

Chapter 9

Planning Hierarchy, Modeling and Advanced Planning Systems

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Along a supply chain, various decisions have to be made continuously, from the rather simple choice, which job to be processed next on a certain machine, to the serious question, whether to build a new factory or to close down an existing one. Within this chapter ‘*Supply chain planning*’ is used as a generic term for the whole range of those decisions on the design of the supply chain, on the mid-term coordination and on the short-term scheduling of the processes in the supply chain. This definition also applies to the traditional notion of *Logistics*. However, in the scope of the recent development of supply chain management, the focus is on the following two aspects of planning:

- *Integral planning* of the entire supply chain: The planning process should consider the supply chain of an enterprise, at least from its suppliers up to its customers, as a whole and take into account the interdependencies of the various activities.
- *True optimization of decisions*: The planning process should be based on a proper definition of alternatives, objectives and constraints and use (exact or heuristic) optimization algorithms.

While the last aspect is quite familiar to Operations Researchers, it has not been the common view in practice for a long time: The wide-spread Enterprise Resource Planning (ERP) software and the included Material Requirements Planning (MRP) logic, in spite of their name, do not provide planning functions in the above sense [Drexel, Fleischmann, Günther, Stadtler, & Tempelmeier, 1994].

The postulates of integral planning and of true optimization are scarcely compatible. A practicable compromise between both postulates is the use of *Hierarchical Planning* (HP) concepts allowing to decompose the overall task into partial planning tasks and to still consider their interdependencies and to coordinate their solution. Hierarchical Planning has also a long tradition in Operations Research, starting with the work of Hax and Meal in

1975, and many planning algorithms have been developed for the various partial planning tasks.

What then is ‘*Advanced Planning*’? This notion has been introduced by software providers for a new type of planning software, the *Advanced Planning Systems* (APS), which are based on the above ideas. It is true that neither the HP concept underlying the APS architecture nor the algorithms used in the single modules are particularly advanced, but the real advance is the *implementation* of these concepts in standard software, enabling the dissemination of reasonable planning concepts and OR based algorithms in practice. This is indeed a great progress as compared to the traditional ERP systems. Moreover, the APS architecture is open to include new modules and new algorithms. This is necessary, because there are various partial problems in supply chain planning that still miss practicable solution algorithms. Thus, APS provide an appropriate framework for putting OR developments into practice.

However, there seems to be some confusion in both science and practice what APS are, which modules and solution methods they include, which purposes they can be used for and how they should be used. Therefore, the aim of this chapter is to analyze first the various supply chain planning tasks and their hierarchical relationship and then the architecture and functionality of APS.

Fisher (1997) already has shown how important it is to identify different types of supply chains in order to derive fitting management strategies. Thus, planning systems, which try to implement these strategies operatively, also have to be tailored to the particular requirements of the type of supply chain under consideration. To support the processes of describing and analyzing different types of supply chains, Section 1 first introduces a *typology* of supply chains, which is illustrated by means of two contrasting examples: consumer goods manufacturing and computer assembly. Section 2 then provides a general framework for deriving the corresponding planning tasks of the respective supply chain type identified. This framework again is applied to the two examples. As it is shown in Fleischmann, Meyr, and Wagner (2002, Chapter 4.3), planning concepts that fit these planning requirements can be designed by means of HP. Therefore, at the end of Section 2, HP concepts, including recent developments, are reviewed.

Section 3 shows that a common modular architecture, which is along the lines of HP, is underlying all APS and discusses the functions of the typical modules. Finally, Section 4 presents a snapshot (state: January 2003) of five particular APS, reveals – as far as possible – the OR methods applied within their modules and reviews case studies of actual APS implementations which have been published in the literature.

1 Types of supply chains

Experience with Production Planning and Control systems has shown that a single production planning concept like the MRP II–concept cannot cover