Capacity Planning and Leveling

Capacity planning and leveling involves the functions of **campaign planning** (rough-cut or long-term planning) and **process planning** (detailed / short-term planning). These functions serve as tools for MRP controllers, plant managers, shop floor controllers, shift foremen and plant operators to plan the use of plant resources, control production runs and ensure that waste facilities are working properly.

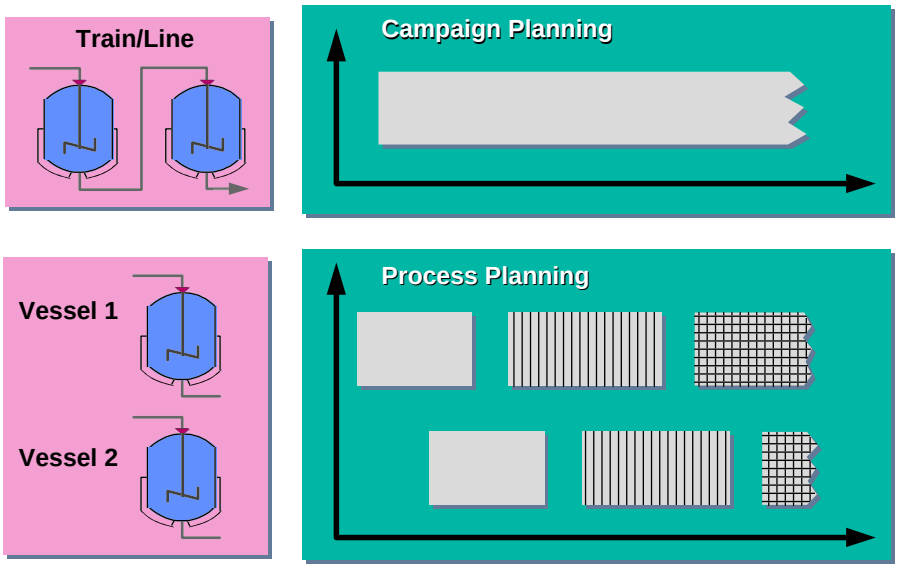

Fig. 7-1: Campaign planning and Process planning

Forms of Planning

In the case of a production plant, planning is initiated via planned requirements, either using a production plan or a campaign.

In the case of a recycling or waste disposal facility, we are dealing with the quantity of remaining materials which has accumulated from other production plants, and which must be processed. In this case, planning is not carried out starting with the product, but rather starting with the ingredients delivered for production.

In both cases, you can specify the available and required capacity and carry out capacity leveling.

Campaign Planning

Planning of Production Campaigns

A **production campaign** is an uninterrupted sequence of process orders of the same type, based on one master recipe. Whereas the planning of batches takes place shortly before production, campaign planning serves to carry out planning from a long-range perspective, at a time when only aggregated information on material requirements, product yields, remaining material quantities and resource requirements is needed or available.

This functionality will be implemented after Release 3.0. Until Release 3.0, campaign planning can be carried out via rough-cut planning in the planned orders (MRP).

Process Planning

Process planning refers to the scheduling of operations in a process order, the checking of material and capacity availability and the release of orders for production.

