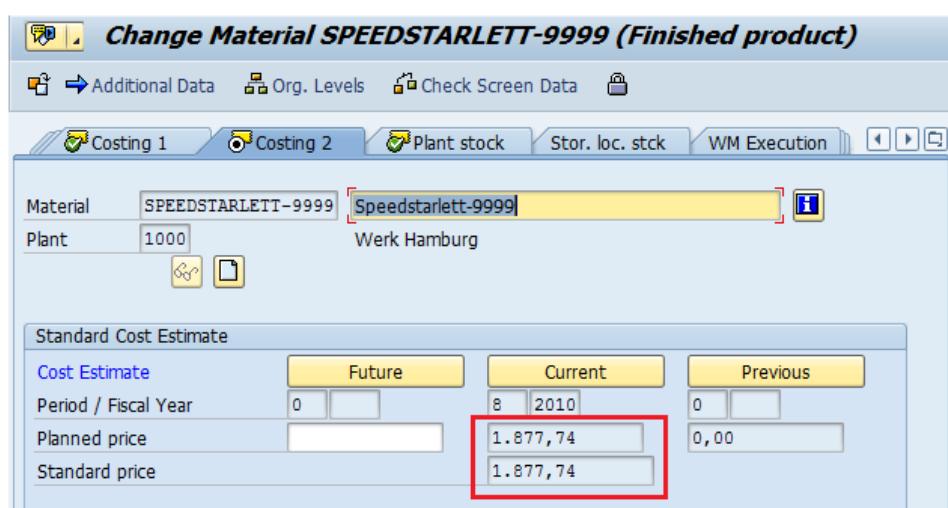


Figure 43: Price Speedstarlett: SAP-System-Screenshot

You can double-check your results in transaction MM60.

The screenshot shows two instances of the SAP Materials List screen. The left instance shows database selection fields like Material and Plant. The right instance shows a grid of material details including Material Description, Last Change, and Price. Red annotations highlight the 'Created by' field in the selection screen and the Price column in the grid.

Material	Plant	Val. Type	Material Description	Last Change	MTyp	Matl Group	Unit	PGr	ABC	Typ	ValCl	Pr.	Price	Crcy	/	Created by
ALU-FRAME-9999	1000		Alu-Frame-9999		ROH	020	PC	000	PD	3000	S	250,00	EUR	1	WIP-99-99	
BASIS-MODULE-9999	1000		Basis-Module-9999	22.08.2010	HALB		PC		PD	790	S	1.588,87	EUR	1	WIP-99-99	
BASIS-MODULE2-9999	1000		Basis-Module2-9999	22.08.2010	HALB		PC		PD	790	S	1.088,87	EUR	1	WIP-99-99	
CARB-FRAME-9999	1000		Carb-Frame-9999		ROH	020	PC	000	PD	3000	S	750,00	EUR	1	WIP-99-99	
CHAIN-9999	1000		Chain-9999		ROH	020	PC	000	PD	3000	S	75,00	EUR	1	WIP-99-99	
GEARING-9999	1000		Gearing-9999		HAWA	020	PC	000	PD	3100	S	200,00	EUR	1	WIP-99-99	
SPEEDSTAR-9999	1000		Speedstar-9999	22.08.2010	FERT		PC		PD	792	S	2.377,74	EUR	1	WIP-99-99	
SPEEDSTARLETT-9999	1000		Speedstarlett-9999	22.08.2010	FERT		PC		PD	792	S	1.877,74	EUR	1	WIP-99-99	
WHEEL-9999	1000		Wheel-9999		ROH	020	PC	000	PD	3000	S	100,00	EUR	1	WIP-99-99	

Figure 44: 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 1588,87
- Speedstar from 3000 to 2377,74
- Basis-module2 from 1500 to 1088,87
- Speedstarlett from 2500 to 1877,74

We now have completed the controlling excursion and you will go back to manufacturing execution at this point.

3.2.2 Update MRP

You note that the construction department changed the routing for the Speedstar. Since you completed MRP (unit material planning) with the old data, you need to carry out MRP again as there were changes to the routing. Thereby, you need to use **planning mode 2 – re-explode BOM and routing**.



Figure 45: Process overview: Material Requirements Planning

Call up the following transaction:

Logistics → Production → MRP → Planning → Single-Item, Multi-Level (MD02)

Enter material **Speedstar-xxyy** and plant **1000**. Use the following data:

	NETCH
- Processing key	3 (!)
- Create purchase req.	3
- Delivery schedules	1
- Create MRP list	1
- Planning mode	2(!)
- Scheduling	1
- Also plan unchanged components	<i>deselect</i>
- Display results before they are saved	<i>deselect</i>
- Display material list	<i>deselect</i>
- Simulation mode	<i>deselect</i>

Execute the MRP run (Press *Enter* twice).

3.2.3 Production of the Speedstar

Now that all preliminary steps (creating product structure, costing, carrying out MRP) are completed, the production of the Speedstar takes place. In this section, the simplified production of the Speedstar is carried out. Therefore, you will firstly check which materials are required for the production of the Speedstar and you will carry out the required orders. After posting the goods receipt of the components required for production and after making components available from stock, the production department can carry out the production process.

The following steps must be completed:

- check MRP status
- create production order
- order components
- goods receipt of required components
- goods issue to production
- confirm production order
- goods receipt in warehouse

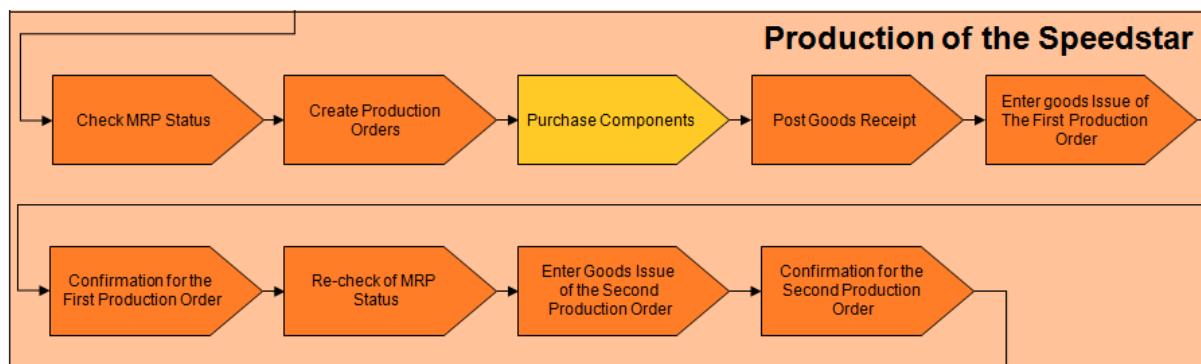


Figure 46: Process overview: Production of the Speedstar

3.2.3.1 Check MRP Status

Briefly check the MRP status. You are already familiar with MRP in SAP ERP from the material planning case study. 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 MRP status, call up the following transaction:

Logistics → Production → MRP → Evaluations → Stock/Requirements List (MD04)

1. Enter **material Speedstar (Speedstar-xxyy)** and **plant Hamburg (1000)**. Confirm with *Enter*.
2. 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).
3. In addition, check the quantity stored of the components Basis-Module (**Basis-Module-xxyy**), gearing (**gearing-xxyy**), wheel (**wheel-xxyy**), chain (**chain-xxyy**) and frame (**carb-frame-xxyy**). You can see the planned orders here as well covering the dependent requirements (DepReq).
4. The other materials (breaks, pedals, handlebar, and saddle) are available from the warehouse in large unit quantities.

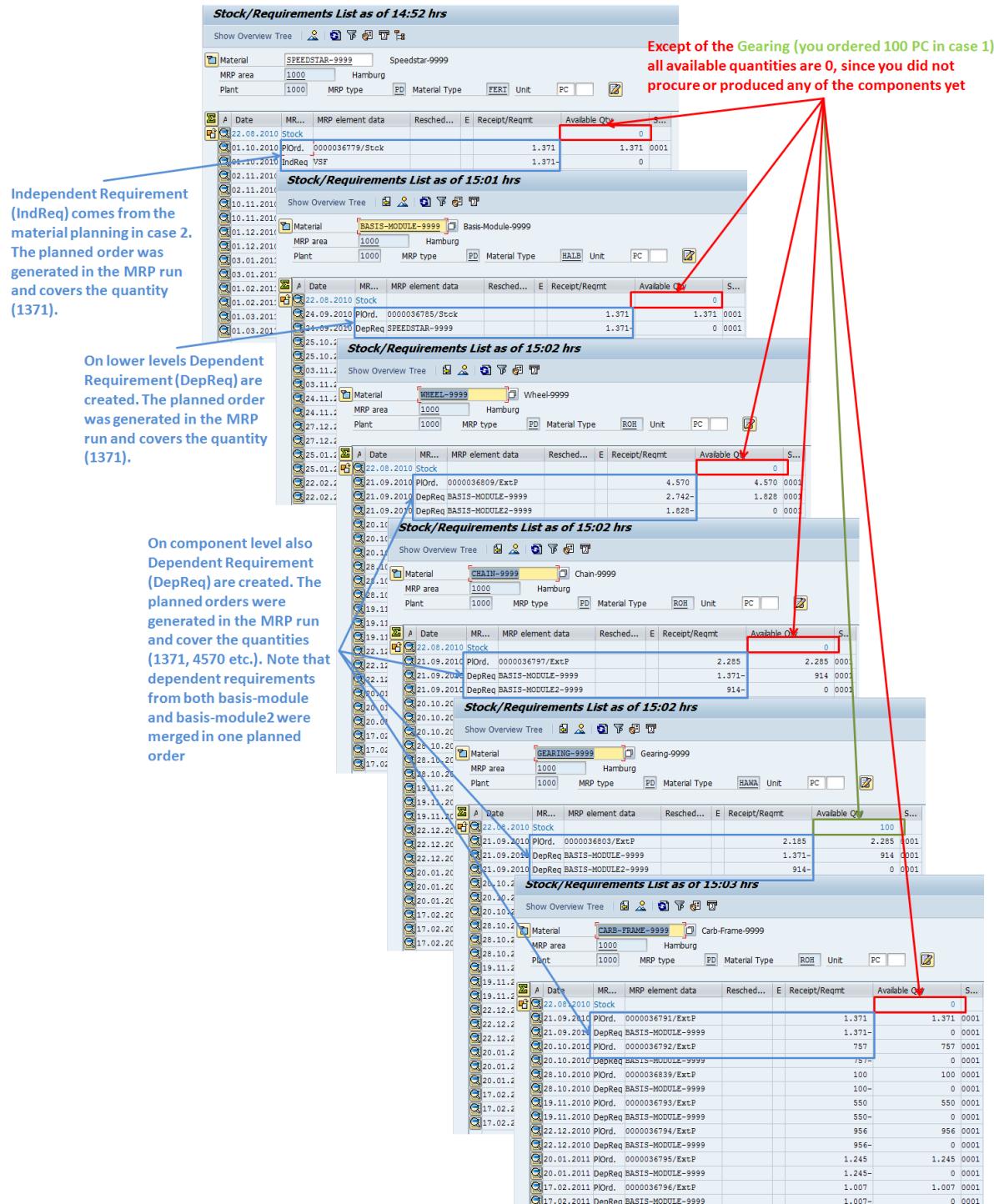


Figure 47: MRP Status: SAP-System-Screenshot

The management decided to produce the first planned order of the Speedstar (in case of the figures here that is 1371 units) and to keep them in stock. Your task as production manager and manufacturing execution manager is to convert planned orders into production orders.

3.2.3.2 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. 1371) into a production order.

Create Production Order for Basis-Module

Start with the Basis-Module and choose the following transaction:

Logistics → Production → MRP → Evaluations → Stock/Requirements List (MD04)

1. Select the **material Basis-Module (Basis-Module-xxxx)** and plant **Hamburg (1000)**. Choose **Enter**.
2. Double-click the row containing the first planned order (**PlOrd.**). This should be a planned order with a quantity of app. 1370 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 the **-> Prod.ord** button (**convert planned order into production order**).

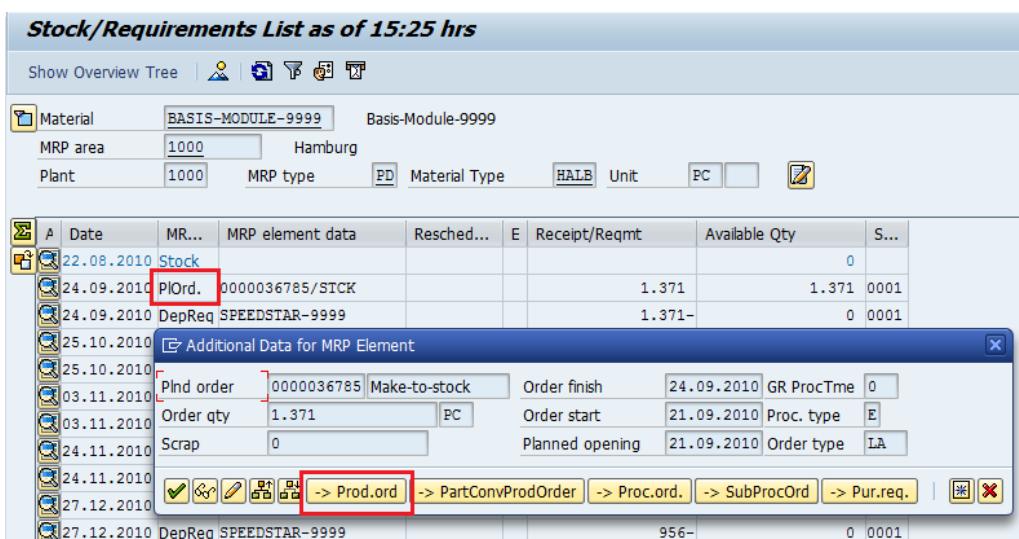


Figure 48: MRP Basis-Module: SAP-System-Screenshot

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 the available quantities of frames, wheels, chains, and gearings are not sufficient.

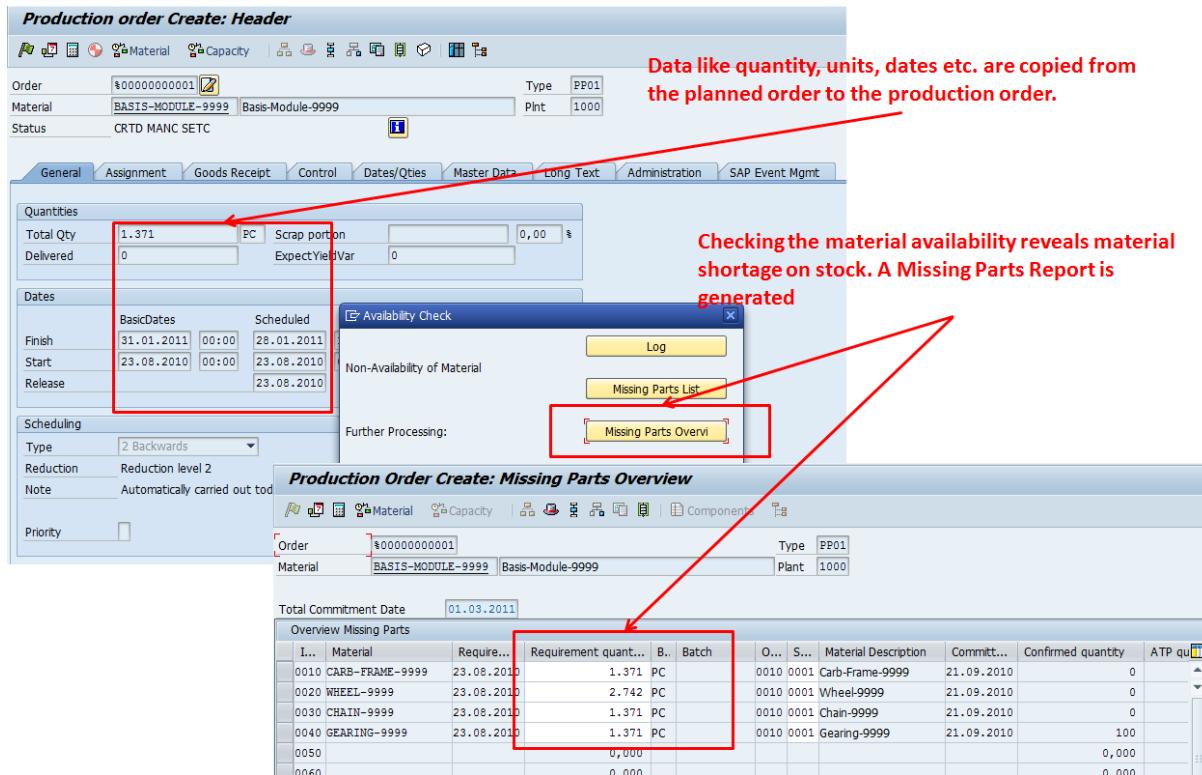


Figure 49: Create Production Order: Material Availability: SAP-System-Screenshot

6. After knowing that the available quantities of frames, wheels, chains, and gearings are not sufficient to produce the Basis-Module, choose the button to go back to the **Create production order: Header** screen.
7. Release the order (the order **status** is currently **CRTD** – created) by clicking the symbol. The system confirms the order release in the status bar. The order status changes to **REL** (released).

