10th International Conference of the Practice and Theory of Automated Timetabling
PATAT 2014, 26-29 August 2014, York, United Kingdom

Large-Scale Rostering in the Airport Industry

Andreas Klinkert

We present a major research and business project aimed at developing efficient and flexible software for automated airport staff rostering. Industrial partner is Swissport International, one of the largest ground handling companies worldwide, and pilot site for the project is Zurich Airport in Switzerland. Swissport provides services for 224 million passengers and 4 million tons of cargo a year, with a workforce of 55,000 personnel at 255 airports. Airport ground handling involves a broad range of different tasks, including passenger services like check-in, gate handling and transfer services, and ramp services like baggage management and aircraft handling, servicing and cleaning.

The diversity of the ground handling functions at Zurich Airport, the large number of operational duties, and the around-the-clock business hours result in hundreds of different types of shifts to be planned every month, and an employee base consisting of several thousand persons with numerous different skills. Further challenges come from a dynamic, demand-driven planning policy which does not rely on repetitive shift patterns rolled out over a long-term horizon, and from a so-called shift-bidding approach which attributes high importance to employee preferences regarding the individual work plans.

We start with an introduction to the business environment of the project, and show its actual planning context which comprises other software tools and human planning activities related to the workforce scheduling process. We discuss the various project requirements and the challenges and goals that shaped the project and the methods used.

Employee scheduling typically involves a number of subproblems including demand modeling, shift design, days-off scheduling, and shift assignment. The rostering process considered here focuses on the days-off planning and shift assignment phase.

Zurich University of Applied Sciences (ZHAW)
Institute of Data Analysis and Process Design (IDP)
Rosenstrasse 3, P.O. Box Winterthur CH-8401 Switzerland
E-mail: andreas.klinkert@zhaw.ch

The methodology used for solving the associated complex large-scale optimization problems comprises a broad range of optimization techniques including preprocessing, decomposition and relaxation approaches, large-scale integer programming models and various heuristic procedures.

We provide insight into several aspects of the solution process, with special focus on the analysis and preprocessing phase which turned out to be crucial for the entire planning system. An important purpose of this phase is to deal with feasibility issues related to incorrect or inconsistent input data. In fact, experience shows that most of the operational instances submitted to the planning tool are infeasible, and detecting and patching the infeasibility is typically very difficult. Without specific hints from the software it is virtually impossible for the human planners to discover the causes of infeasibility, and to adjust the input data accordingly. The tools developed for this planning phase range from simple but thorough data checking and analysis modules to sophisticated mathematical models for bottleneck analysis, identification of minimal infeasible constraint systems, and rapid presolving techniques.

Finally, we present computational experience with real world instances and discuss operational impacts of the developed planning tool. The operational deployment started in 2011 in Zurich Airport and has continually been extended since then. Bottom line benefits include faster and more robust planning processes, improved roster quality, better fairness, reduced planning capacity requirements, and as a result, substantial financial savings.