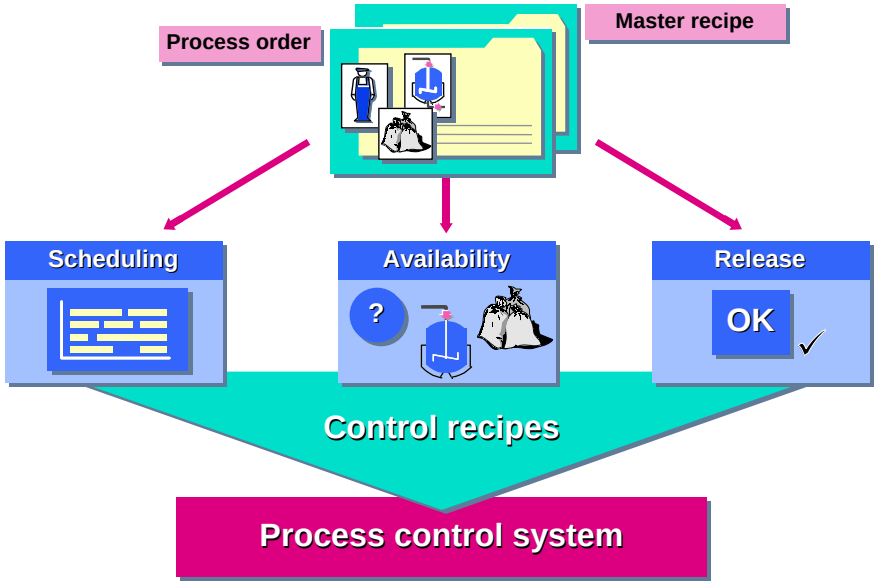

Fig. 7-2: Functions of process planning

Process Orders and Scheduling

The core of process planning is formed by the process orders and their operations. The standard values of the operations are used to calculate the lead times in the formulas you have defined. The lead time is calculated using forward or backward scheduling, depending on whether you enter a start or a finish date. In this way the system calculates all operation dates and thus also the lead time and dates for the entire order.

The duration of operations from process orders are determined via phases and the relationships defined for them. You can get further information on this subject in the section on planning strategies below, as well as in Chapter 6 *Process Orders.*

Capacity Requirements

Capacity requirements are calculated using the operations in planned and process orders. For all capacities of resources to be scheduled, the system calculates the corresponding requirements.

Available Capacity

The available capacity is calculated using the capacity allocated to the resources involved in a production process. There are two ways of calculating the capacity: exactly for a point in time or aggregated over defined

periods. When the available capacity is calculated, two questions need to be answered:

- When is the capacity available? This is represented via the shift schedule defined for the resource.
- How much capacity is available? This is represented using individual capacities and capacity utilization.

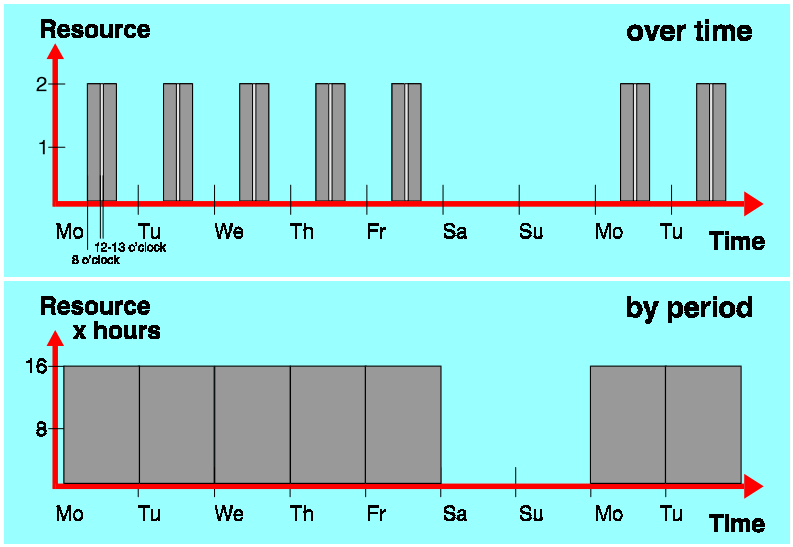

Fig. 7-3: Capacity available, regarded over time and by period

Defining Available Capacity for Resources

Resources are characterized by one or several capacities. Time-oriented capacities are defined by the shift schedule allocated to this resource, which contains pre-defined shift sequences valid for a certain period and for all resources.

The capacities defined for this can also be subdivided into individual capacities and displayed as such.

You can get further information on available capacity in Chapter 4 *Resources.*

Capacity Scheduling

When process orders are scheduled (dispatched) to the resources, the system carries out capacity scheduling. In this form of scheduling, also called *finite scheduling*, the limited available capacity of the resource is taken into consideration when the dates are determined. The comparison of capacity available for individual resources and the adjustment of underloads or overloads for them is called *capacity leveling*. It forms part of the functionality of the R/3 PP module and is used accordingly for the scheduling of resources in PP-PI.

Capacity Leveling

The functionality of capacity leveling has been available since Release 2.2. It enables various user-defined views of different scheduling data, as well as providing a number of functions for the planning of process orders (process planning).

Capacity leveling is controlled via a so-called overall profile, which is set in Customizing and which contains several sub-profiles. These sub-profiles contain settings for selection screens and general settings for evaluations and the screen layout of lists.