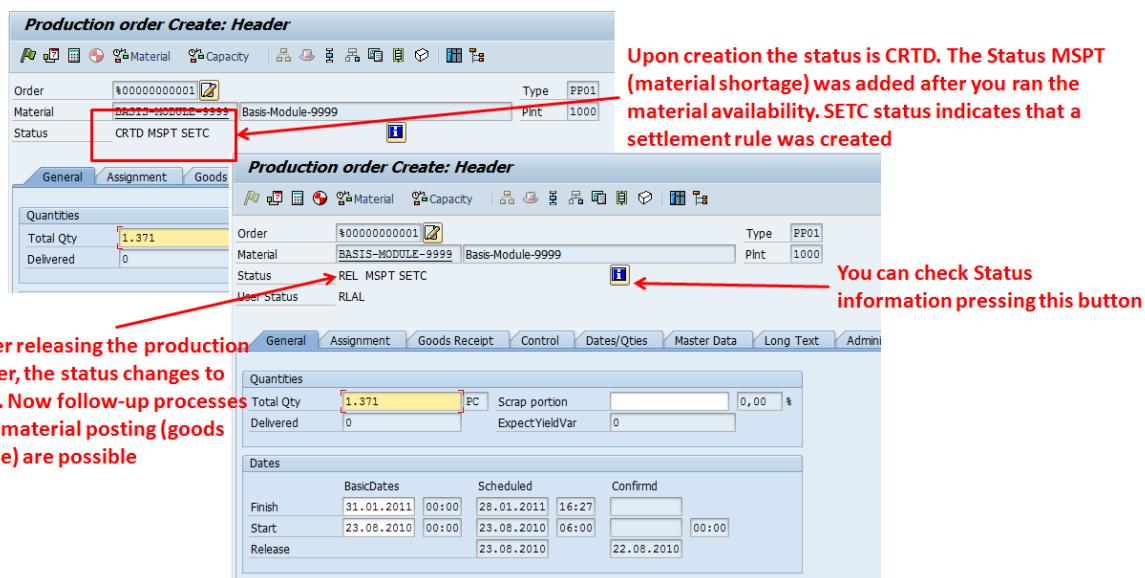


Figure 50: Create Production Order: Order Status: SAP-System-Screenshot

8. Save the order and list the order number:

Production order 1 (Basis-Module): _____

9. Return to the **stock/requirements list** screen (MD04). Update the list by clicking the  symbol. Instead of the planned order, the system displays the production order (**Prod.Ord.**)

Please 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.

Stock/Requirements List as of 15:41 hrs								
		Basis-Module-9999						
Material	BASIS-MODULE-9999	Basis-Module-9999						
MRP area	1000	Hamburg						
Plant	1000	MRP type	PD	Material Type	HALB	Unit	PC	
	A	Date	MR...	MRP element data	Resched...	E	Receipt/Reqmt	Available Qty
	22.08.2010	Stock						0
	24.09.2010	DepReq	SPEEDSTAR-9999				1.371-	1.371-0001
	25.10.2010	PIOrd.	0000036786/Stck	24.09.2010	30		757	614-0001
	25.10.2010	DepReq	SPEEDSTAR-9999				757-	1.371-0001
	03.11.2010	PIOrd.	0000036838/Stck	24.09.2010	30		100	1.271-0001
	03.11.2010	DepReq	SPEEDSTAR-9999				100-	1.371-0001
	24.11.2010	PIOrd.	0000036787/Stck	24.09.2010	30		550	821-0001
	24.11.2010	DepReq	SPEEDSTAR-9999				550-	1.371-0001
	27.12.2010	PIOrd.	0000036788/Stck	25.10.2010	30		956	415-0001
	27.12.2010	DepReq	SPEEDSTAR-9999				956-	1.371-0001
	25.01.2011	PIOrd.	0000036789/Stck				1.245	126-0001
	25.01.2011	DepReq	SPEEDSTAR-9999				1.245-	1.371-0001
	31.01.2011	PrdOrd	000060003505/PP01/Re				1.371	0 0001
	22.02.2011	PIOrd.	0000036790/Stck				1.007	1.007 0001
	22.02.2011	DepReq	SPEEDSTAR-9999				1.007-	0 0001

**Due to production capacities, the production process will take app. 4 month.
Note that in column MRP element the abbreviation changed from PIOrd to PrdOrd**

Figure 51: Production Order in Stock/Requirements List: SAP-System-Screenshot

Create Production Order for Speedstar

Next, create the second production order using the system-created planned order for the Speedstar. Again, call up the following transaction:

Logistics → Production → MRP → Evaluations → Stock/Requirements List (MD04)

1. Select the **material Speedstar (Speedstar-xxyy)** and plant **Hamburg (1000)**. Choose **Enter**.
2. Double-click the row containing the planned order (**PIOrd.**) with more than **1300 Speedstars**.
3. You can now see the **additional data for MRP element screen**. Click the **-> Prod.ord** button (**convert planned order into production order**). Ignore a possible **notification** regarding the Speedstar-xxyy document with “Yes”.

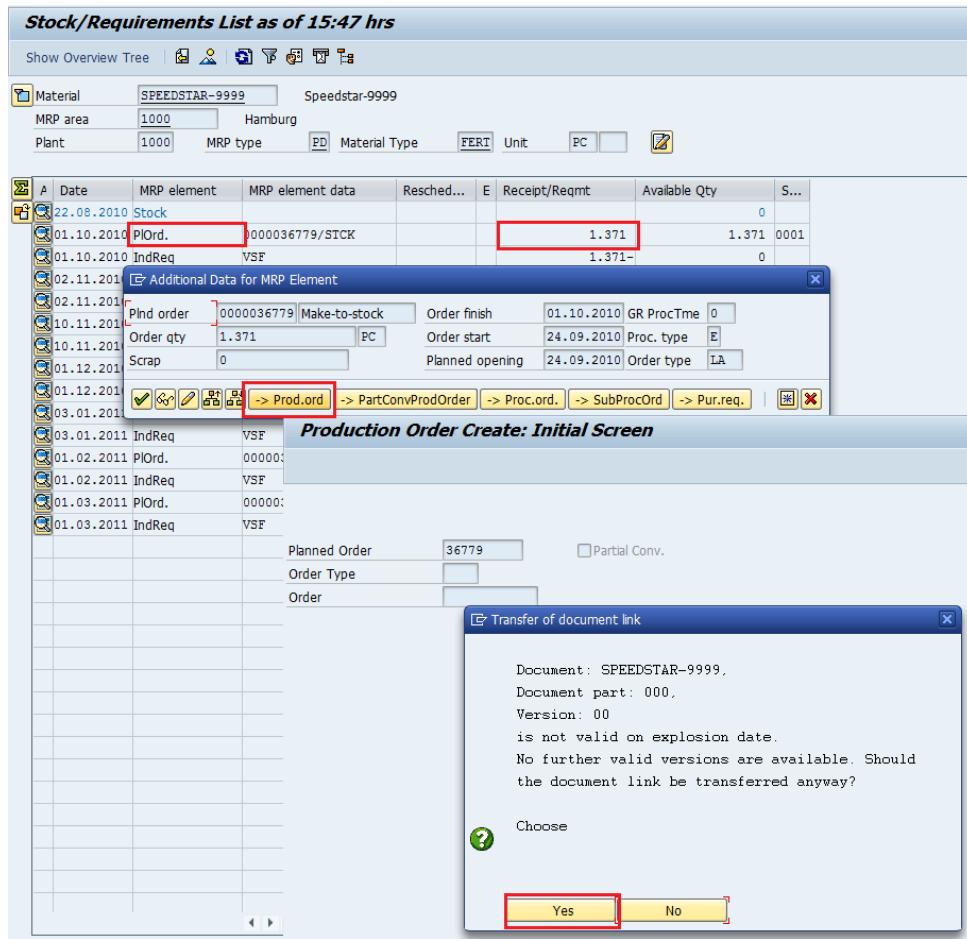


Figure 52: Production Order for Speedstar: SAP-System-Screenshot

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 symbol (**material**). Then, click the **missing parts overview button**.

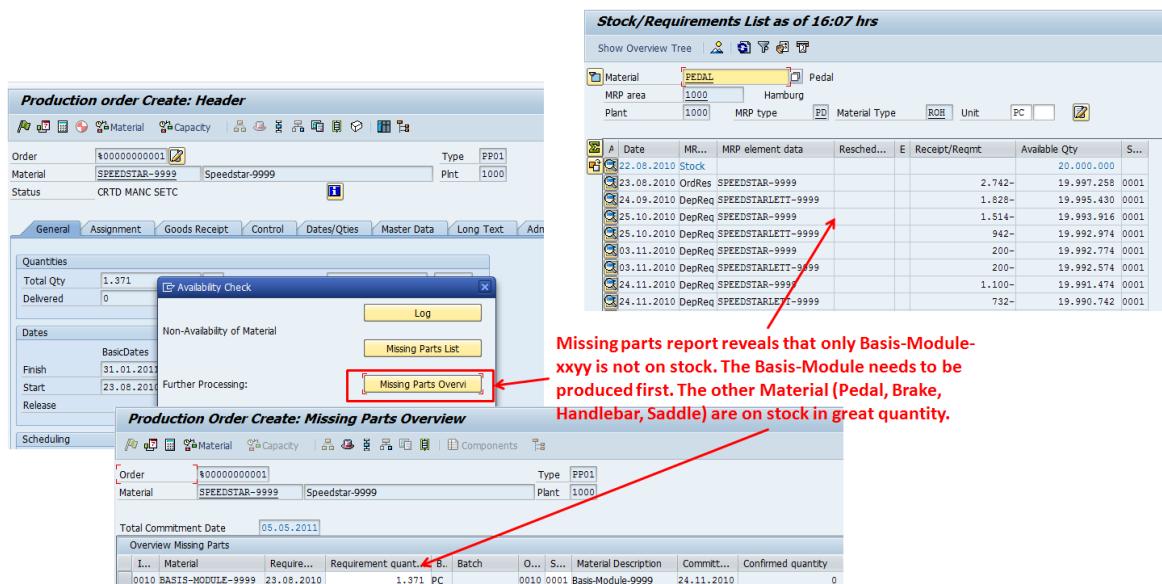


Figure 53: Missing Part Report: SAP-System-Screenshot

6. Choose the button to go back to the **Create production order: 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 clicking the button. You see the following figure with the materials from the BOM.

Here you see the BOM copied from the planned order into the production order. You can change the BOM here if necessary for your production process. Note that changes done here have no effect on the original BOM you created in CS01.



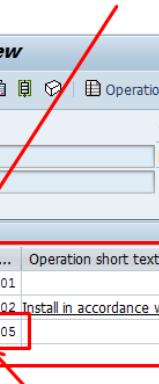
Production Order Create: Component Overview

Component Overview										Batch
1...	Component	Description	Reqmt Qty	U.	I.	O...	S...	P...	S...	Batch
0010	<u>BASIS-MODULE-9999</u>	Basis-Module-9999	1.371	PC	L	0010	0	1000	0001	
0020	<u>PEDAL</u>	Pedal	2.742	PC	L	0020	0	1000	0001	
0030	<u>BRAKES</u>	Brakes	2.742	PC	L	0020	0	1000	0001	
0040	<u>HANDLEBAR</u>	Handlebar	1.371	PC	L	0020	0	1000	0001	
0050	<u>SADDLE</u>	Saddle	1.371	PC	L	0020	0	1000	0001	
0060										

Figure 54: Component Overview Speedstar: SAP-System-Screenshot

8. Return to the previous screen and click the button to look at the operations from the routing.

Here you see the routing copied from the planned order into the production order. You can change the routing here if necessary for your production process. Note that changes done here have no effect on the original routing you created in CA01.



Production Order Create: Operation Overview

OperationOverview																
Op.	S...	Start	Start	Work ...	P...	C...	StdT...	Operation short text	T.	SysStatus	User Stat	C...	P...	TP	D.	End
0010		23.08.2010	06:00:00	1420	1000	PP01	P000001		<input type="checkbox"/>	CRTD	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	23.08.2010	
0020		23.08.2010	06:34:17	1420	1000	PP01	P000002	Install in accordance with...	<input checked="" type="checkbox"/>	CRTD	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	03.12.2010	
0030		03.12.2010	13:42:51	1420	1000	PP01	P000005		<input type="checkbox"/>	CRTD	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	28.01.2011	

The standard key P000005 causes the automatic goods receipt to stock after you completion (confirmation) of the production order. That is, after confirming the production order, you do not need to post goods receipt. The finished goods are transferred to stock automatically and a material document is generated.

Figure 55: Operations Overview Speedstar: SAP-System-Screenshot

9. Return () to the previous screen and release the order by clicking the symbol.
10. Save the order and list the order number:

Production order 2 (Speedstar): _____

11. Return to the **stock/requirements list** screen. Update the list by clicking the symbol. Instead of the planned order, the system displays the production order (**Prod.Ord.**).

3.2.3.3 Purchase Components

Apparently, you do not have a sufficient quantity of components to produce the Speedstar and the semi-finished product Basis-Module. Procure the components by **creating purchase orders**.

Purchase orders: Purchase orders for external procured components are also created with reference to the planned orders that were automatically generated by the MRP run. Now, you need to convert planned orders into purchase requisitions. Purchase requisitions contain all required information, for example, regarding the materials to order and the vendor. You maintained these data in the procurement process case study. After that, you will convert these purchase requisitions into purchase orders.

Create Purchase Order

To create a purchase order, you need to convert planned order to purchase requisition first. Choose once again the following transaction:

Logistics → Production → MRP → Evaluations → Stock/Requirements List (MD04)

1. Select the **material gearing (gearing-xxyy)** and **plant Hamburg (1000)**. Confirm with **Enter**.
2. You see the following situation illustrated in the following figure.

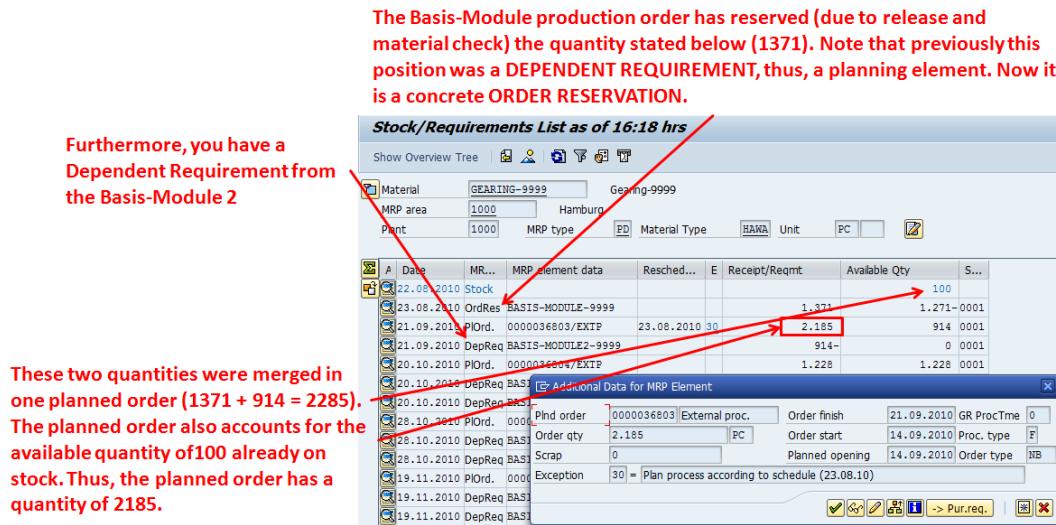


Figure 56: Create Purchase Requisition: SAP-System-Screenshot

Double-click the line containing the planned order with the same quantity in the received/required quantity column (approx. 2180) like your production order reservation for the Basis-Module and the dependent requirement for the Basis-Module 2.



Caution

Please bear in mind the following: Always pay attention to the quantities, in this unit and later in “unit 6 - sales order management”, 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 (wheel, breaks, 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.

Always pay attention to the available quantity of a component in MD04. 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 1300 Speedstars (according to your planning process) in contrast to the script, then 1300 Basis-Modules, 1300 gearings, 2600 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:

- 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 planned order, create a purchase requisition and change the number to 1200 in the purchase requisition. Then continue as described in the script.
- Convert several planned orders to purchase orders or production order to meet the required quantity or even exceed it. However, this is more complex!

3. You see the **additional data for MRP element screen**. Click the **Pur.Req.** (purchase requisition) button to create a purchase order from the purchase requisition.

