10 Production Planning and Scheduling

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Assuming that the master plan has been generated, we can now derive detailed plans for the different plants and production units. In the following we will describe the underlying decision situation (Sect. 10.1) and outline how to proceed from a model to a solution (Sect. 10.2). Some of these steps will be presented in greater detail, namely model building (Sect. 10.3) and updating a production schedule (Sect. 10.4). Whether Production Planning and Scheduling should be done by a single planning level or by a two-level planning hierarchy largely depends on the production type of the shop floor. This issue will be discussed together with limitations of solution methods in Sect. 10.5.

10.1 Description of the Decision Situation

*Production Planning and Scheduling* aims at generating detailed production schedules for the shop floor over a relatively short interval of time. A *production schedule* indicates for each order to be executed within the planning interval its start and completion times on the resources required for processing. Hence, a production schedule also specifies the sequence of orders on a given resource. A production schedule may be visualized by a gantt-chart (see Fig. 10.4).

The *planning interval* for Production Planning and Scheduling varies from one day to a few weeks depending on the industrial sector. Its “correct” length depends on several factors: On the one hand it should at least cover an interval of time corresponding to the largest throughput time of an order within the production unit. On the other hand the planning interval is limited by the availability of known customer orders or reliable demand forecasts. Obviously, sequencing orders on individual resources is useful only if these plans are “reasonably” stable, i.e. if they are not subject to frequent changes due to unexpected events like changing order quantities or disruptions.

For some production types (like a job shop) Production Planning and Scheduling requires sequencing and scheduling of orders on potential bottlenecks. For other production types (like group technology) an automated, bucket-oriented capacity check for a set of orders to be processed by a group within the next time bucket(s) will suffice. Sequencing of orders may then be performed manually by the group itself.
Planning tasks can and should be done decentrally, utilizing the expertise of the staff at each location and its current knowledge of the state of the shop floor (e.g. the availability of personnel). Readers interested in the daily business of a planner and scheduler and resultant requirements for decision support are referred to McKay and Wiers (2004).

The master plan sets the frame within which Production Planning and Scheduling at the decentralized decision units can be performed. Corresponding directives usually are:

- the amount of overtime or additional shifts to be used,
- the availability of items from upstream units in the supply chain at different points in time,
- purchase agreements concerning input materials from suppliers – not being part of “our” supply chain.

Furthermore, directives will be given by the master plan due to its extended view over the supply chain and the longer planning interval. As directives we might have

- the amount of seasonal stock of different items to be built up by the end of the planning horizon (for production units facing a make-to-stock policy),
- given due dates for orders to be delivered to the next downstream unit in the supply chain (which may be the subsequent production stage, a shipper or the final customer).

10.2 How to Proceed from a Model to a Production Schedule

The general procedure leading from a model of the shop floor to a production schedule will be described briefly by the following six steps (see Fig. 10.1).

Step 1: Model building

A model of the shop floor has to capture the specific properties of the production process and the corresponding flows of materials in a detail that allows to generate feasible plans at minimum costs.

Only a subset of all existing resources on the shop floor – namely those which might turn out to become a bottleneck – will have to be modeled explicitly, since the output rate of a system is limited only by these potential bottlenecks. Details on model building are presented in Sect. 10.3.