Personnel Scheduling in HARMONY

Laurens Fijn van Draat, Gerhard Post, and Bart Veltman

ORTEC bv, Groningenweg 6K, 2803 PV Gouda, The Netherlands, www.ortec.com, lfijnvandraat@ortec.nl

The mission of ORTEC, and specifically of HARMONY, is to provide planners and managers access to the benefits of mathematics, and operations research in particular. The basic philosophy of HARMONY is to integrate workforce management with administrative and (other) logistic processes of an organisation and to enrich decision-making within workforce management by OR/MS techniques. The integral approach of workforce management distinguishes HARMONY from most of the studies in the OR/MS literature. Furthermore, HARMONY offers an environment to embed algorithms that add value to planners in the real world.

HARMONY provides an advanced planning environment for shift scheduling and rostering. It offers the user a complete spectrum of support varying from fully manual planning to fully automatic planning. In HARMONY one can for example design cyclic rosters, construct calendar-related rosters based upon these cyclic rosters, make a holiday planning, etcetera.

The planning process starts with the definition of shifts and ends with the realisation of these shifts. In this process one can identify three phases, that are all supported by the mathematical engines in HARMONY. Although none of our clients face the problems of all of these three phases, they all face at least one of them (which is most often the second phase).

The first phase is the definition of the shifts: given a demand for resources per time interval and some constraints for the shifts, one has to construct a minimum set of shifts that satisfies all constraints and fulfils the demand. The engine in HARMONY that supports this phase solves the problem with a set covering algorithm.

The second phase consists of assigning these shifts to the available employees (i.e., create a roster). Here, the user can specify many different types of soft and hard constraints on four different levels (organisation, department, group or individual). For this part of the planning process, HARMONY contains two engines. The first engine uses an insertion technique. It allows for fast construction of good rosters and is ideal for simulation analysis and for completing existing (partial) rosters. The second engine is more powerful and is useful for the construction of complete rosters. It uses a genetic algorithm, local search, and variable neighbourhood search to iteratively improve existing rosters.

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In the third phase of the planning process the planner has to specify *where* the employees have to work. The input of this phase is the output of the previous phase, i.e. a roster with the specifications of *when* the employees have to work. The planning in this phase is usually made shortly before it is actually carried out (for example one day or one week). The engine in HARMONY defines this problem as a min cost max flow problem.

In our demonstration, we will briefly go through several aspects of HARMONY, and after that focus on the engines in HARMONY that solve the three problems described above.

References

1. S.L. van de Velde, *ORTEC HARMONY. Innovative advanced planning software for an integrated approach to workforce management optimization*, OR/MS Today, April 2002.