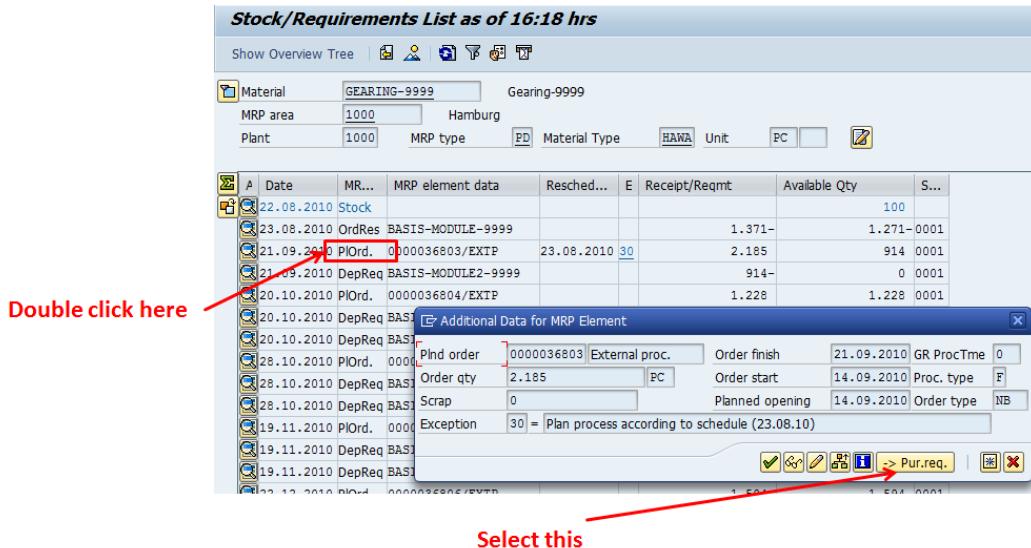


Figure 57: Create purchase requisition: SAP-System-Screenshot

4. You can see that the purchase requisition already contains vendor data. Additionally, the system copied the quantity from the planned order. This quantity refers to the demand of Speedstar and Speedstarlett (resp. Basis-Module and Basis-Module2).

The screenshot shows the 'Convert Planned Order into Purch. Req.: Details' dialog box. The 'Purchase requisition data' section is the active tab. It contains fields for Purchase requisition (set to 2.185), MRP Area (1000), Plant (1000), and Delivery date (21.09.2010). A red box highlights the 'Converted quantity' field. Other sections visible include 'Planned order data' and 'Reference Options'.

Figure 58: Create Purchase Requisition: SAP-System-Screenshot

5. Since you also want to assemble the Speedstarlett later (and, thus, will need more components than for the Speedstar only), confirm the purchase requisition (and the

quantity) by clicking **save**. List the number of the purchase requisition on your data sheet.

Purchase requisition gearing: _____

6. Choose the  button to update the MRP list. You can see that the planned order was converted into purchase requisition.
7. Now, double-click the purchase requisition and select the **purchase order button** to convert the purchase requisition into a purchase order.

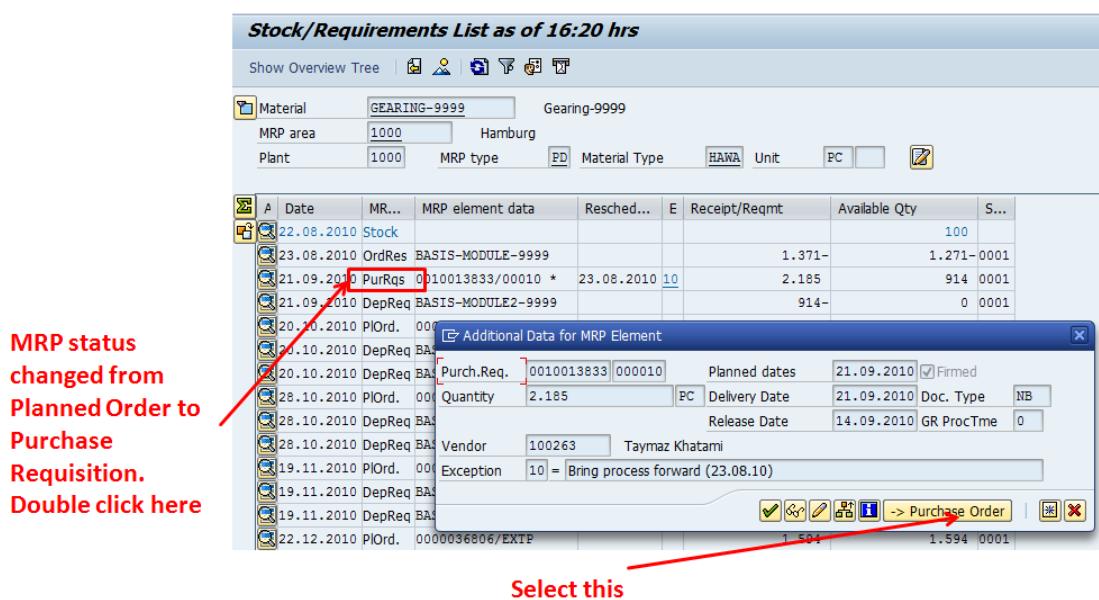


Figure 59: Create Purchase Order: SAP-System-Screenshot



Now, you can see the **create purchase order screen** which you already know from the procurement case study. 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 you like.

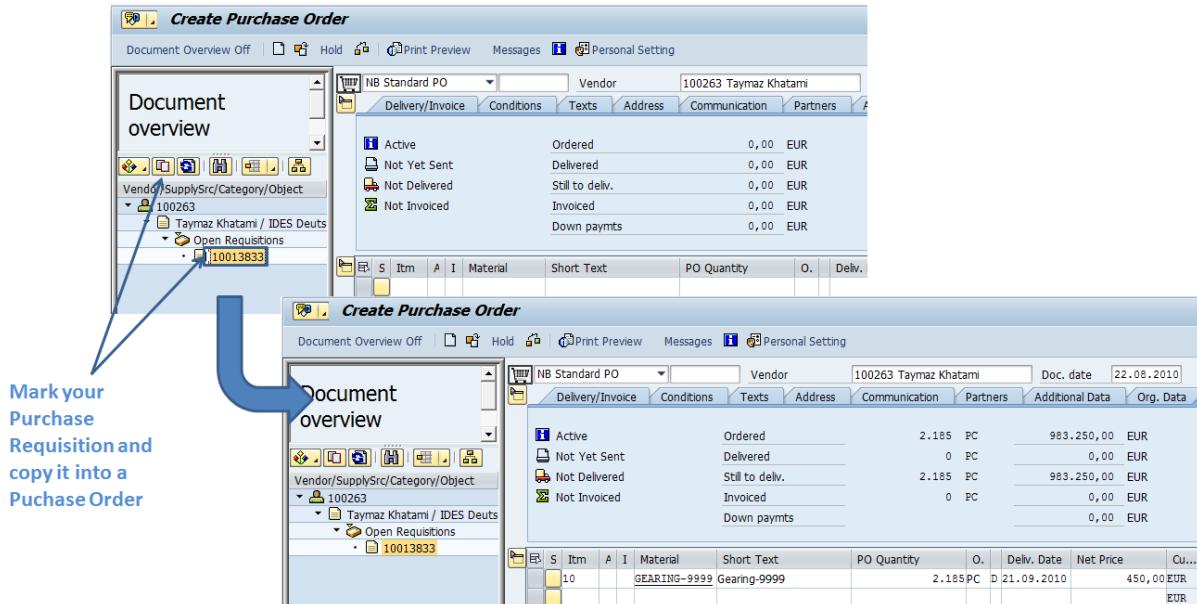


Figure 60: Create Purchase Order: SAP-System-Screenshot

8. On the **create purchase order** screen, select the number of the open purchase requisitions (on the left hand side below the document overview window) and click the button (**copy**) in the left window. As a result of this, the detailed data from the purchase requisition is copied to the new **purchase order**.
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).
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 symbol. The purchase requisition (Pur.Req.) is converted to a purchase order delivery schedule line (POItem). Click on the button.

MRP status changed to PchOrd (Purchase Order)

If you did not noted the number of your Purchasing Order, you can retrieve it here.

Stock/Requirements List as of 16:22 hrs																																																																						
Material		GEARING-9999	Gearing-9999	Plant		1000	Hamburg	MRP type																																																														
MRP area		1000		MRP type		PD	Material Type	HAWA Unit																																																														
Plant		1000		PC		PC																																																																
<table border="1"> <thead> <tr> <th>A</th><th>Date</th><th>MR...</th><th>MRP element data</th><th>Resched...</th><th>E</th><th>Receipt/Reqmt</th><th>Available Qty</th><th>S...</th></tr> </thead> <tbody> <tr> <td></td><td>22.08.2010</td><td>Stock</td><td></td><td></td><td></td><td></td><td>100</td><td></td></tr> <tr> <td></td><td>23.08.2010</td><td>OrdRes</td><td>BASIS-MODULE-9999</td><td></td><td></td><td>1.371-</td><td>1.271-0001</td><td></td></tr> <tr> <td></td><td>21.09.2010</td><td>PchOrd</td><td>4500017329/00010</td><td>23.08.2010 10</td><td></td><td>2.185</td><td>914 0001</td><td></td></tr> <tr> <td></td><td>21.09.2010</td><td>DepReq</td><td>BASIS-MODULE2-9999</td><td></td><td></td><td>914-</td><td>0 0001</td><td></td></tr> <tr> <td></td><td>20.10.2010</td><td>PlOrd.</td><td>0000036804/ExtP</td><td></td><td></td><td>1.228</td><td>1.228 0001</td><td></td></tr> <tr> <td></td><td>20.10.2010</td><td>DepReq</td><td>BASIS-MODULE-9999</td><td></td><td></td><td>757-</td><td>471 0001</td><td></td></tr> </tbody> </table>								A	Date	MR...	MRP element data	Resched...	E	Receipt/Reqmt	Available Qty	S...		22.08.2010	Stock					100			23.08.2010	OrdRes	BASIS-MODULE-9999			1.371-	1.271-0001			21.09.2010	PchOrd	4500017329/00010	23.08.2010 10		2.185	914 0001			21.09.2010	DepReq	BASIS-MODULE2-9999			914-	0 0001			20.10.2010	PlOrd.	0000036804/ExtP			1.228	1.228 0001			20.10.2010	DepReq	BASIS-MODULE-9999			757-	471 0001	
A	Date	MR...	MRP element data	Resched...	E	Receipt/Reqmt	Available Qty	S...																																																														
	22.08.2010	Stock					100																																																															
	23.08.2010	OrdRes	BASIS-MODULE-9999			1.371-	1.271-0001																																																															
	21.09.2010	PchOrd	4500017329/00010	23.08.2010 10		2.185	914 0001																																																															
	21.09.2010	DepReq	BASIS-MODULE2-9999			914-	0 0001																																																															
	20.10.2010	PlOrd.	0000036804/ExtP			1.228	1.228 0001																																																															
	20.10.2010	DepReq	BASIS-MODULE-9999			757-	471 0001																																																															

Figure 61: Purchase Order in Stock/Requirements List: SAP-System-Screenshot

12. Repeat steps 1 – 11 for the other materials and list the respective numbers on your data sheet.

Purchase requisition wheel: _____

Standard purchase order wheel: _____

Purchase requisition chain: _____

Standard purchase order chain: _____

Purchase requisition carb-frame: _____

Standard purchase order carb-frame: _____

If you did everything correctly, you should have the following three 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!

Stock/Requirements List as of 17:27 hrs											
Material		CARB-FRAME-9999	Carb-Frame-9999								
MRP area	1000	Hamburg	Plant	1000	MRP type	PD	Material Type	ROH	Unit	PC	
Stock/Requirements List as of 17:26 hrs											
Material		WHEEL-9999	Wheel-9999								
MRP area	1000	Hamburg	Plant	1000	MRP type	PD	Material Type	ROH	Unit	PC	
Stock/Requirements List as of 17:26 hrs											
Material		CHAIN-9999	Chain-9999								
MRP area	1000	Hamburg	Plant	1000	MRP type	PD	Material Type	ROH	Unit	PC	
Stock/Requirements List as of 17:26 hrs											

Figure 62: 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.

3.2.3.4 Post Goods Receipt

To simplify the case study, the vendor delivers the ordered goods at the same day. Post the goods receipt and goods issue regarding the four created purchase orders.

Enter goods receipt for purchase order

Call up the following transaction

Logistics → Materials Management → Inventory Management → Goods Movement → Goods Receipt → For Purchase Order → PO Number Known (MIGO)

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-xxyy) in the field on the right hand side of the drop-down menu. Press *Enter*.

3. The system proposes goods receipt quantities according to the purchase order. Enter * in the delivery note field. Select the **position ok** field on the lower part of the screen to mark the goods receipt document as checked. *Save*.

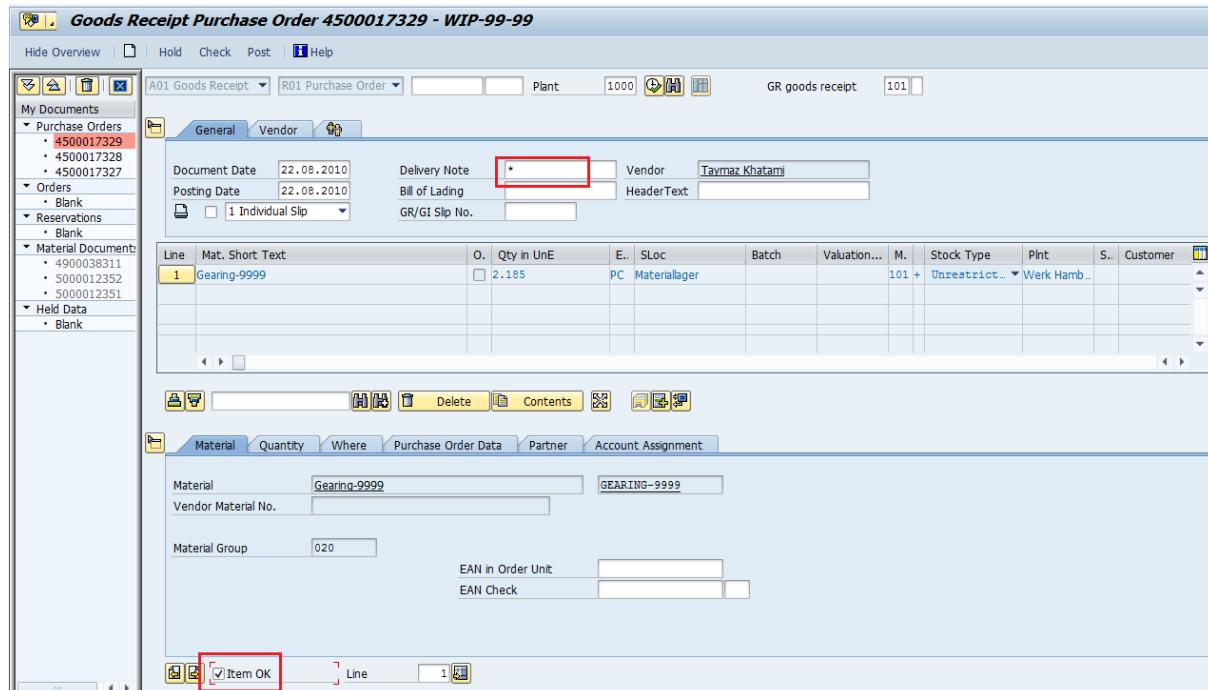


Figure 63: Post Goods Receipt: SAP-System-Screenshot

4. List the document number goods receipt.

Document 1 for gearing: _____

5. Carry out the same steps for the other materials.

Document 2 for wheel: _____

Document 3 for chain: _____

Document 4 for carb-frame: _____

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 transaction **MD04** and look at the goods you just received (gearing, wheel, carb-frame, chain). You can see that the quantities received are listed in the first line of the **available quantity** column.

