AIRCRAFT LINE MAINTENANCE STAFFING AND SCHEDULING WITH STAFF SKILL HETEROGENEITY

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Abstract - Aircraft line maintenance is performed during ground time between flights to ensure continued airworthiness. These tasks include minor inspections, troubleshooting, fault rectification, etc., and are expected to be conducted within given time windows provided by aircraft routes. As multiple tasks may overlap within ground time windows at an airport, those conducting tasks must respect the manpower availability of the maintenance provider in each maintenance slot. Traditionally, most previous studies assume homogeneous staff skills, i.e., any staff can perform any task. In reality, maintenance personnel have heterogeneous capabilities, that is, a staff member may be capable of performing only some of the tasks. Thus, the set of capable staff varies by task, which affects manpower availability. Maintenance duration depends on the number of qualified staff assigned; specifically, more qualified staff reduces task duration, whereas fewer staff extend it. Timely maintenance is critical to airline operations, as maintenance delays can cause flight delays and disrupt aircraft routes. Our research problem, therefore, determines both the timing (start and completion times of each maintenance task) and the number of staff assigned for each task, each with the appropriate skill set, with the objective of minimizing total maintenance delays and ensuring professional operational efficiency. We formulate the problem as a mixed-integer linear programming model. Due to its complexity, we develop a column generation-based approach, where each column represents a schedule for an individual staff member, and staff capabilities for each maintenance task are incorporated as parameters in the master problem. Computational results demonstrate the effectiveness of the proposed column generation method. We also conduct a computational study comparing our model with the traditional model which assumes staff skill homogeneity. The results show that the traditional model may produce schedules where staff cannot actually perform the assigned tasks, which leads to greater delays.

Keywords: Aircraft Line Maintenance Staffing And Scheduling; Column Generation; Staff Skillheterogeneity