Grouping of Capacity Requirements

Within the framework of capacity leveling, you can group capacity requirements according to the needs of your plant, i.e. you can group them according to various criteria, such as:

- Capacity requirements per capacity category
- Capacity requirements listed according to planned and process orders
- Capacity requirements per process order and / or operation

Every requirements group is displayed in a separate line of the planning table.

Filtering of Requirements

Capacity leveling supports the definition of user-defined filters for the planning table, for example the display of only one type of capacity (time available to processing units in a plant, or volume per vessel) and the requirements determined for this capacity.

Sorting of Requirements Groups

Via a user-defined sort key, you can specify the display sequence of all requirements groups. This sorting can be changed dynamically, i.e. you can choose between various predefined sort keys.

Evaluation and Planning Period

For the evaluation and planning period, there are user-defined time profiles. They enable you to define time periods in absolute form, for example the months 6/95 to 9/95. It is also possible to use the current date for this display, for example all working days -10 to +30.

Period-oriented Process Planning

Process planning can be carried out *by period*. For this, the system dispatches operations to the individual planning periods (month, week, day, etc.). For operations taking longer than a defined period, there is an automatic distribution of operations over the periods in question.

For every period, the available and the required capacity are displayed and the quotient displayed in the form of a percentage load. For each resource, you can set an overload factor specifying the permissible overload.

Planning Table Screen

For period-oriented process planning, the R/3 System provides the Planning Table Screen, containing the above data.

Process Planning over Time

Process planning can also be carried out over time. For this, the operations are scheduled at an exact start or finish time. The start date/time enables scheduling to calculate the finish date/time and vice versa. The prerequisite for successful dispatching of operations is the available capacity for the scheduled duration of the operation.

Graphic Planning Table

For time-oriented process planning, the R/3 System provides the graphic planning table (see figure below). It is interactive and enables the dispatching, deallocation and rescheduling of operations at resources (usually the processing units).