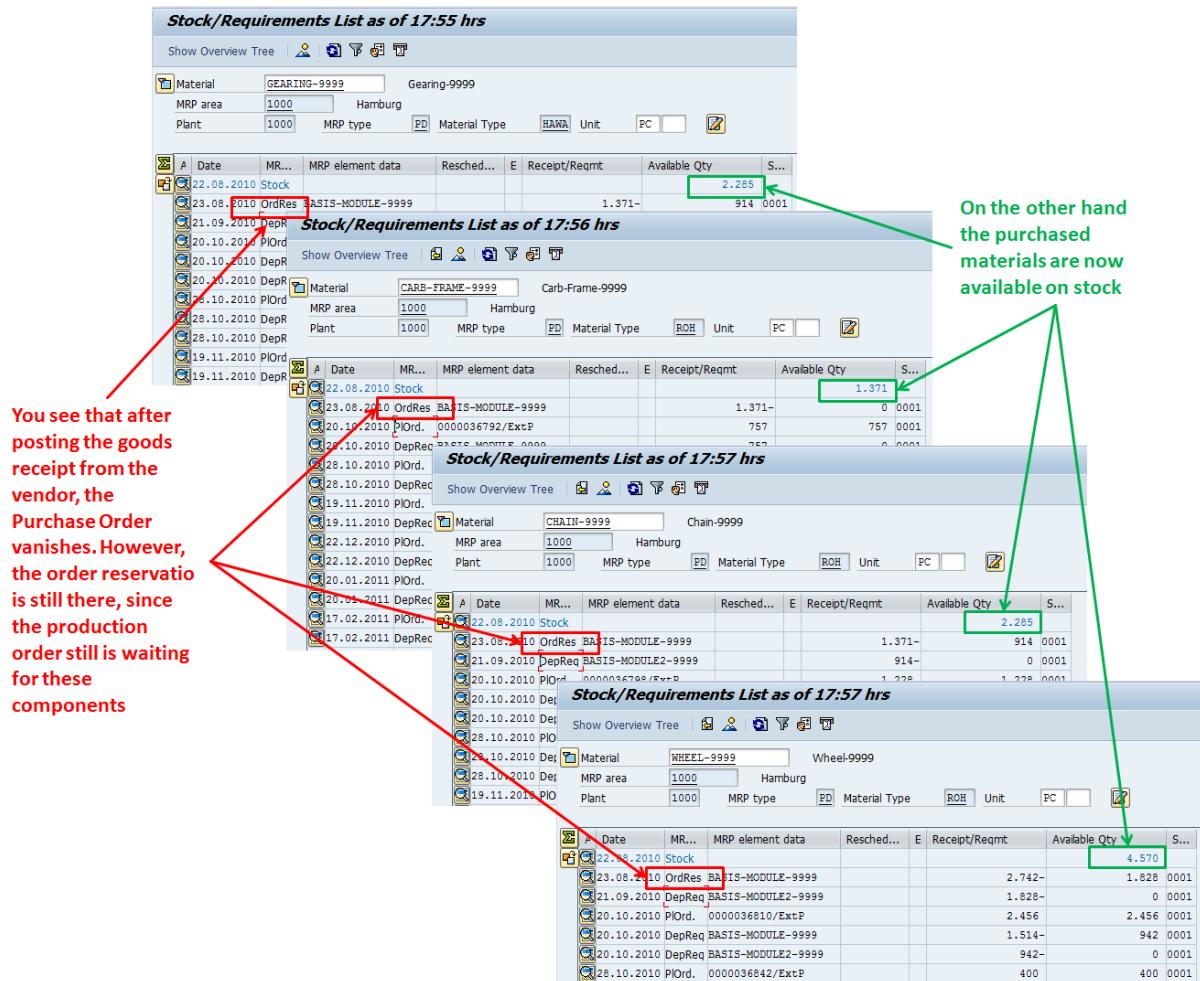


Figure 64: Available Quantities after Goods Receipt: SAP-System-Screenshot

3.2.3.5 Enter Goods Issue of 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). Call up the following transaction:

Logistics → Materials Management → Inventory Management → Goods Movement → Goods Issue (MB1A)

1. Click the **To Order...** symbol (**To Order**).
2. Enter the **number of the first production order (Basis-Module)** in the **order column**. Confirm with *Enter*.

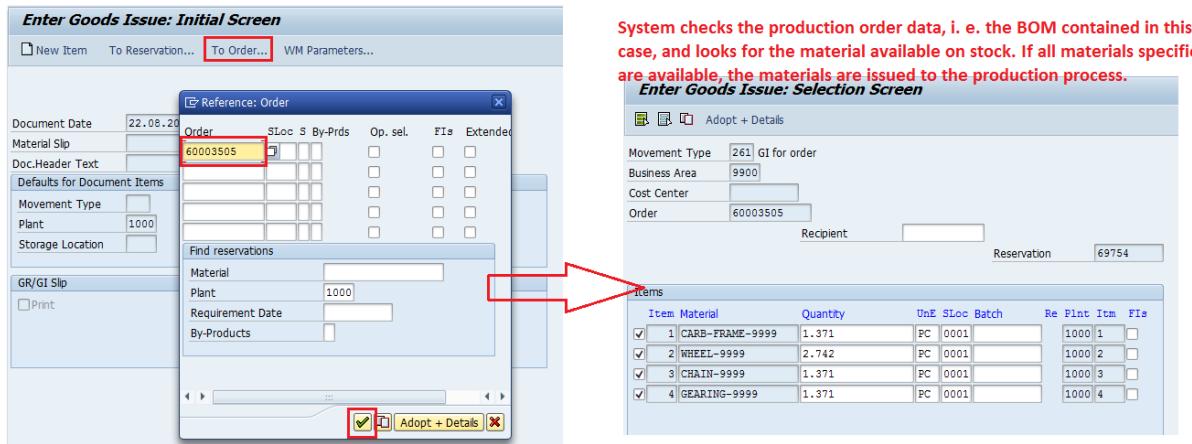


Figure 65: Post Goods Issue: SAP-System-Screenshot

3. The system proposes the four correct material positions. *Save* and list the document number.

Document (Basis-Module): _____

3.2.3.6 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 1420** 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, call up:

Logistics → Production → Shop Floor Control → Confirmation → Enter → For Order (CO15)

1. In the **order field**, enter *the number of the production order for the Basis-Module*. Press *Enter*.
2. Select the confirmation type *final confirmation*.

3. Click the “**goods movement**“-button and make sure that the storage location is **storage 0001**.

The figure consists of two screenshots from SAP. The left screenshot shows the 'Confirmation of Production Order Enter : Actual Data' screen. It includes fields for Order (60003505), Status (REL MSPT PRC GMPS SETC), Material Number (BASIS-MODULE-9999), and Current to Confirm (1.371). A red box highlights the 'Goods Movements' button. The right screenshot shows the 'Confirmation of Production Order Enter : Goods Movements' screen, displaying a table of goods movements. A red arrow points from the 'Goods Movements' button on the left screen to the 'Storage' column in the table on the right, which shows '0001' for the first row.

Material	Quantity	U.	P...	S...	Batch	Valuation...	D.	M.	S
BASIS-MODULE-9999	1.371	PC	1000	0001					101

Figure 66: Confirm Production Order: SAP-System-Screenshot

4. Since the selected operation is marked as mile stone in the routing, this confirmation automatically confirms all previous steps as well and a **goods receipt posting** to the storage is created. Click the Symbol.
5. The system issues a notification that the confirmation was saved. You should see that **one goods movement** and no errors occurred.

3.2.3.7 Re-check of MRP Status

To re-check the MRP status, call up the following transaction:

Logistics → Production → MRP → Evaluations → Stock/Requirements List (MD04)

1. Enter **material Basis-Module-xxxx** and **plant Hamburg (1000)**. 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, frame, and chain 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.

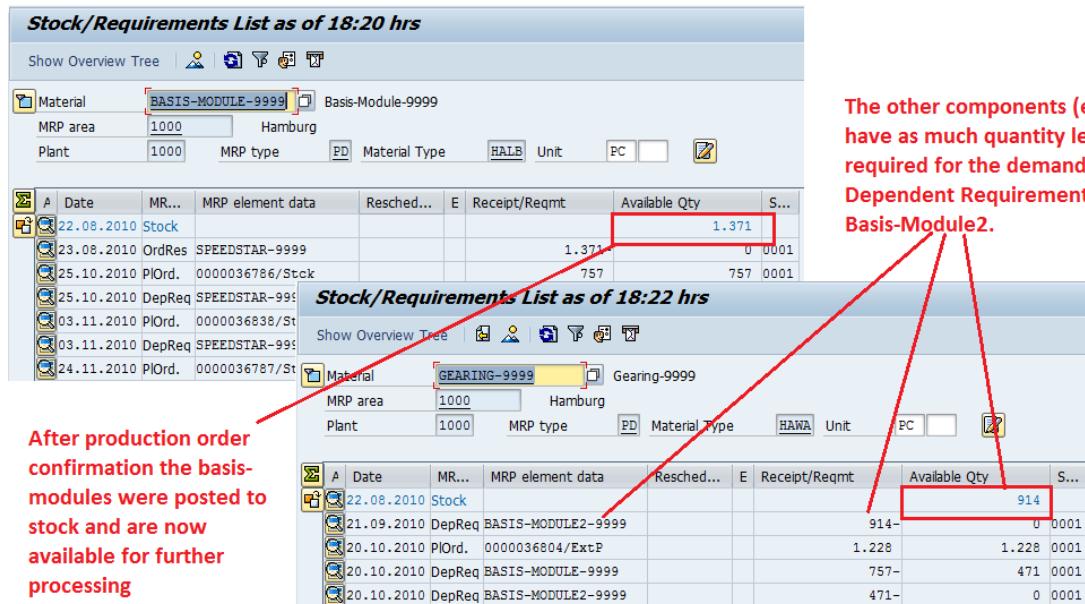


Figure 67: Check Storage Status: SAP-System-Screenshot

3.2.3.8 Enter Goods Issue of the Second Production Order (Speedstar)

Now that the semi-finished product is available in storage 0001, we can produce the finished product Speedstar. Again, we commence with making the materials (gearing, wheel, chain, frame, 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. Choose

Logistics → Materials Management → Inventory Management → Goods Movement → Goods Issue (MB1A)

1. Click the **To Order...** symbol (**for order**).
2. Enter the **number of the second production order (Speedstar)** in the **order column**. Confirm with **Enter**.
3. The system proposes the five correct material positions.
4. During production, 200 breaks were damaged. Thus, a higher demand is the case. Independently **add (!) 200** to the demand for breaks to (now 2942 units).



The system does not know that there are 200 additional breaks required and will only propose the quantities required according to BOM/production order. The information concerning the 200 additional breaks needs to be entered manually by the manufacturing execution manager (that's you!).

Item	Material	Quantity	UnE	SLoc	Batch	Re	Plnt	Itm	FIs
1	BASIS-MODULE-9999	1.371	PC	0001		1000	1	<input type="checkbox"/>	
2	PEDAL	2.742	PC	0001		1000	2	<input type="checkbox"/>	
3	BRAKES	2.942	PC	0001		1000	3	<input type="checkbox"/>	
4	HANDLEBAR	1.371	PC	0001		1000	4	<input type="checkbox"/>	
5	SADDLE	1.371	PC	0001		1000	5	<input type="checkbox"/>	

Figure 68: Goods Issue to Production: SAP-System-Screenshot

- Save and list the document number.

Document (Speedstar): _____

3.2.3.9 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.

Select the following transaction:

Logistics → Production → Shop Floor Control → Confirmation → Enter → For Order (Transaction Code: CO15)

- In the **order** field, enter *the number of the second production order (Speedstar)*. Press **Enter**.
- Select the confirmation type *final confirmation*.
- Click the “**goods movement**“-button and make sure that the storage location is **storage 0001**.
- Since the selected operation is marked as milestone in the routing, this confirmation automatically confirms all previous steps as well and a goods receipt posting to the storage is created. Click the symbol.
- The system issues a notification that the confirmation was saved. You should see that **one goods movement** and no errors occurred.
Note that at this point **one material document**, **one accounting document** and **one costing document** are created.

To re-check the MRP status, call up the following transaction:

Logistics → Production → MRP → Evaluations → Stock/Requirements List (MD04)

1. Enter material **Speedstar-xxyy** and plant **Hamburg (1000)**. 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.

Stock/Requirements List as of 18:31 hrs										
Show Overview Tree										
Material		SPEEDSTAR-9999	Speedstar-9999							
MRP area	1000	Hamburg	Plant	1000	MRP type	PD	Material Type	FERT	Unit	PC
	A	Date	MR...	MRP element data	Resched...	E	Receipt/Reqmt	Available Qty	S...	
		22.08.2010	Stock					1.371-	1.371	
		01.10.2010	IndReq	VSF				1.371-	0	
		02.11.2010	PlOrd.	0000036780/Stck				757	757 0001	
		02.11.2010	IndReq	VSF				757-	0	
		10.11.2010	PlOrd.	0000036837/Stck				100	100 0001	
		10.11.2010	Order	0000013324/000010/0...				100-	0	

Figure 69: 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 sales order management case study.

3.2.4 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 70: Process Overview: Closing Operations

3.2.4.1 Check Goods Movement Document

The goods movement postings to stock should have been carried out automatically – as described in the last step. Check the goods receipt to stock. Choose the following transaction:

Logistics → Materials Management → Inventory Management → Environment → List Displays → Material Documents (MB51)

1. With this transaction, you can check all material documents that were generated so far for a specific material. Enter material **Speedstar-xxyy** and plant **1000**. Write down

the document number listed (there is only one, since you did not do much with the Speedstar yet).

Document number Speedstar 2: _____

Double-click on the document number to enter the document details.

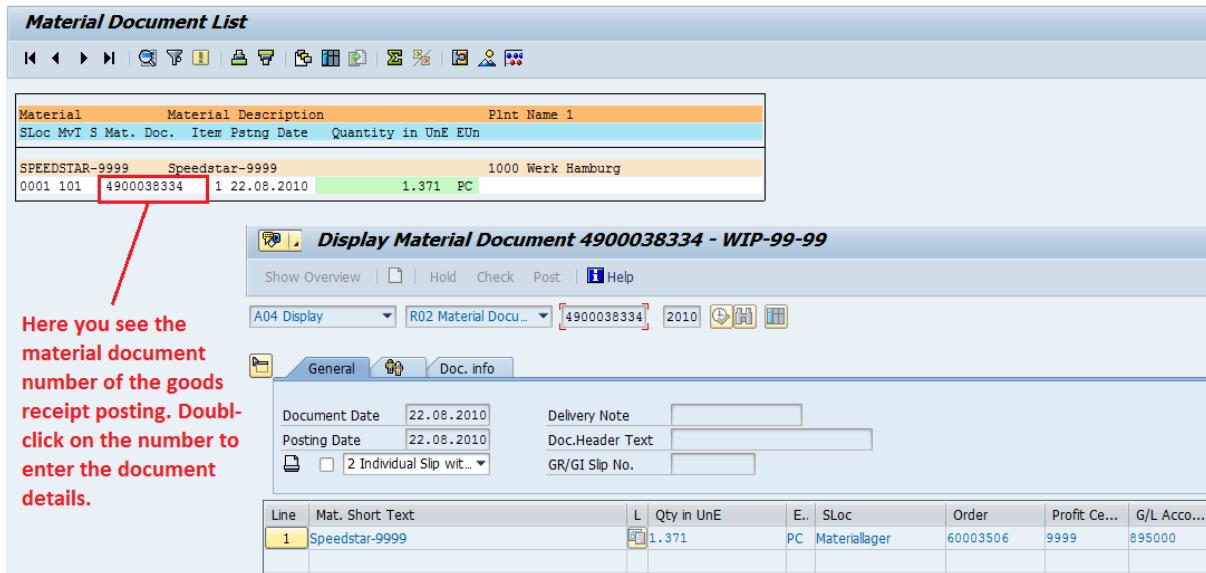
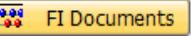


Figure 71: Document List and Document Details: SAP-System-Screenshot

- To display the corresponding accounting document (SAP FI), go to the **Doc. info** tab and click the  symbol. Select **accounting document**.

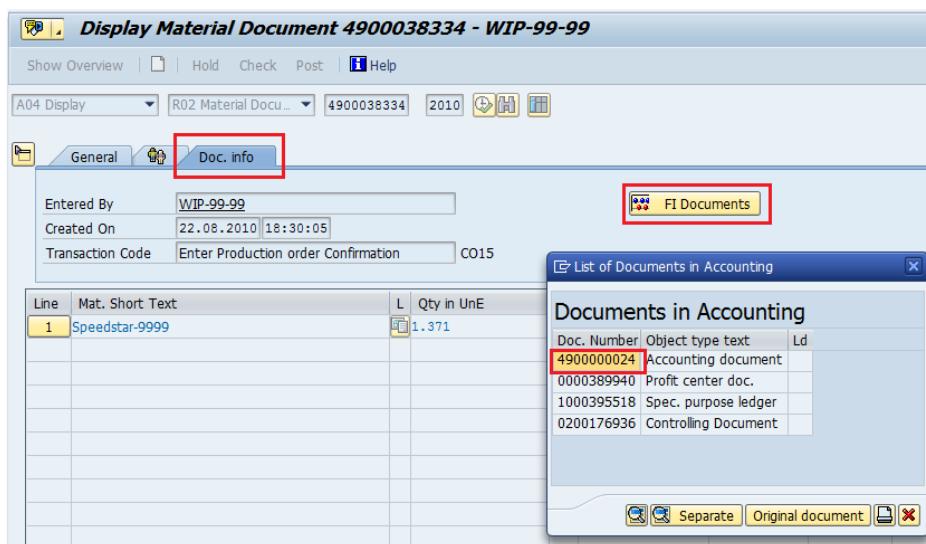


Figure 72: Accounting Document of SAP FI: SAP-System-Screenshot

- You can see that this document reflects the value of the material (2,377.74 € production costs from costing) multiplied with the production quantity of 1371 units. Stock available in a company is always valued with the costs from the costing view.

