Allocation of Ground Handling Resources at Copenhagen Airport

Operating an airport is a very complex task involving many stakeholders. The primary role of airport management is to ensure that the airport provides sufficient capacity in all operational areas and that all the companies carrying out business at the airport have the best possible working conditions. Moreover, management must ensure that the airport stays competitive and that its business goals are met to the greatest possible extent.

The European Organization for the Safety of Air Navigation (EUROCONTROL) expects demand for air services in Europe to double by 2030 and identifies airport capacity as a potential bottleneck that may slow this growth. Many European airports are already operating at the limit of their capacity; moreover, they are under competitive pressure from both nearby airports and fast-growing mega-hubs in the Middle East. Providing efficient and reliable airport operations is imperative for the viability and continued development of both individual airports and the air transportation industry in general.

This thesis gives a general introduction to the management of airport operations. It describes the main airport processes and optimization problems that these processes give rise to. The primary focus is on ground handling resource allocation problems, it looks in detail at the following problems: the check-in counter allocation problem, the baggage make-up position problem, the tactical stand and gate allocation problem, the operational stand and gate allocation problem, and the taxiway route allocation problem. Although these problems arise from different airport processes and involve different stakeholders, they share some characteristics and can be formulated as variants of the same mathematical model.

Many real-world aspects must be taken into consideration when solving airport optimization problems; the models and solutions that are developed must be able to meet the needs of airlines to the greatest possible extent. They must be easy to configure and efficient to solve. For three of the problems considered here, real-world restrictions reduce the number of possible variables to such an extent that the problem can be efficiently solved to optimality with modern, state-of-the-art MIP solvers. For the remaining problems, an LP based heuristic was developed. The method iteratively solves a restricted LP relaxed version of the problem and exploits expert knowledge to generate appropriate initial variables, enabling the heuristic to efficiently find near-optimal and operationally valid solutions.

The work described in this thesis was carried out in the context of an Industrial PhD project at Copenhagen Airport in collaboration with the Technical University of Denmark. It contributes to both the introduction and definition of various ground handling resource allocation problems, and proposes a mathematical formulation of the problems. These contributions are presented in four scientific papers and one technical report, which are included. All the models and solution methods described here are currently implemented and used in various settings at Copenhagen Airport. These include weekly operational planning of check-in counter allocation and long-term capacity/demand analyses of the airport’s stands and gates.

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