5 Structure of Advanced Planning Systems

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APS have been launched independently by different software companies at different points in time. Nevertheless, a common structure underlying most of the APS can be identified. APS typically consist of several *software modules* (eventually again comprising several software components), each of them covering a certain range of planning tasks (see Rohde et al. 2000).

In Sect. 4.2 the most important tasks of supply chain planning have been introduced and classified in the two dimensions *planning horizon* and *supply chain process* by use of the SCP-Matrix (Fig. 4.3). As Fig. 5.1 shows, certain planning sections of the SCP-Matrix, e. g. mid-term procurement, production and distribution, are typically covered by a respective software module. The names of the modules vary from APS provider to APS provider, but the planning tasks that are supported are basically the same. In Fig. 5.1 supplier-independent names have been chosen that try to characterize the underlying planning tasks of the respective software modules.

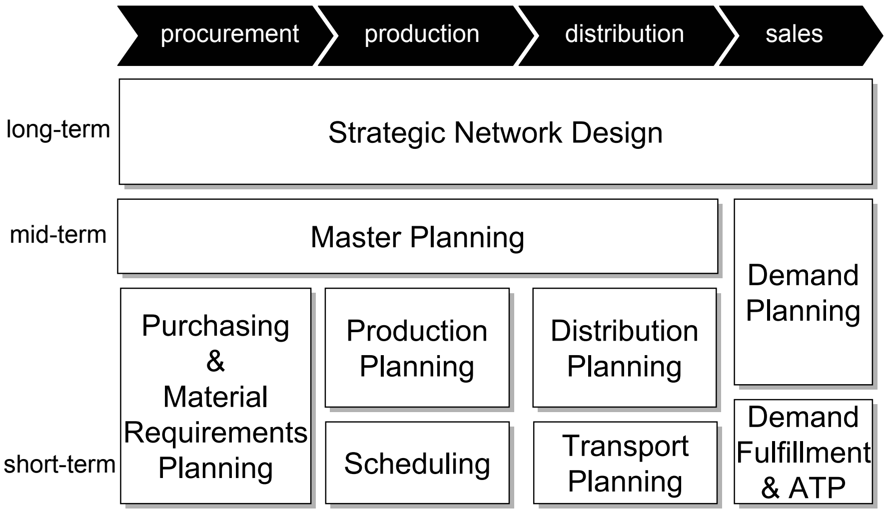

Fig. 5.1. Software modules covering the SCP-Matrix

APS typically do not support all of the planning tasks that have been identified in Sect. 4.2. In the remainder of the book it will be shown which tasks are actually considered (Part II), how to select and implement APS (Part III), how to build models using software modules (Part IV) and which solution methods are commonly used (Part VI). In the meantime, the following provides an overview of the structure of the software modules and the planning tasks concerned:

Strategic Network Design covers all four long-term planning sections, especially the tasks *plant location* and the design of the *physical distribution structure*. Some questions that arise in *strategic sales planning* (e. g. which products to place in certain markets) can be considered, too. Basically, the design of the supply chain and the elementary material flows between suppliers and customers are determined.

Demand Planning. Further tasks of *strategic sales planning* (e. g. long-term demand estimates) and the *mid-term sales planning* are usually supported by a module for Demand Planning.

Demand Fulfillment & ATP. Most APS providers offer Demand Fulfillment & ATP components that comprise the *short-term sales planning*.

Master Planning coordinates procurement, production, and distribution on the mid-term planning level. The tasks *distribution, capacity* and *mid-term personnel planning* are often considered simultaneously. Furthermore, *master production scheduling* is supported.

Production Planning and Scheduling. If there are two separate software modules for Production Planning and Scheduling, the first one is responsible for *lot-sizing* whereas the second one is used for *machine scheduling* and *shop floor control*. Quite often, however, a single software module ought to support all three tasks.
Planning on such a detailed, short-term planning level is particularly dependent on the organization of the production system. Therefore, all bottlenecks have to be considered explicitly. If multi-stage production processes and product structures exist, they have to be coordinated in an integrative manner. In order to meet the specific requirements of particular industries, some software vendors offer alternative Production Planning and Scheduling modules.

Transport Planning and Distribution Planning. The short-term *transport planning* is covered by a corresponding software module. Sometimes an additional Distribution Planning module deals with material flows in a more detailed manner than can usually be done by Master Planning.

Purchasing & Material Requirements Planning. The planning tasks *BOM explosion* and *ordering of materials* are often left to the ERP system(s), which traditionally intend to supply these functionalities and are needed as transaction systems, anyway. As far as non-bottleneck materials are concerned, the BOM explosion indeed can be executed within an ERP system. However, an “advanced” purchasing planning for materials and components, with respect to alternative suppliers, quantity discounts, and lower (mid-term supply contracts) or upper (material constraints) bounds on supply quantities, is not supported by ERP systems. Not all APS providers launch a special software module Purchasing & Material Requirements Planning that supports (mid- to) short-term procurement decisions directly. Sometimes, at least a further Collaboration module helps to speed up the traditional interactive (collaborative) procurement processes between a manufacturer and its suppliers.