For comparison:

Your screen should look like this:



Depending on the number of Speedstars you produced, the displayed amount may vary. The figure below applies to a quantity of 1371 Speedstars produced!

You can also go one step back and double-click on **costing document** to display the document created in SAP CO due to the production order confirmation. Note that there have been (at least) 3 documents created: Material (SAP MM), Accounting (SAP FI), Costing (SAP CO). Profit Center and Special Ledger documents are optional and depend on system settings.

C..	Itm	PK	S	Account	Description	Amount	Curr.	Tx	Cost Center	Order	Profit Center	Segment	Billing Doc.	SL...
1000	1	89		792000	Finished goods invent	3.259.881,54	EUR							
	2	91		895000	Factory output of pr	3.259.881,54-	EUR			60003506	9999			

Figure 73: Accounting Document: SAP-System-Screenshot

3.2.4.2 Variance and Cost Analyses

During production, variances to the plan occurred. Thereby, 200 additional breaks were consumed in comparison to the plan. In the next steps, you will clarify these variances. Call up the following transaction:

Logistics → Production → Shop Floor Control → Order → Display (CO03)

1. Enter the production order number of the **second order (Speedstar)** and confirm with **Enter**.
2. You can see that 1371 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 . Select the row with the **breaks** and choose **Component → Component Details** from the menu. You can see that **Requirement quantity** and **Withdrawal quantity** vary by 200 units.
4. Go back to the last screen and select operations overview . Select the row with **operation 10** and choose **Operation → Operation Detail** 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 1371 units are in stock and, thus, there is no variance regarding the final quantity.

5. Go back to the initial screen of your production order (**display production order: header**).

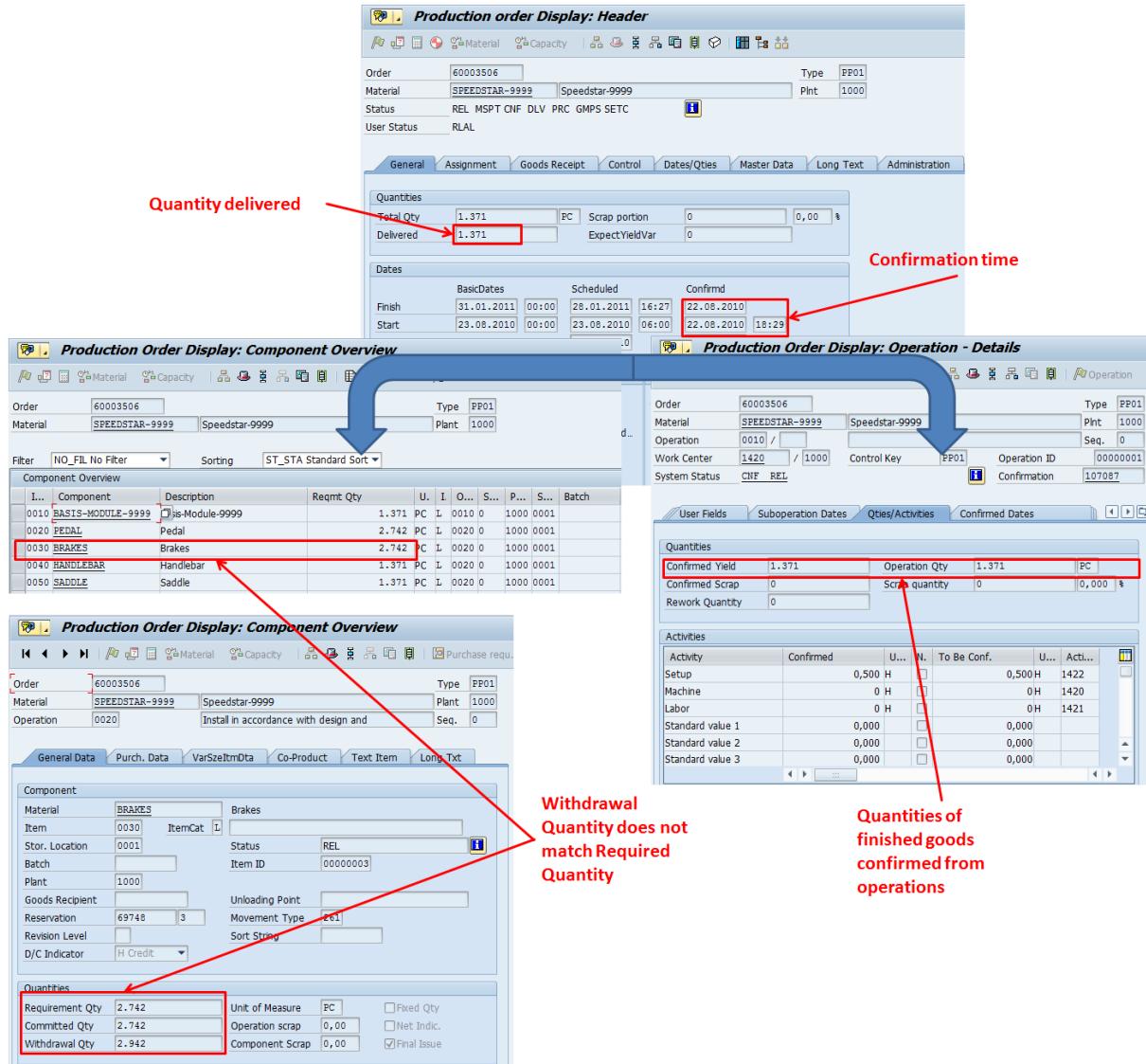


Figure 74: Quantities Delivered, Required and Withdraw: SAP-System-Screenshot

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 **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 breaks.

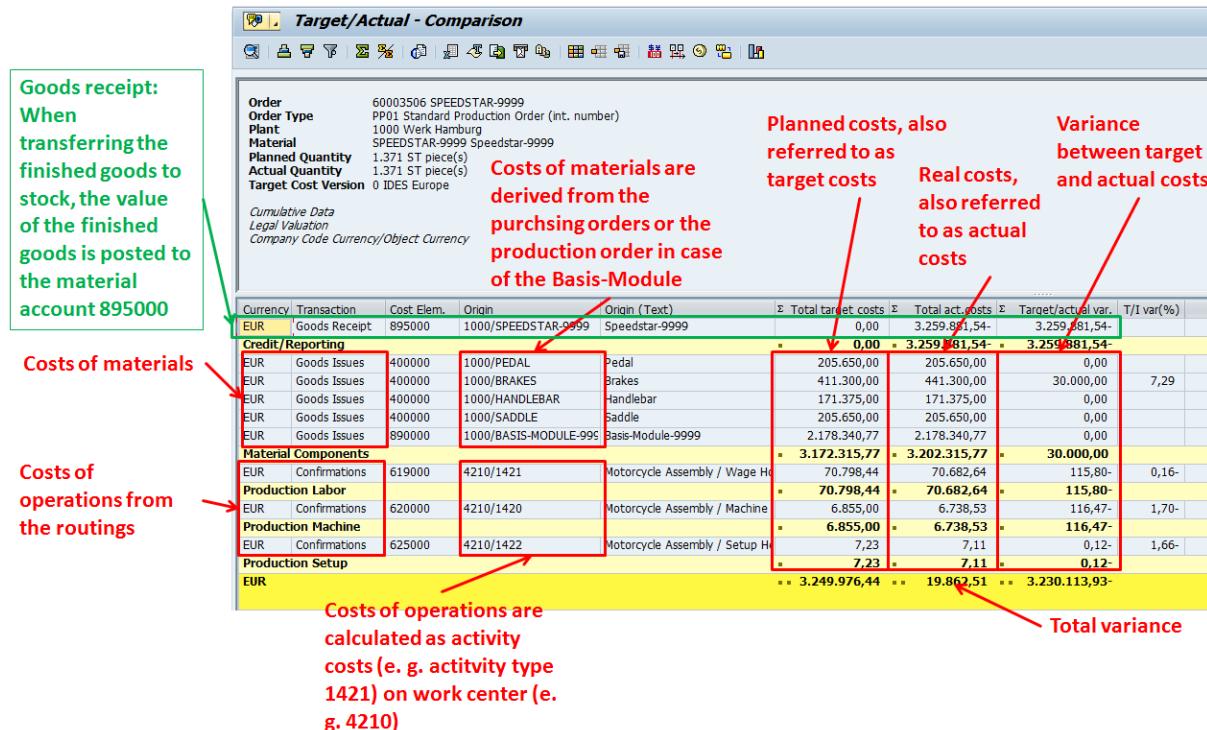


Figure 75: Cost Analysis for Production Order: SAP-System-Screenshot

The result of this cost analysis shows that:

1. The value generated through the production process (in the figure above) is 3.259.881,54. This refers to the value of the materials produced with this production order. Note that for the material pricing the material cost estimation price 2377,74 is used ($2377,74 \text{ €} * 1371 \text{ PC} = 3.259.881,54 \text{ €}$). This is the actual value (according to material cost estimation) of the material moved to warehouse and that is posted on the finished goods account!
2. Variances occurred in production process totaling a surplus of 19.862,51 €
 - Operation costs were lower than expected: $-232,39$ ($115,8 + 116,47 + 0,12$)
 - Material costs were higher than expected: $+30.000$ (Brakes)
 - Difference between material value moved to warehouse (3.259.881,54 € based on cost estimation) and planned production costs based on the quantities produced (3.249.976,44 €): $-9.905,10$ €
3. Thus, your production process cost 3.279.744,05 € (actual costs column) from which 3.259.881,54 € were posted on the finished goods account 895000. Leaving a total variance of 19.862,51 € on your order.
4. The total variance of 19.862,51 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 or in terms of accounting).

Now check the settlement rule applied in the production order.

1. Go back to the first screen of **Production order Display: Header**. Select **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 the V was set in the Speedstar, the 19.862,51 € would increase the average price of the material in stock. Example: You have 9 Speedstar on stock with a total value of 9000 €. Now you produce 1 Speedstar costing you 1100 € (Variance = 200). The average price moves to 1010 € each ($(9000+1100)/10 = 1100$) prior to 900 each.
- price control parameter S: This parameter is set in the material master of Speedstar. In that case the variance is posted to the material account 895000 after settlement process. This was also already done after completion for the actual costs (see figure above: Account 895000).

Distribution rules										
Cat	Settlement Receiver	Receiver Short Text	%	Equivalence ...	S...	N.	S..	Fr...	Fro...	
MAT	SPEEDSTAR-9999	Speedstar-9999	100,00	0	FUL	1		0		

Figure 76: Settlement Rule: SAP-System-Screenshot

3. Now leave transaction CO03.

Due to the displayed cost analysis, you want to gain additional information about the production-related variances occurred regarding 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, select

Logistics → Production → Shop Floor Control → Period-End Closing → Variances → Individual Processing (KKS2)

1. In case you need to enter the controlling area, enter **1000** and press **Enter**.
2. Enter the following data:

- | | |
|---|---|
| <ul style="list-style-type: none"> - Order - Period - Fiscal year | <i>order number for the Speedstar</i>
<i>current period</i> (current month)
<i>current year</i> |
|---|---|

- Selected Target Cost Version 000 *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.

Variance Calculation: List						
Basic List		Cost Elements	Scrap	Variance Categories		
Period	8	Fiscal year	2010	Messages	1	Currency
Version	0 IDES Europe (0)			10 Company code currency		
Plant	Cost Object	Target Costs	Actual Costs	Allocated Actl	Work in Process	Scrap
1000	ORD 60003506	3.249.976,44	3.279.744,05	3.259.881,54	0,00	0,00
						Variance
						19.862,51

Figure 77: Variance calculation (1): SAP-System-Screenshot

4. Select the row with the material **brakes** and select **Variances**.

Variance Calculation: List						
Basic List		Cost Elements	Scrap	Variance Categories		
Period	8	Fiscal year	2010	Messages	1	Currency
Version	0 IDES Europe (0)			10 Company code currency		
Plant	Cost Object	Target Costs	Actual Costs	Allocated Actl	Work in Process	Scrap
10	ORD 60003506	3.249.976,44	3.279.744,05	3.259.881,54	0,00	0,00
						Variance
						19.862,51
Variances						
Cost	Cost Element (Text)	Origin	Σ Total tot	Σ Ttl actual	Σ Total ctrl	Σ WIP
400000	Consumption, raw mat:	1000/BRAKES	411.300,00	441.300,00	441.300,00	0,00
400000	Consumption, raw mat:	1000/HANDLEBAR	171.375,00	171.375,00	171.375,00	0,00
400000	Consumption, raw mat:	1000/PEDAL	205.650,00	205.650,00	205.650,00	0,00
400000	Consumption, raw mat:	1000/SADDLE	205.650,00	205.650,00	205.650,00	0,00
619000	Dir. Int. Act. Alloc. Proj:	4210	70.798,44	70.682,64	70.682,64	0,00
620000	Dir. Int. Act. Alloc. Mac:	4210	6.855,00	6.738,53	6.738,53	0,00
625000	Dir. Int. Act. Alloc. Set:	4210	7,23	7,11	7,11	0,00
890000	Consumption of semifin:	1000/BASIS-MODULE	2.178.340,77	2.178.340,77	2.178.340,77	0,00
Debit	3.249.976		3.279.744,0		3.279.744,0	
895000	Factory output produc:	1000/SPEEDSTAR-99	3.259.881,54	3.259.881,54	0,00	0,00
Delivery	3.259.881		3.259.881,5		0,00	

Figure 78: Variance calculation (2): SAP-System-Screenshot

5. In the report, search the appropriate field and answer the following questions:
- Which **variance type** was calculated for material **breaks**?
 - Why was it calculated?

List the answers on your **data sheet**.

3.2.4.3 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 **automatical** in one posting run. After order settlement, the system displays an extensive list. Check the **sender/receiver information** in this list.

Choose

Logistics → Production → Shop Floor Control → Period-End Closing → Settlement → Individual Processing (KO88)

1. Enter the following data:

- Order	<i>order number of the Speedstar</i>
- Period Field	<i>current period</i>
- Fiscal Year	<i>current year</i>
- Processing type	<i>automatic</i>
- Test run	Deselect
- Select execute .	

2. Select detail list 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 by using the **sender** and **receiver** buttons.

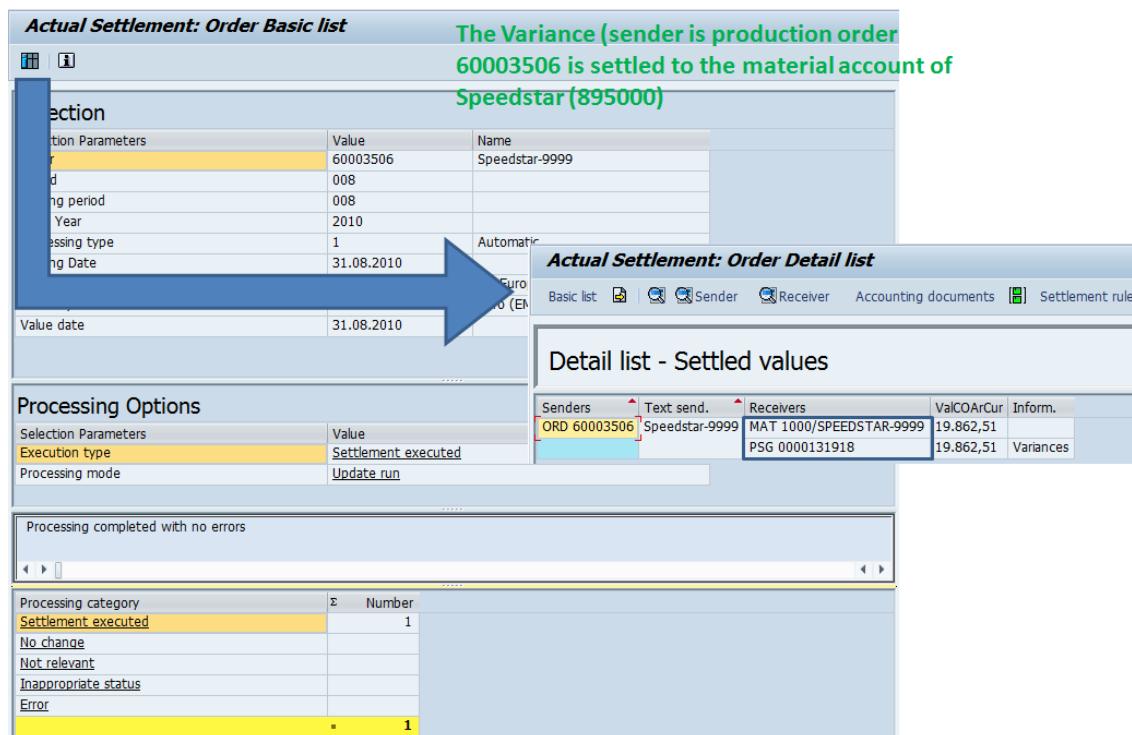


Figure 79: Order Settlement: SAP-System-Screenshot

4. Thus, variances between actual and target costs are settled and assigned to the finished product.

3.2.4.4 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. Select

Logistics → Production → Shop Floor Control → Order → Change (CO02)

1. Enter the production order number of the **second order (Speedstar)** and confirm with **Enter**.
2. Select **Goto → Costs → Analysis**. You see that the variance of the actual costs column is 0.