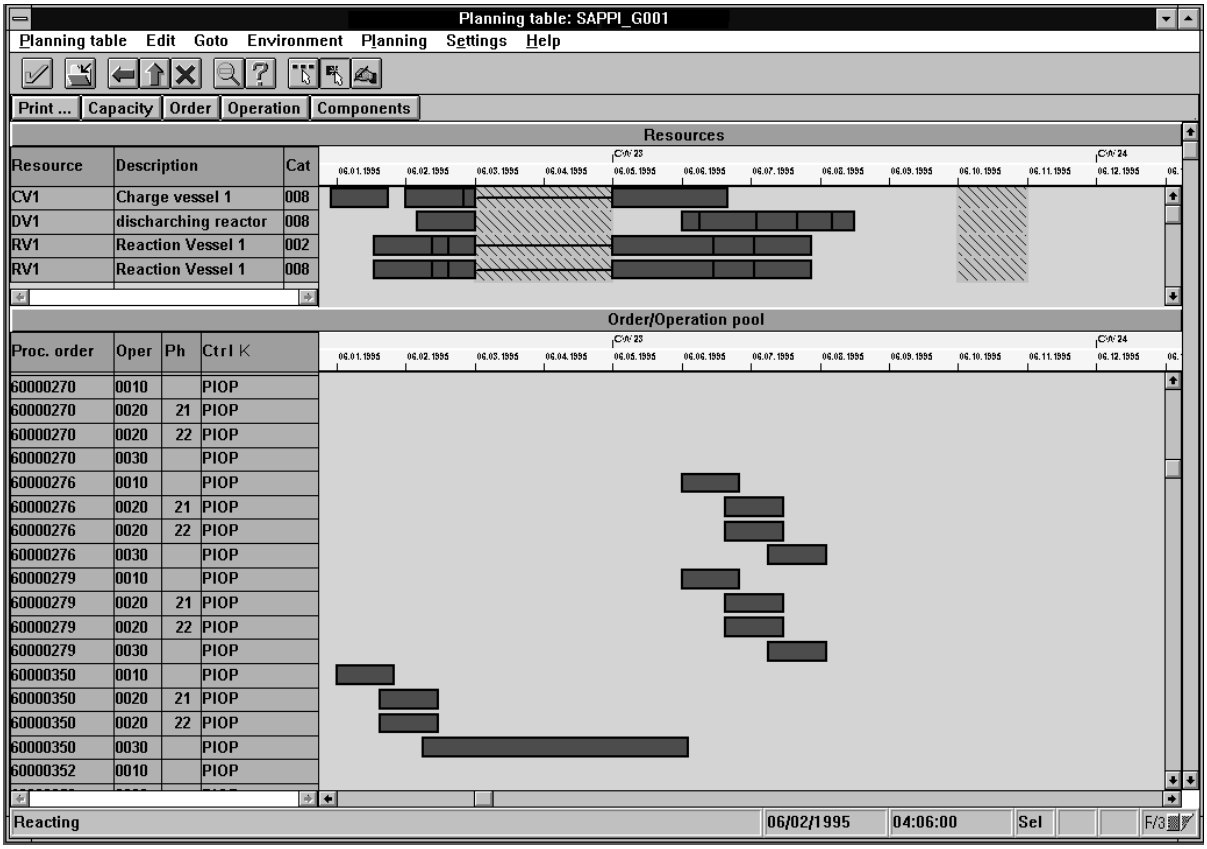

Fig. 7-4: Graphic planning table

The graphic planning table is made up of several parts, each consisting of a table area and a graphic area.

Table Area

The table area contains information on the identification and description of the individual requirements groups (for example, resources, orders, operations) to be displayed. The tables can be scrolled through individually.

Graphic Area

The graphic area contains the capacity requirements and their dates on a time axis, displayed by bars, lines and other symbols, similarly to a Gantt chart.

The graphic area can be seen as a window on the time axis. This window shows the same time period for all tables involved, but it can be changed via a zoom function changing the scale.

Preliminary Planning Period Follow-up Period

The planning table contains all capacity requirements for a specific evaluation period. However, you can also define a so-called “planning period”. For this, the periods before and after the period in the window can be scaled in relation to the planning period itself. In this way, you can aggregate the data before and after the planning period for overview purposes (see Fig. 7-5).

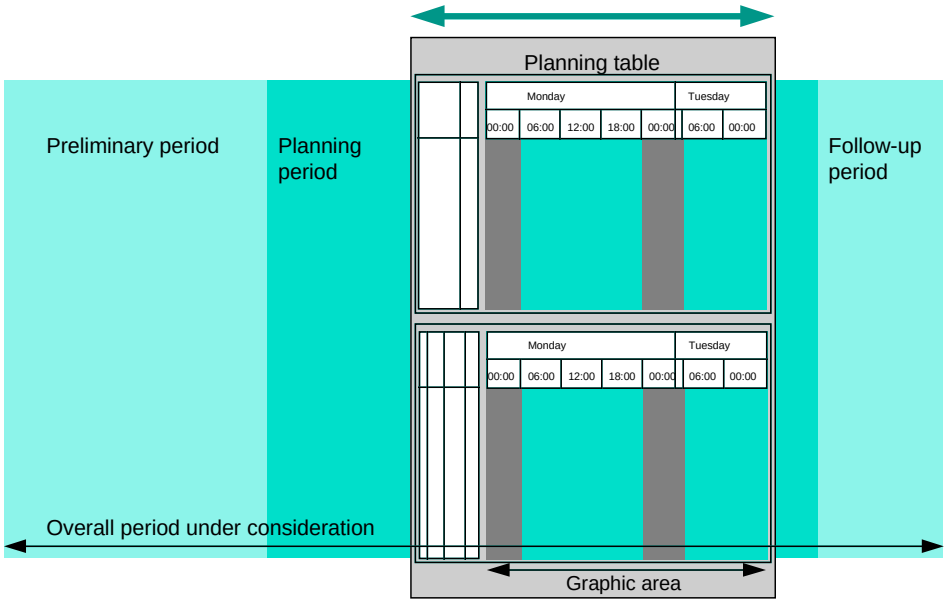

Fig. 7-5: Planning table as a window on the time axis

Customizing of Colors/Patterns

You can customize many different parts of the graphic planning table with respect to colors and patterns desired. In particular, you can highlight requirements groups and individual capacity requirements with a bright color, for example, so that important information is visible immediately.

In the **table area**, you can change the font size and color of individual objects from the requirements groups. In the **graphic area**, you can set the type of dates to be used for the graphic display (for example, earliest dates, latest dates or both).