The software modules of APS are dedicated to deterministic planning. However, there are uncertainties on both the inbound (unreliable suppliers, machine breakdowns) and the outbound (unknown customer demand) side. In order to hedge against uncertainty, buffers have to be installed – either in the form of safety stocks or safety times. Buffering against uncertainty is a task that covers all supply chain processes and actually cannot be assigned to a single software module because it depends on the particular industry and the locations of the decoupling points (see Tempelmeier 2001). However, in accordance with some software providers, we describe the safety stock planning functionality of APS in Chap. 7, when discussing the details of the Demand Planning module.

The planning tasks may vary substantially dependent on the particular industries and supply chains, respectively. This is especially true for the short-term planning tasks (see e.g. Drexl et al. 1994). APS providers are increasingly becoming aware of this situation. Therefore, they offer several software components and/or software modules covering the same planning tasks, yet respect the peculiarities of the particular type of supply chain considered. So actually, a third dimension *supply chain type* should be added to Fig. 5.1. For the sake of clarity, however, the need for industry-specific solutions is visualized in a separate figure (Fig. 5.2).

Software modules can be seen as some sort of "planning kit". The users buy, install and integrate only those modules that are essential for their business. In most cases, not all modules of an APS provider are installed. Sometimes, but not often, components of different APS providers are combined.

The revers is also possible. Some APS providers do not offer software modules for all planning tasks. However, APS suppliers seem to be highly interested in providing complete solutions. As a result, further modules for supplier and customer collaboration and supply chain execution (as we will see later on) have been launched. Quite often, APS vendors bundle APS modules together with modules for ERP and CRM in order to provide a comprehensive supply chain suite. Thus, sometimes it may be hard to identify the *planning* modules of the suite (especially their functionality) and to verify the APS-structure described above when visiting the web pages of the respective software companies.

Software modules are not always implemented for the planning tasks they originally had been designed for. For example, a Master Planning module can

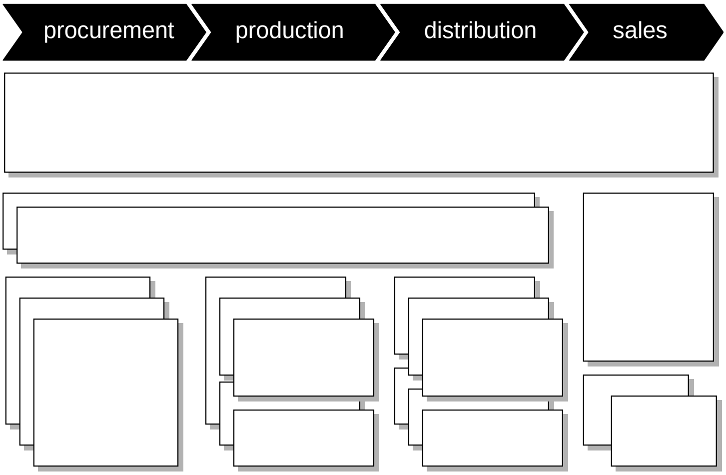

Fig. 5.2. Modules of APS for particular industries

be used for Distribution Planning. This happens if modeling features of the modules are quite similar and the same solution method can be applied to different types of problems.

Besides the already proposed software modules, additional software components are frequently supplied, which support the coordination of different software modules as well as the integration with other software systems, e. g. ERP systems or Data Warehouses (see Chap. 13).

However, preparing the technological capability to establish information links between different software modules is only the first step. The crucial question is what information should flow at which point in time. So the problem is to design and implement planning concepts that coordinate these software modules with respect to the objectives of the enterprise and supply chain as a whole, respectively, in the most effective manner. In Chap. 4 such planning concepts have been presented and it has been shown that they have to fit the particular planning requirements of different types of supply chains. Quite often, APS vendors provide solutions for particular industries, i.e. they arrange a set of software modules that are intended to serve a certain industry well. So far, however, "workflows" for particular industries are only seldom provided. Such workflows give some advice on how to establish the information flows between these modules so that they are well-integrated with respect to the peculiarities of the respective industry. This is achieved by rather general templates.

Also frequently offered are the tools for the integration (mostly using Internet technology) of different supply chain partners operating in different locations. These software components provide the necessary data for a supply chain-wide, long- and mid-term planning, and communicate the outcome of a central planning process to the respective de-central units. In most cases, an alert system supports the interaction between central and de-central planning (see Sect. 4.1). Since Internet technology can be applied for various purposes, APS suppliers increasingly offer additional e-business tools, e. g. for the opening of virtual markets in order to purchase raw materials.

This book, however, concentrates on collaboration, not on market-based coordination. Market-based processes focus on pricing mechanisms to achieve coordination between two or more parties. Thus, they are of competitive nature. Collaboration or *Collaborative Planning*, however, places the emphasis on processes of cooperative nature as pursued in SCM.

Figure 5.3 shows the collaboration interfaces of an APS. Collaboration appears in two directions: collaboration with customers and collaboration with suppliers. From the view of a single member of the supply chain, collaboration is important on both ends of its SCP-matrix, the sales and the procurement side. The difference between the two types of collaboration is the divergent structure in the case of customer collaboration and the convergent structure in the case of supplier collaboration.