Currency	Transaction	Cost Elem.	Origin	Origin (Text)	Σ	Total target costs	Σ	Total act. costs	Σ	Target/actual var.	T/I var(%)
EUR	Goods Receipt	895000	1000/SPEEDSTAR-9999	Speedstar-9999		3.259.881,54-		3.259.881,54-		0,00	
EUR	Settlement	895000		(without origin)		0,00		19.862,51-		19.862,51-	
Credit/Reporting						3.259.881,54-		3.279.744,05-		19.862,51-	
EUR	Goods Issues	400000	1000/SADDLE	Saddle		205.650,00		205.650,00		0,00	
EUR	Goods Issues	400000	1000/HANDLEBAR	Handlebar		171.375,00		171.375,00		0,00	
EUR	Goods Issues	400000	1000/BRAKES	Brakes		411.300,00		441.300,00		30.000,00	7,29
EUR	Goods Issues	400000	1000/PEDAL	Pedal		205.650,00		205.650,00		0,00	
EUR	Goods Issues	890000	1000/BASIS-MODULE-999	Basis-Module-999		2.178.340,77		2.178.340,77		0,00	
Material Components						3.172.315,77		3.202.315,77		30.000,00	
EUR	Confirmations	619000	4210/1421	Motorcycle Assembly / Wage Ho		70.798,44		70.682,64		115,80-	0,16-
Production Labor						70.798,44		70.682,64		115,80-	
EUR	Confirmations	620000	4210/1420	Motorcycle Assembly / Machine		6.855,00		6.738,53		116,47-	1,70-
Production Machine						6.855,00		6.738,53		116,47-	
EUR	Confirmations	625000	4210/1422	Motorcycle Assembly / Setup Ho		7,23		7,11		0,12-	1,66-
Production Setup						7,23		7,11		0,12-	
EUR						9.905,10-		0,00		9.905,10	

Figure 80: 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. Select **Functions → Restrict Processing → Complete Technically**
 4. Now selects **Functions → Restrict Processing → Close**
 5. The status of your order changes accordingly.

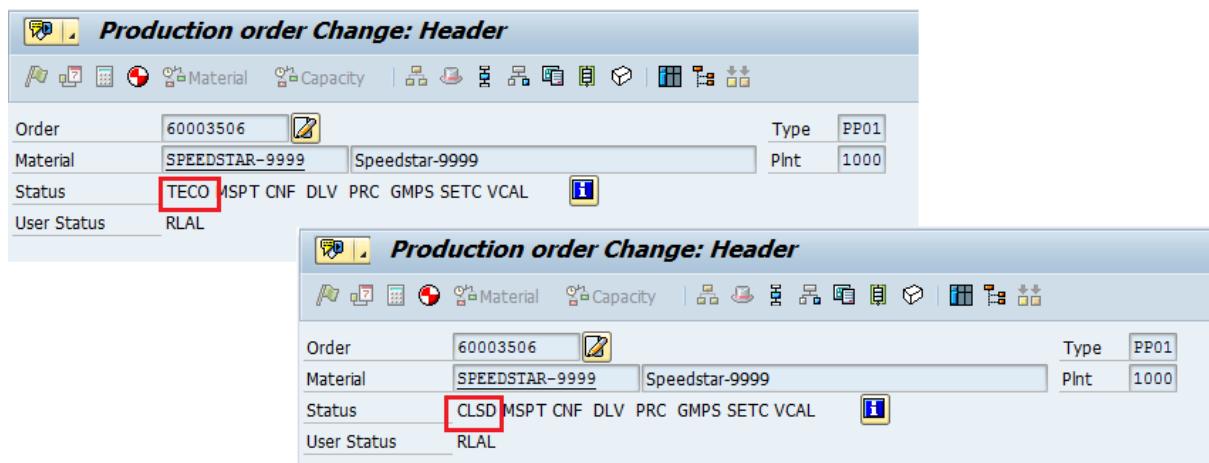


Figure 81: Technical Completion and Closing: SAP-System-Screenshot

3.2.5 Order Information System

You want to display a document containing all production orders for material **Speedstar-xxyy** in **plant 1000**. 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.



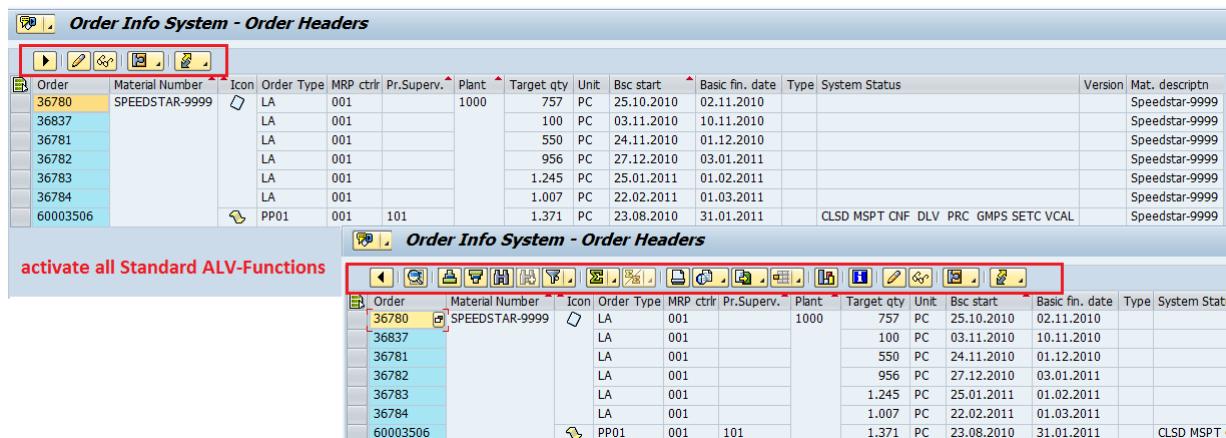
Figure 82: Process Overview: Order Information System

Choose

Logistics → Production → Shop Floor Control → Information System → Order Information System (COOIS)

1. On the order information systems screen, enter the following data:
a. List **PPIOH000 Order Headers**

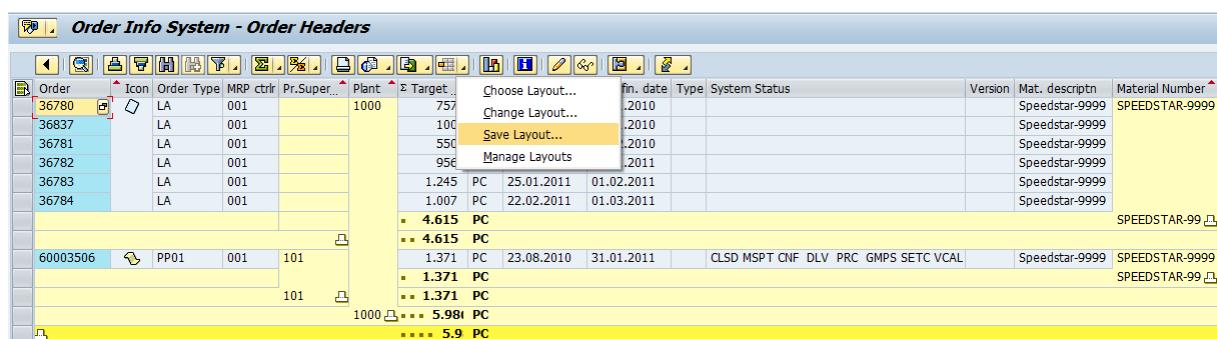
- b. Layout **000000000001 Standard layout**
 - c. Material **Speedstar-xxyy**
 - d. Production Plant **1000**
 - e. Plnnd orders **select**
 - f. Choose execute
2. In the report output, you need to activate all **standard ALV functions**. Select standard ALV functions on ().



The figure consists of two side-by-side screenshots of the SAP Order Info System - Order Headers report. Both screenshots show a table with columns: Order, Material Number, Icon, Order Type, MRP ctrlr, Pr.Super., Plant, Target qty, Unit, Bsc start, Basic fin. date, Type, System Status, Version, Mat. descriptn, and a row of buttons at the bottom: CLSD MSPT CNF DLV PRC GMPS SETC VCAL. The top screenshot has a red box around the toolbar icons, and the bottom screenshot also has a red box around the toolbar icons, but it is labeled "activate all Standard ALV-Functions".

Figure 83: Production Order Information System: SAP-System-Screenshot

3. In the report, pull the **material number** field right next to the **material description** field.
4. To add a total amount, select the **target quantity column** by clicking the column header and select **sum** .
5. To save the **report layout**, choose **select layout** and then **save layout**.



The figure shows a SAP report with a context menu open over the target quantity column. The menu items include "Choose Layout...", "Change Layout...", "Save Layout...", and "Manage Layouts". Below the menu, there are several layout options listed: "4.615 PC", "4.615 PC", "1.371 PC", "1.371 PC", "1.371 PC", and "5.981 PC". The "Save Layout..." option is highlighted with a red box.

Figure 84: Save Layout: SAP-System-Screenshot

6. Enter the following data:
 - a. **Save layout** **Manu-xxyy**
 - b. **Name** **Manufacturing xxyy Layout**
 - c. **User-specific** **select**
 - d. Choose **Enter**.
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.

3.3 Elucidation



What have we learned so far?

You have learned how production orders are processed in the manufacturing process and what elements the production order consists of. Furthermore, you have learned the connection between SAP PP and SAP CO and got acquainted with the order information system.



What is a production order?

The work processes within a company are executed using orders. A production order is a document that contains all the information necessary to process the production process of a product in SAP ERP. Production orders are a fundamental part of Production Planning and Control (SAP PP). SAP PP is part of SAP Logistics (SAP LO) component and has, among others, interfaces to

- Sales and Distribution (SAP SD)
- Materials Management (SAP MM)
- Controlling (SAP CO)

A production order defines which material is to be processed, at which location, at what time and how much work is required. It also defines which resources are to be used and how the order costs are to be settled. Production orders are used to control production within a company and also to control cost accounting.

As soon as a planned order or other request is generated from material requirements planning, the information is passed on to shop floor control; the order-relevant data is also added to ensure complete order processing.

You can use the production order to specify:

- *What is to be produced?*
- *When production is to take place?*
- *Which capacity is necessary to process the order?*
- *How much are the production costs?*

What type of production order (production order type) is used, depends on several criteria in the company. Those criteria might be, for example, the production process, the complexity of a product, and production stability. SAP ERP provides multiple production types to satisfy different requirements to shop floor control. Among others, the following production types are supported:

- **Make-to-Order Production:** *This production order type is considered for the "classic" production process. The production order is controlled or induced by a sales order. That is, a customer orders a product and, thus, starts the follow-up processes like material planning (planned order creation) and production planning (production order creation).*
- **Process Manufacturing:** *The component Production Planning for Process Industries (PP-PI) provides an integrated planning tool for batch-oriented process manufacturing. It is primarily designed for the chemical, pharmaceutical, food and beverage in-*

dustries as well as the batch-oriented electronics industry. PP-PI supports the integrated planning of production, waste disposal, and transport activities within a plant. Process orders can be used for various production procedures and are identified, for example, according to the criteria product complexity and product stability. Process order management is a central part of complex process chain starting with a requirement (planned or customer requirement) and ending with the goods issue of a finished product. Process order management controls the whole process of the in-house production of products. Process order execution is integrated with the functions of capacity requirements planning, costing, and inventory management. In addition, there are links or interfaces to Quality Management, external laboratory information systems (LIMS), and process control systems.

- **Repetitive Manufacturing:** You can use repetitive manufacturing as either make-to-stock REM or make-to-order REM such as in the automotive industry, for example. The goals of repetitive manufacturing are the following:
 - Creation and revision of production quantities on a period and quantity basis (reduction in individual lot and order-specific processing).
 - Reduction in the production control effort and simpler backflushing tools (with the option of using the full scope of the PP functionality).

You can implement Repetitive Manufacturing if the following is true for your production process:

- You produce the same or similar products over a lengthy period of time.
- You do not manufacture in individually defined lots. Instead, a total quantity is produced over a certain period at a certain rate per part-period.
- Your products always follow the same sequence through the machines and work centers in production.
- Routings tend to be simple and do not vary much.
- **Project-oriented Production:** The system creates a WBS element for the production lot. The maintenance of the master data, in addition to the planning, production and cost determination are executed with reference to the WBS element. The WBS element is an object from Project System (teaching unit 11). The management of changes is also supported by means of Engineering Change Management.
- **KANBAN:** The KANBAN method for controlling production and material flow is based on the actual stock quantity in production. Material that is required on a regular basis is continually provided in small quantities in production. Replenishment or the production of a material is only triggered when a higher production level actually requires the material. This replenishment is triggered directly in production using previously maintained master data. The entries you have to make in the system have been reduced to a minimum, for example, the scanning of a bar code. All other actions in the system are carried out automatically in the background. With KANBAN, the production process controls itself and manual posting is reduced as far as possible. The effect of this is a reduction in lead time and in stock. In KANBAN, the signal for material replenishment can be triggered, for example, by the work center that requires the material (demand source) by sending a card to the work center that is responsible for manufacturing the material (supply source). This card describes which material is

required, the quantity of the material required and where the material is to be delivered.

3.3.1 Processing Production Orders

A production order process contains multiple consecutive steps. Not all steps are mandatory (PDC and Print are optional), some steps can be automated or executed in background:

- **Order Request:** A request for producing 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.
 - **Order Creation:** A production orders 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 be executed in a **background** job.
 - **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 check can be executed manually or *automatically*. Availability checks can be executed in a **background** job.
 - **Machine Commitment:** Work Center capacity, if available, can be reserved exclusively for the production order. Can be executed in a **background** job.
 - **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 a production order that has been created:
 - o Confirmations for the order cannot be executed, yet.
 - o Shop floor papers cannot be printed.
 - o Goods movements 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*.
- **Download to PDC System (process system):** The PP-PDC interface is available for plant **data collection**. You can use the interface to connect subsystems used for entering time ticket and time event confirmations during production execution. PDC might be a subsystem that controls the individual machines (e.g., production robots) or employees in the factory. Can be executed in a **background** job.
 - **Order Print:** Order documents, like general order information or shop floor papers can be printed manually or automatically upon order release. Can be executed in a **background** job.
 - **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).
 - **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.
- The stock values are updated in the material master record and the stock/consumption accounts are updated.
- **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 ERP system. Can be executed in a *background* job.
- **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, who 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*.
- **WIP Determination:** You can determine the quantity and value of items that are not finished yet or waiting in a queue for further processing. Can be executed in a *background* job.
- **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.
 - The stock values are updated in the material master record and the stock/consumption accounts are updated.
- **Variance Calculation:** Here you can calculate the variance between the planned 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.). Can be executed in a *background* job.
- **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 corresponding receiver cost-object and can be displayed in reporting. Can be executed in a *background* job.
- **Archiving/Deleting:** Production orders can be deleted (if not released yet) or they can be archived. Can be executed in a *background* job.

3.3.2 Elements of a Production Order

The production order structure has the following elements:

- **Order Header:** General information like order number, plant, production scheduler (person responsible for scheduling)
- **Operations:**
 - o Contains the routing operations.
 - o One operation must be assigned at least. If no operation is available the system assigns a default operation.
 - o **Sub-operations** are allowed within an operation.
 - o Work center, control key, and standard value are retrieved from the materials routing. You can also assign/change them manually.
 - o You can add **material components, production resources/tools, and trigger points** to an operation.
- **Operation Sequences:**
 - o You can create **multiple (parallel) operation sequences**
 - o You can choose from different **alternative sequences** if available and assign one of them
- **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.
- **Settlement Rule:** When running production costs like work force, material consumption etc. are generated. These costs are determined at **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.
- **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.
- **Documents:** Production orders can be linked to documents (texts, specifications, order descriptions, etc.) in the **document management system (DMS)**.

3.3.3 Order Release Functions

- **Order release** is a mandatory step before you can start manufacturing.
- Status **released** allows subsequent processes such as printing order documents, material withdraw, etc.
- Example: You cannot post a goods receipt to production for a not released order.
- At the time of order release, the status of an order is created (CRTD).
- When an order is released, the status is released (REL).
- **Availability check** for materials, PRTs, and work center capacity can be run automatically. That is, if the production order type (e.g., PP01) is set this way in customizing, after creating the order (saving in transaction CO01) an availability check is executed.