In addition, you can specify colors and patterns for the lines and bars representing capacity requirements. You can also add other symbols (such as triangles, diamonds, arrows, etc.) in order to code specific information.

All the data on a particular object of capacity requirements can be selected for display and adjusted accordingly.

Capacity Requirements and Pegged Requirements

For many objects linked to individual or grouped capacity requirements, you can display the corresponding data:

- Resource, capacity, person
- Process order, operation, material component, inspection characteristic, inspection lot

For important objects, it is possible to branch directly to the detail screen, for example, on operation dates, standard values for an operation, etc.

Changing Objects

Objects with a direct planning relevance can be changed directly in the planning table.

- The capacity can be changed, in order to maintain alternative shifts, for example, in the case of restricted or extended capacities.
- Orders can be changed, in order to adjust to existing delivery dates.
- Operations can be changed, for example, in order to correct standard values for them.

All changes to objects are first carried out temporarily. Together with the planning results, you can then save or reject the changes made.

Dispatching/Deallocation/ Rescheduling of Operations

Planned and process orders can be dispatched directly in both forms of the planning table. You can also deallocate operations or reschedule them.

- In the Planning Table Screen, you can do this by linking process orders and periods.
- In the Graphic Planning Table, you can dispatch operations via the bar representing capacity requirements using Drag & Drop (see Fig. 7-6). The requirements can be shifted on the time axis for a resource, so that the desired start or finish date is displayed. The system will check the availability of the capacity over the entire period of the requirements.

Scheduling of Phases

When an order is scheduled, the operation dates/times are derived from the phase dates/times. During capacity leveling, the operation whose duration has been determined by the phases is now dispatched. This ensures that all phases of an operation can be dispatched without interruption by other operations.

Scheduling of Secondary Resources

The requirements of secondary resources of an operation or phase can be taken into consideration during capacity scheduling. The dates for these required resources are derived from the dates of the operation or phase involved.

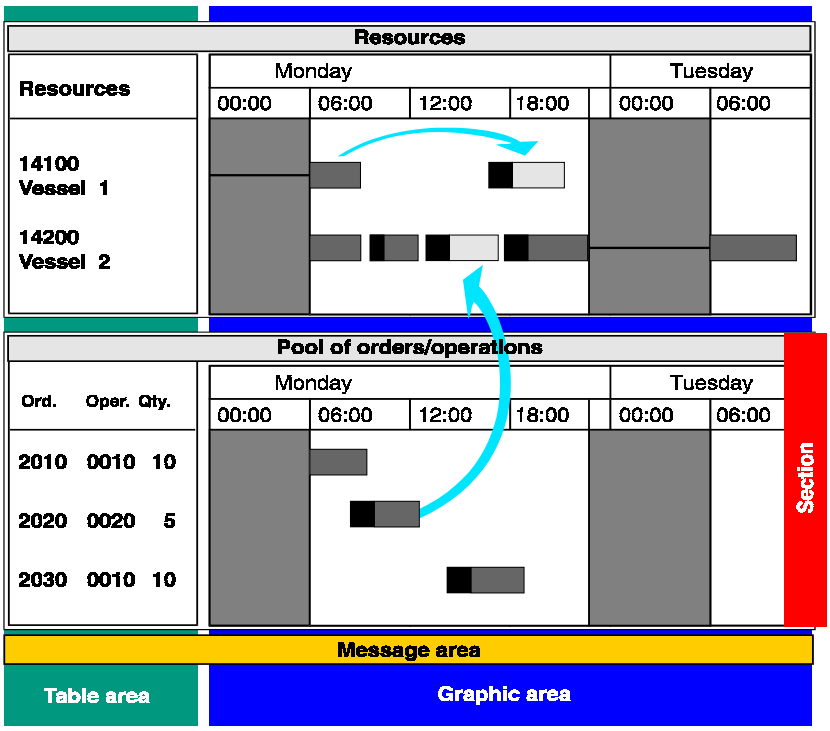

Fig. 7-6: Dispatching, deallocation and rescheduling of planned/process orders

Automatic Dispatching

For the automatic dispatching of one or several capacity requirements, there are several planning strategies available (see next section).