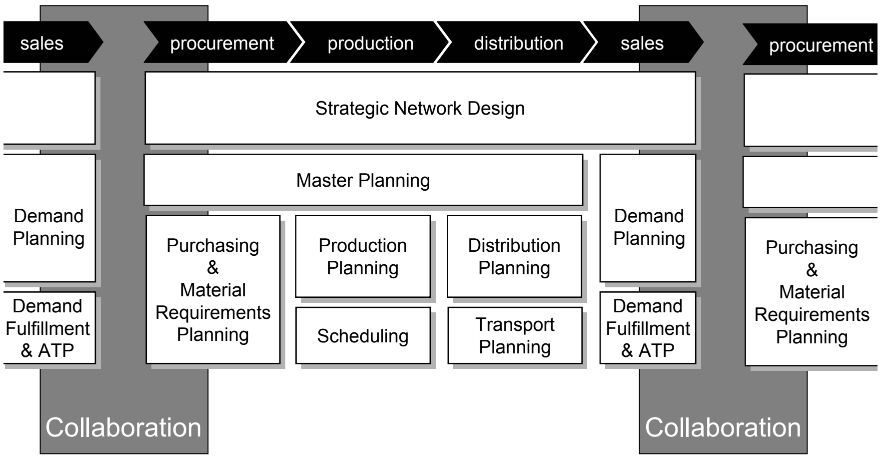

Fig. 5.3. Collaboration between APS

- One of the main applications of *Sales Collaboration* is the mid-term collaborative demand planning. In an iterative manner, forecasts are jointly generated. During this task, forecasts have to be coordinated and adjusted, e. g. by means of judgmental forecasting processes, as opposed to only aggregated. In shortage situations in particular, short-term collaboration may support ordinary ATP processes by providing additional information on alternative product configurations, delivery dates and prices.
- The task of mid-term *Procurement Collaboration* is to come to an agreement on procurement plans derived from master plans. Aggregated product quantities have to be disaggregated and allocated to possible suppliers

with respect to their capabilities. These capabilities can be evaluated and utilized efficiently in an iterative collaboration process. Thus, it is possible to generate procurement plans and delivery schedules that avoid material shortages.

As already shown in Sect. 4.1, Supply Chain Execution Systems (SCES) bridge the gap between preparing decisions in an APS and the final implementation of these decisions in practice (“execution”). Figure 5.4 (see e.g. Kahl 1999) shows that software modules for supply chain execution also cover the supply chain processes “procurement”, “production”, “distribution” and “sales.” However, the planning tasks tackled there concern the execution, and thus comprise an even shorter–term planning horizon. For example, SCES deal with material handling, order transmission to suppliers, shop floor control, transportation execution (including tracking and tracing) and on–line response to customer requests. If necessary, they enrich the planning instructions of APS with further details (e.g. by human support), but mainly they monitor and control the execution of the decisions prepared by the APS. An *on–line* monitoring of the execution processes allows *real–time* reaction to unforeseen events.

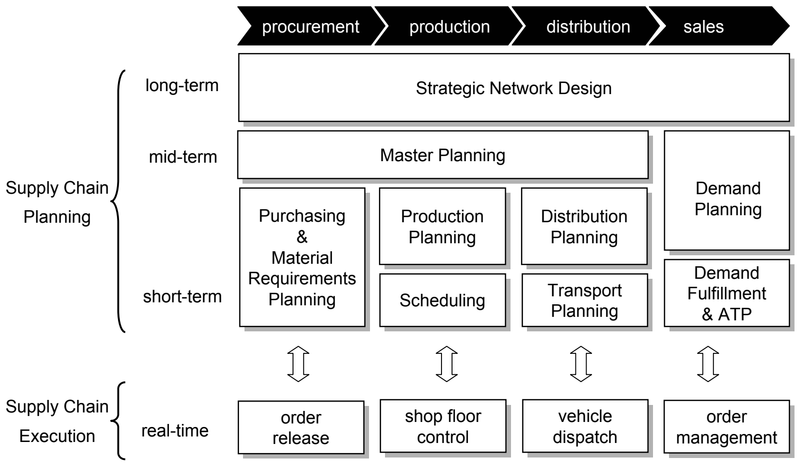

Fig. 5.4. Relation between APS and Supply Chain Execution Systems

SCES are closely coupled to APS by means of alert management systems, so-called Supply Chain Event Management (SCEM) systems. Thus, they are able to overcome the static planning intervals of traditional rolling horizon planning and allow for a reactive, event-driven planning. The borders between APS’ and SCES’ functionality cannot be clearly defined. For example, the order promising function may be part of both APS and SCES. Usually ATP quantities are allocated to customer groups within an APS (see Chap. 9), whereas the on–line search for free ATP and real-time responses to customers are executed by an SCES. The search rules for ATP consumption may be defined in the APS (and sent to the SCES as directives) or may be customized directly within the SCES.

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