- A single operation or multiple operations or multiple orders can be released together (**mass release** transaction provided)

3.3.4 Goods Issue Posting

- At this point of the manufacturing execution process, you have created the production order, ran all availability checks, have assigned materials and capacities to the production order and have **released (!)** the order.
- Now you begin to produce and start to consume material during the production order process. Therefore you need to post **goods issue** (GI) to transfer the material from storage to production work center.
- The following steps are executed for a **goods issue posting**:
 - o **Stock and consumption fields** are updated at the respective storage location. For instance, the stock quantity in storage location 0001 of plant 1000 is reduced.
 - o If materials were reserved by the production order before hand (planned withdrawal) the quantity in this stock type is reduced. For instance, the stock quantity of stock type **reserved** (still remember the different stock types like quality inspection, etc. from procurement;-)) in storage location 0001 of plant 1000 is reduced.
 - o The production order is updated and the **actual costs** are determined. That is, the costs of the material withdrawal are accounted on the production order.
 - o With a goods issue posting the following **three** documents are **always** created:
 - The **material document** gives information about goods movements from a materials management (stock) point of view.
 - 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.
 - The **controlling documents** are used for various cost analyses purposes.
 - o A **goods issue document** can be printed

The goods issue posting is controlled using **movement type** (261), to which each posting refers. This procedure can be carried out both manually or automatically.

3.3.5 Production Order Confirmation

Production is now finished and the good was produced. Now the production execution manager confirms this in transaction CO15.

With a confirmation you specify

- The quantity in an operation that was produced as yield, scrap, and the quantity to be reworked

- How much work was actually done
- Which work center was used for the operation
- Who carried out the operation

Thus, 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.

Hence, 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 SAP ERP.
- The work centers that provide the activities needed for the production process have a certain capacity of working hours etc. 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 automatic (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. The opposite procedure is what you did in the practical part of this teaching unit. You posted the materials you needed for production manually for goods issue in transaction MB1A. The posting was 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 particular control key in the routing of the material produced. If you remember, you set the control key **PP99** for the last operation of your routing. When you confirmed your production order, the material produced (Speedstar) was automatically put on stock and a material document (which was not displayed) was created for this goods movement. If you had not set this control key, you would have to post the goods receipt to stock manually in transaction MB1C to move the confirmed Speedstars from the production into stock.
- 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).

3.3.6 Goods Receipt Posting

- After (partial) confirmation was executed and the good was 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**.
- The following steps are carried out for a goods receipt posting:
 - o Again (like for the goods issue) three documents are created:
 - The **material document** gives information about goods movements from a materials management (stock) point of view.
 - 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.
 - o You can print a **goods issue document**.
 - o 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
 - o The receipt is evaluated.
 - o Depending on the settlement rule, a credit to order is carried out.
 - o The plant activity is updated.

The goods receipt posting is controlled using **movement type** (101), which each posting refers. This procedure can be carried out both manually or automatically.

3.3.7 Integration of Management Accounting

Production Planning SAP PP and SAP CO are highly integrated. You have already learned that costs of production are accumulated on the production order. The production order is a cost collector and is referred to as cost unit in order-based production.

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). Based on this cost structure the preliminary costing is executed. 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.

The following figure displays the BOM and the routing of the Speedstar and the connection to the material cost estimation.

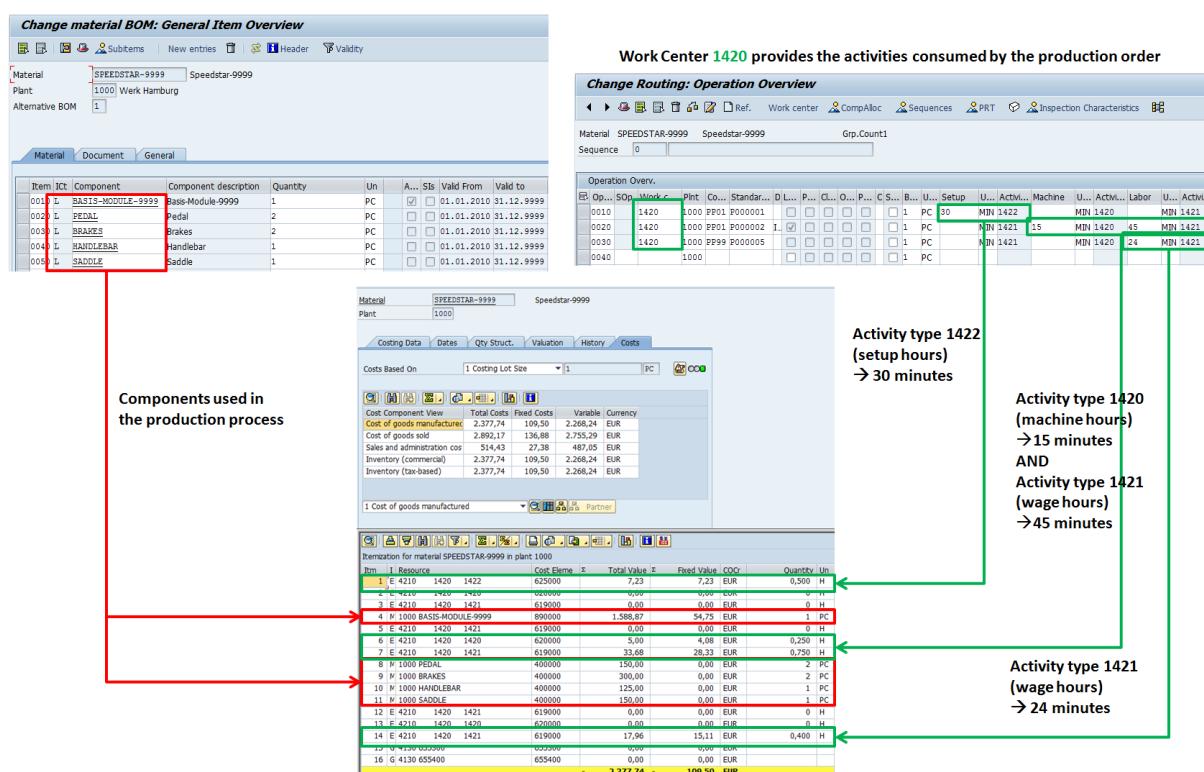


Figure 85: BOM, routing and Cost estimation Speedstar: SAP-System-Screenshot

As you can see from the figure above, the production costs for **one** Speedstar are derived as follows:

Material components

- Basis-Module	1588,87 €
- Pedal (2x)	150 €
- Brakes (2x)	300 €
- Handlebar	125 €
- Saddle	150 €

Activities provided by work center 1420

- 1422 (setup hours)	30 min	7,23 €
----------------------	--------	--------

- 1420 (machine hours) 15 min 5,00 €
- 1421 (wage hours) 45 min 33,68 €
- 1421 (wage hours) 24 min 17,96 €

The total estimated costs for producing one Speedstar is **2377,74 €**

The prices for the material components are derived from the particular material components.
But where does the activity prices come from?

In the following figure (transaction KP26, see teaching unit 9), you can see the **planned** prices for the activities provided by work center 1420 on cost center 4210. Cost center 4210 is assigned to work center 1420 and manages all controlling relevant processes for this work center.

Planned prices for the activities

Activity	Plan activity	Capacity	Fixed price	Variable pr...	Price ...	Pl... P... A...	Alloc. cost...	T EquiNo	Act. sched.	L...		
1422	100.000	0	100.000.000	0	A	14,46	00001 1	<input type="checkbox"/>	625000	1	1	0

Wage hours

Activity	Plan activity	Capacity	Fixed price	Variable pr...	Price ...	Pl... P... A...	Alloc. cost...	T EquiNo	Act. sched.	L...			
1421	100.000	0	100.000.000	0	B	37,77	7,13	00001 1	<input type="checkbox"/>	619000	1	1	0

Machine hours

Activity	Plan activity	Capacity	Fixed price	Variable pr...	Price ...	Pl... P... A...	Alloc. cost...	T EquiNo	Act. sched.	L...			
1420	100.000	0	100.000.000	0	H	16,32	3,68	00001 1	<input type="checkbox"/>	620000	1	1	0

Figure 86: Planned Prices for Activities: SAP-System-Screenshot

In the preliminary cost estimation mentioned above you calculate the planned costs for the production order. This step is usually (depends on system settings) executed automatically upon production order creation or release. In the following figure you can see how the planned price of 3.249.976,44 € for producing 1371 PC of Speedstar is determined:

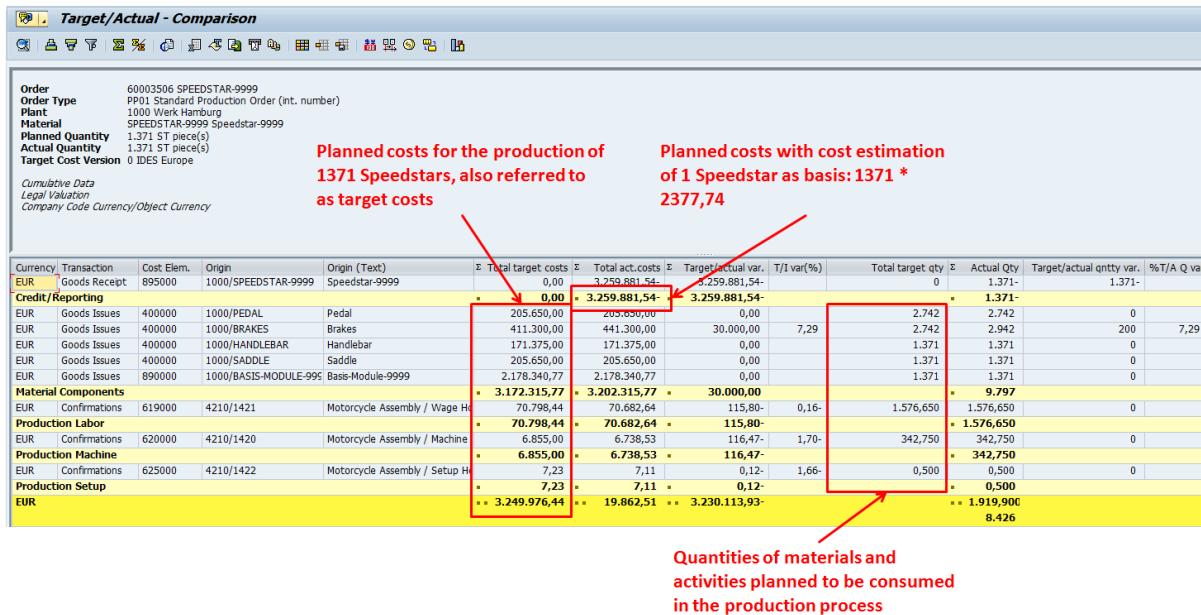


Figure 87: Planned Costs of the Production Order: SAP-System-Screenshot

Note that the planned price calculated on the basis of the material cost estimation for one Speedstar (3.259.881,54) differs from the planned price calculated on the basis of the quantities required (3.249.976,44). The explanation for this is pretty simple: The planned price on the basis of the material cost estimation contains the setup hours (7,23 €) 1371 times. But the machines need to be set up only once for a **production lot** and, thus, are only calculated once in the planned costs based on the quantities.

Material/Activity	Planned Quantity	Planned Price per unit	Planned Total Costs
Pedal	2742 PC	75 €	205.605 €
Brakes	2742 PC	150 €	411.300 €
Handlebar	1371 PC	125 €	171.375 €
Saddle	1371 PC	150 €	205.650 €
Basis-Module	1371 PC	1588,87 €	2178.340,77 €
1421 wage hours	1576,65 hours (=1371 * [45 + 24 min])	44,91 €	70.798,44 €
1420 machine hours	342,75 hours (=1371 * 15 min)	20,00 €	6855,00 €
1422 setup hours	0,5 hours (setup of production process only needs to be set up once for a production lot)	14,46 €	7,23 €

Costs generation and variance calculation:

- After releasing a production order and during processing and confirmation several types of costs occur that are posted to the production order (as the cost collector). That is, the production order is debited with the costs of materials, production costs (internal work center activities), external activities, process costs, overhead costs etc. For instance, when a production order consumes raw materials as components for production, the stock quantity of this raw material is reduced. At the same time a raw material account in SAP FI is **credited** with the value that was withdrawn and the production order is **debited** with the same amount.

The following figure (you need to zoom a little in to see the details;-)) displays what the goods issue for the production order initiates:

- You post the goods issue in transaction MB1A. The goods issue creates a material document (1) which captures the goods movement from warehouse to your production order. That is, you reduce the quantity of the components (pedal, brakes, handlebar etc.) on stock and move it to the production facilities.
- Simultaneously, the goods issue creates a cost accounting document (controlling document) (2) to capture the costs incurred with the posting in SAP CO. The costs are debited on the production order.
- Additionally, an accounting document (3) is created, which captures the value-based changes of stock materials. That is, e. g. the quantity of material Pedal is reduced by 1371 PC. These 1371 PC of Pedal are worth 205.650 €. This value was previously posted on the raw material account 300000 in SAP FI. Now the material is withdrawn for production and, thus, the material account is credited (value is reduced) by the value of material withdrawn.
- (4) In the production order's cost analysis you see the material costs that debit the production order in the column Target/actual costs. The column Target/actual var. displays the variance of actual costs to planned costs. Here you have a variance of 30.000 € due to the 200 unplanned Brakes.

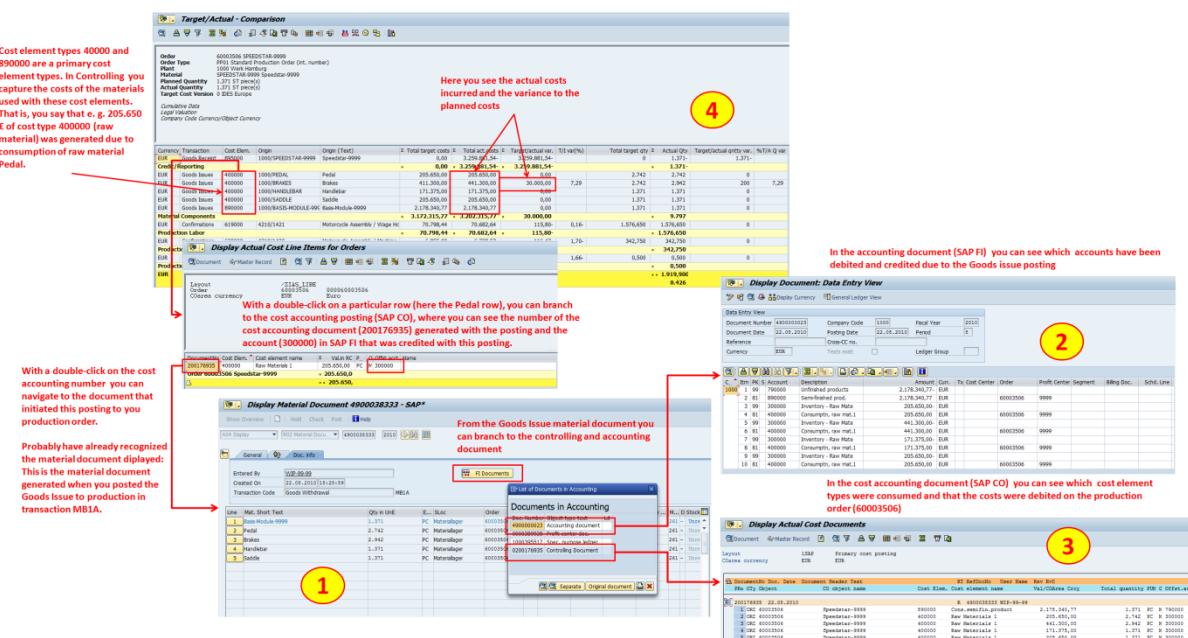


Figure 88: Material Costs of Production Order: SAP-System-Screenshot

2. The consumption of activities is similar to the consumption of materials: When you confirm the consumption of activities, the price for the activity performed is determined from the cost center associated with the work center that performs the activity. At the time of the activity consumption only the planned price for this activity is known, since the actual price is not known yet (compare to figure 86). The actual price of an activity on a cost center is determined based on many variables e.g. the amount of overhead costs (rent, electricity, etc.) that need to be allocated (see teaching unit 9). Hence, the actual price of activities most certainly differs from the planned prices on the cost centers, no matter how good your planning was. Even your production order

itself has effects on the actual price by using work center capacities etc. However, the production order is debited with the quantity of activity used multiplied by the actual costs of this activity. Consider that due to the differences between the planned and the actual price variances occur.