Planning Strategies

Introduction

Capacity leveling is carried out along the company-wide process chains, in order to schedule required resources in accordance with a limited available capacity. This needs to be done although some of the goals involved (short lead times, low inventory, adherence to delivery dates, optimum order mix, etc) are contradictory.

A planning strategy is a combination of control parameters in order to reach one or more of the above goals.

Planning Parameters

You can make use of the following planning parameters for the control of dispatching:

- **Planning direction:** The system can carry out the scheduling of operations in forward or backward direction.
- **Dispatching at earliest dates:** This indicator is activated if an operation is to be scheduled as early as possible within the planning period.
- **Insertion of operations:** An operation or a number of operations can be inserted at a particular point in time. Other resource commitments are shifted, depending on the planning direction, and rescheduled.
- **Closing of planning gaps:** This indicator specifies that you can trigger further actions after you have deallocated an operation. The gaps ensuing from the deallocation can be closed by the system shifting commitments normally displayed at the end of the deallocated operation in the ensuing gap.
- **Error-based planning termination:** This indicator enables you to specify that the planning of the current order is to be terminated if an error occurs when another function - for example, material not available - is activated.
- "**ATP logic" when regarding periods:** Overloads in individual periods must be taken into consideration in future periods. For example, a 200% load of one period will mean that the next period cannot have any work dispatched to it.
- **Dispatching sequence:** The sequence according to which the selected and displayed operations are to be sorted and dispatched can be specified via a user-defined sort key. Alternatively, you can also program a "user-exit" which will carry out the sorting in the way you need.
- **Planning log**: In every planning run, the functions activated will generate log messages for the operations. These messages can be grouped (all information, warning or error messages) and analyzed for future reference. This may mean that the planning strategy needs to be changed.

Influencing of Operations

Operation data can be "influenced" via the planning strategy. This strategy can be set up in such a way that an operation can only be scheduled within the floats calculated during order scheduling (floats before/after production). If, for example, an operation is dispatched in such a way that it consumes part of the float before production, this means that the other operations of this order only have the rest of the float before production available for scheduling.

Activating of Functions

In connection with capacity scheduling, additional functions are provided which can be deactivated if necessary. These are:

- Sorting of operations to be dispatched
- Checking of operation dates: Here, the system checks the dispatch dates against the basic order dates (from the planned order) or against the dates of previous or following operations in the order.
- Material availability check: The availability of the allocated components of an operation at the planned date can be checked.
- Immediate midpoint scheduling of the order.

Splitting and Allocating Capacity Requirements

Capacity requirements can be split and in this way distributed over several individual resources, for example, in order to reduce lead times.

It is also possible to further detail the planning run by allocating individual resources such as persons. You can get more information on the allocation of resources in Chapter 4 *Ressources*.

Resource Selection

In order to dispatch operations and phases, you have to determine which resources are to be committed for production.

In the master recipe, you can define technological and other selection criteria for the subsequent selection of a resource to be committed. These selection criteria are valuated in the form of characteristics in the R/3 classification system.

When the operation of a process order is released, it is necessary to select a resource from the defined class. During dispatching, it is possible to make a manual resource selection. The corresponding characteristics of the operation are valuated for this.

In the case of automatic dispatching of several operations, the selection of the resource is carried out using the correspondences of the characteristics of operation and resource. During rescheduling as well, the suitability of a new resource can be checked using the defined characteristics.

In the case of automatic dispatching with a planning strategy, this rule limits the selection of the potential resource.

Ressource Network

The planning functions take the resource network into consideration. This means that the system will only permit dispatching of an operation if there is a network link from the preceding resource.

You can get more information on resources in Chapter 4 *Ressources*.

Capacity leveling in PP-PI, together with the graphic functionality of the planning table, enables an exact and detailed planning and display of all scheduled production data flows.

For which objects in PP-PI can capacity planning be carried out?

- On the rough-cut planning level, you can plan the capacities of planned orders and (after Rel. 3.0) campaigns
- On the detailed planning level you can carry out detailed (finite) capacity scheduling for process orders, including capacity leveling

What is the purpose of the graphic planning table?

The graphic planning table serves to help you plan your production runs in a user-friendly interactive manner. Using the graphic planning table, you can dispatch, deallocate and reschedule process orders or individual operations, as well as display and change the use of resources.