Here you see the actual costs incurred and the variance to the planned costs

Currency	Transaction	Cost Elem.	Origin	Origin (Text)	Total target costs	Total act. costs	Target/actual var.	T/I var(%)	Total target qty	Actual Qty	Target/actual qntty var.	%T/A var
EUR	Goods Receipt	895000	1000/SPEEDSTAR-9999	Speedstar-9999	0,00	3.259.881,54-	-3.259.881,54-		0	1.371-		1.371-
Credit/Reporting					0,00	3.259.881,54-	-3.259.881,54-					
EUR	Goods Issues	400000	1000/PEDAL	Pedal	205.650,00	205.650,00	0,00		2.742	2.742		0
EUR	Goods Issues	400000	1000/BRAKES	Brakes	411.300,00	441.300,00	30.000,00	7,29	2.742	2.942	200	7,29
EUR	Goods Issues	400000	1000/HANDLEBAR	Handlebar	171.375,00	171.375,00	0,00		1.371	1.371		0
EUR	Goods Issues	400000	1000/SADDLE	Saddle	205.650,00	205.650,00	0,00		1.371	1.371		0
EUR	Goods Issues	890000	1000/BASIS-MODULE-999	Basis-Module-9999	2.178.340,77	2.178.340,77	0,00		1.371	1.371		0
Material Components					3.172.315,77	3.202.315,77	-30.000,00					9,79%
EUR	Confirmations	619000	4210/1421	Motorcycle Assembly / Wage Hc	70.798,44	70.682,64	115,80-		0,16-	1.576,650	1.576,650	0
Production Labor					70.798,44	70.682,64	115,80-					1.576,650
EUR	Confirmations	620000	4210/1420	Motorcycle Assembly / Machine	6.855,00	6.738,53	116,47-		1,70-	342,750	342,750	0
Production Machine					6.855,00	6.738,53	116,47-					342,750
EUR	Confirmations	625000	4210/1422	Motorcycle Assembly / Setup Hc	7,23	7,11	0,12-		1,66-	0,500	0,500	0
Production Setup					7,23	7,11	0,12-					0,500
EUR					-- 3.249.976,44 --	-- 19.862,51 --	-- 3.230.113,93--					-- 1.919,900 --
												8.426

Figure 89: Activity Costs of Production Order: SAP-System-Screenshot

- At this point in time, you have a production order which carries all the costs incurred during production. When you confirm the last operation of your production order, an automatic goods receipt (due to key PP99 in your routing) to warehouse is executed. In the top row you can see that the Goods Receipt to the storage location (the material is moved from your production facilities to the warehouse) credits the production order with the value of the 1371 Speedstar produced (3.259.851,54 €). That is, the stock quantity for Speedstars is increased by 1371 PC, simultaneously the value of these 1371 PC Speedstar is posted to the finished goods material account in SAP FI. Hence, your production order is not debited with the value of the produced Speedstars anymore. BUT....

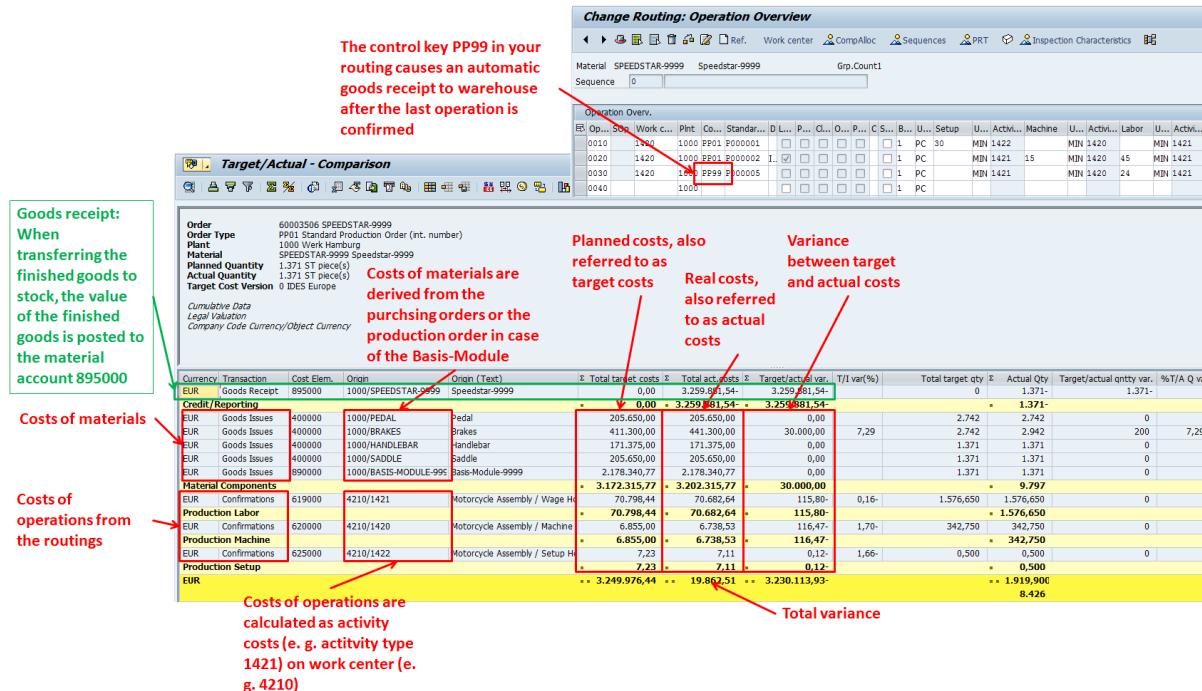


Figure 90: Summary Cost Analysis for Production Order: SAP-System-Screenshot

4. ...as you witnessed before, there were several types of variances in your production process. On the one hand, you consumed 200 brakes more than planned (**deficit** of 30.000 €). On the other hand, you had a **surplus** of 232,39 € regarding the activities consumed due to differences between planned and actual activity prices. The total variance between planned and actual costs is calculated as follows:

- The value generated through the production process (in the figure above) is 3.259.881,54. This refers to the value of the materials produced with this production order. Note that for the material pricing the material cost estimation price 2377,74 is used ($2377,74 \text{ €} * 1371 \text{ PC} = 3.259.881,54 \text{ €}$). This is the actual value (according to material cost estimation) of the material moved to warehouse and that is posted on the finished goods account!
- Variances occurred in production process totaling a surplus of 19.862,51 €
 - o Operation costs were lower than expected: -232,39 ($115,8 + 116,47 + 0,12$)
 - o Material costs were higher than expected: +30.000 (Brakes)
 - o Difference between material value moved to warehouse (3.259.881,54 € based on cost estimation) and planned production costs based on the quantities produced (3.249.976,44 €): -9.905,10 €
- Thus, your production process cost 3.279.744,05 € (actual costs column) from which 3.259.881,54 € were posted on the finished goods account 895000. Leaving a total variance of 19.862,51 € on your order.
- The total variance of 19.862,51 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 or in terms of accounting).

5. These **variances** can be allocated subsequently via different functions. For a production order to be closed technically and from a business point of view you need to bal-

ance out the order costs. That is, a production order must not have any costs left on it if you want to close it. Closing the order is the last step in the production order process. To balance a production order out you must **settle** the costs.

- Similarly to the variances **work in process** is handled. Thereby, WIP encompasses all costs that are perhaps already posted in FI as expenses but not yet on a finished product. For instance, that could be materials left in the process and which are not finished by the end of a period. 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.

Costs settlement price control

- In our example we had 19.862,51 € variance costs left on the production order and no WIP. These costs are now settled according to the settlement profile defined in the production order. In the production order you have the settlement rule MAT (material) set. This means that the variance and WIP left on the production order is allocated on the material produced. Note that there are many different rules and procedures available for settling costs of an order.

Cat	Settlement Receiver	Receiver Short Text	%	Equivalence ...	S...	N.	S..	Fr...	Fro...
MAT	SPEEDSTAR-9999	Speedstar-9999	100,00	0	FUL	1	0		

Figure 91: Settlement Rule of Production Order: SAP-System-Screenshot

- For in-house production of materials, it is generally best to use standard price control. Here you must consider the following:

- When a production order is settled to a material account, the amount settled is the difference between the actual costs incurred for the order and the costs credited to the order when the goods produced were delivered to stock.
- The production order is credited with the settled costs. Following the credit posting, the order has a balance of zero. The offsetting entry for this credit is made as follows:
 - If the Price control indicator in the material master record is S (like in the Speedstar master data), a price difference account is debited. That is, the variance in cost calculation is posted on a special account. In our case the variance is posted to the material account 895000.
 - 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, 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 that difference out.

- Example: You have 9 Speedstars with an average price of 100 € on stock. Now you produce a Speedstar and for some reason the production costs are 200 €. With the price indicator V the average price of all Speedstars on stock moves to 110 € ($9 \cdot 100 + 1 \cdot 200 = 1100$).

Summary of SAP PP and SAP CO Integration

- Variant of **cost object controlling** (COC) selected in controlling determines the way in which a production order is credited or debited. That is, it determines how costs are accounted on the production order and how they are settled to other costing objects.
- The two possible variants are **order-related** manner and **product-related** manner.
- Generally (depending on controlling settings), a production order serves as cost object. All costs (material costs, production costs, personnel costs, etc.) incurring during production are debited on the production order. The production order is a cost collector.
- The goods receipt to storage location credits the production order with the material value produced. Everything left on the production order is treated as variance or WIP and must be settled.
- **A production order is credited at the time of order settlement** with the amount of variance and WIP:
 - 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).
 - After settlement is done, the production order does **not** bear costs **anymore**. It can be **closed** both *technically* and in terms of *accounting*.
- Usually, settlement is periodic (e.g., monthly) and is controlled via a **settlement profile**.

3.3.8 Information Systems for Order Management

The order information system is a tool for shop floor control and process industries with reporting functions for production orders, planned orders and process orders.

You can view all the orders in the system, including the orders with deletion flags or deletion indicators. Archived orders are not taken into account. The order information system has the following display options:

- In an **individual object list**, a list is generated for the selected object (for instance, order header, operation, component). You can define the structure and appearance of the individual object list with a **layout**.
- On the **object overview** the individual orders are displayed with their subordinate objects in a hierarchical structure. With an **overall profile**, you can define which fields are displayed and which objects (order headers, items, sequences, etc.) are read or displayed. In addition, you can define which fields are displayed for the individual objects.

In addition to the evaluation options, there are the following options in the SAP PP-IS

- **Capacity evaluations**

- **Event Manager (SCM)**
- **Alert Monitor (APO)**
- **Batch where-used list**
- **Evaluation of digital signatures** and other lists.

4 Data Sheet

In the case study Manufacturing Execution in SAP ERP, you learned about the functional area **Production Planning and Scheduling**.

Finally, please **submit the carefully completed data sheet** to your tutor (use support email address) for the case study ***manufacturing execution***.

Please comply with the naming rules. Non-compliant data sheets will not be accepted; i.e. rename the document that you downloaded from this course's download area as follows:

04-manufacturing-xxyy-zzz-surname.doc

Thereby, you need to replace **xxyy** with your user number **without** the “**WIP**“ and without the hyphen (WIP-xx-yy) 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-99-99**. Then, name the document as follows:

04-manufacturing-9999-901-Mustermann.doc

5 Reflexion



In this section you are confronted with some question regarding the theoretical chapters of this teaching unit. Try to answer the questions on your own before taking a look at the standard solutions.

5.1 Questions

True/False Questions

1. The structure of a routing contains operations to be performed.
-

2. Standard operation times for operations are defined at work center level.
-

3. Order confirmations are used for entering activities executed within your company concerning an order.

Comprehension Questions

4. The Material Master can be created in two ways – what are they?

5. Why do you need to release a production order?

6. Name the elements of a production order.

7. Name the other application components integrated with manufacturing execution.

Multiple Choice Questions

8. Which of the following statements about Work Centers are correct?
(3 correct answers)

- a. A cost center can be assigned to a work center.
- b. People, Positions and Qualifications can be assigned to a work center on the Scheduling tab.

- c. Formula keys are used to calculate cost, calculate execution time and calculate capacity requirements.
 - d. Work Centers are used to maintain resource related data.
9. Which of the following are elements of a Production Order?
(3 correct answers)
- a. A production order must have at least two operations.
 - b. Material components, PRTs and trigger points can be assigned to a Production Order.
 - c. Documents from the Document Management System can be linked to Production Orders.
 - d. Only Actual costs can be tracked on a Production Order.
 - e. The Production Order Status controls the allowed activities.
10. Which functions of a production order can be automated?
(3 correct answers)
- a. Order Release
 - b. Material Staging
 - c. Material Withdrawal Posting
 - d. Goods Receipt.
 - e. Order Settlement
11. Which documents are created as a result of Goods Issue Posting?
(3 correct answers)
- a. Pick List
 - b. Material Document
 - c. Accounting Document
 - d. Controlling Document
 - e. Production Order Document
12. What status must a Production Order be at in order to complete Material Withdrawals?
(1 correct answer)
- a. Created
 - b. Material Availability Check
 - c. Settlement Rule Created
 - d. Released
 - e. Printed
13. A plant is a:
(3 correct answers)
- a. Manufacturing facility
 - b. Distribution Center
 - c. Plant Maintenance Plant
 - d. Inventory

14. What kind of documents are created during goods issue for a production order?

(3 correct answers)

- a. Purchase Requisition
- b. Material Reservation
- c. Controlling Document
- d. Material Document
- e. Financial Accounting Document

15. How would you describe the integration of the Vendor Master:

(2 correct answers)

- a. Be directly used in production.
- b. Groups of views for SD
- c. Groups of views for FI
- d. Be used to post directly in supplier or vendor accounting.

16. Name the material master view that is responsible or relevant for integration with production?

(1 correct answer)

- a. Cost Planning
- b. Work Scheduling
- c. Sales and Distribution
- d. MRP

5.2 Standard Solution

True/False Questions

1. The structure of a routing contains operations to be performed.

True! Operations to be performed are included in a routing.

2. Standard operation times for operations are defined at work center level.

False! Standard operation times are defined in the routing. The work center however, monitors the parameters (e.g., setup time, labor) set in the routing.

3. Order confirmations are used for entering activities executed within your company concerning an order.

True! Order confirmations are used for entering activities performed within your company concerning an order.

Comprehension Questions

4. The Material Master can be created in two ways – what are they?

Answers: Create Special – specifies the type

Create General – you have to specify the type

5. Why do you need to release a production order?

You need to release an order so that subsequent processes such as printing a production document, goods issue, and order completion can be carried out.

6. Name the elements of a production order.

Order header, settlement rule, costs, operation sequences, operations, material components, PRTs, and document links.

7. Name the other application components integrated with manufacturing execution.

Inventory management, quality management, financial accounting, controlling, sales and distribution, order, project systems and human capital management.

Multiple Choice Questions

8. Which of the following statements about Work Centers are correct?
(3 correct answers)
- a. A cost center can be assigned to a work center.
 - b. People, Positions and Qualifications can be assigned to a work center on the Scheduling tab.
 - c. Formula keys are used to calculate cost, calculate execution time and calculate capacity requirements.
 - d. Work Centers are used to maintain resource related data.

Answers: a, c, d

9. Which of the following are elements of a Production Order?
(3 correct answers)
- a. A production order must have at least two operations.
 - b. Material components, PRTs and trigger points can be assigned to a Production Order.
 - c. Documents from the Document Management System can be linked to Production Orders.
 - d. Only Actual costs can be tracked on a Production Order.
 - e. The Production Order Status controls the allowed activities.

Answers: b, c, e

10. Which functions of a production order can be automated?
(3 correct answers)
- a. Order Release
 - b. Material Staging
 - c. Material Withdrawal Posting
 - d. Goods Receipt.
 - e. Order Settlement

Answers: a, c, d

11. Which documents are created as a result of Goods Issue Posting?
(3 correct answers)
- a. Pick List
 - b. Material Document
 - c. Accounting Document

- d. Controlling Document
- e. Production Order Document

Answers: b, c, d

12. What status must a Production Order be at in order to complete Material Withdrawals?

(1 correct answer)

- a. Created
- b. Material Availability Check
- c. Settlement Rule Created
- d. Released
- e. Printed

Answer: d

13. A plant is a:

(3 correct answers)

- a. Manufacturing facility
- b. Distribution Center
- c. Plant Maintenance Plant
- d. Inventory

Answers: a, b, c

14. What kind of documents are created during goods issue for a production order?

(3 correct answers)

- a. Purchase Requisition
- b. Material Reservation
- c. Controlling document (**Yes – posting to cost center**)
- d. Material Document (**Yes – Inventory movement document**)
- e. Financial Accounting Document (**Yes – Financial accounting document**)

Answers: c, d, e

15. How would you describe the integration of the Vendor Master:

(2 correct answers)

- a. Be directly used in production.
- b. Groups of views for SD
- c. Groups of views for FI
- d. Be used to post directly in supplier or vendor accounting.

Answers: c, d

16. Name the material master view that is responsible or relevant for integration with production?

(1 correct answer)

- a. Cost Planning
- b. Work Scheduling (**Yes – related to capacity planning**)
- c. Sales and Distribution
- d. MRP

Answer: b