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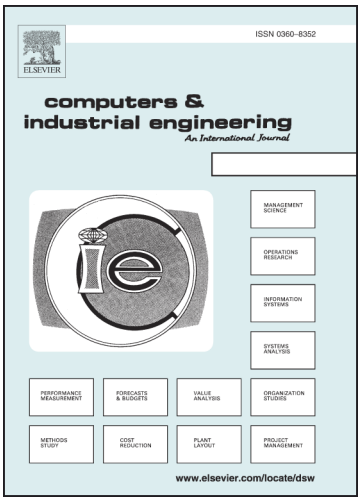

Joint optimization using a leader-follower Stackelberg game for coordinated configuration of stochastic operational aircraft maintenance routing and maintenance staffing

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ACCEPTED MANUSCRIPT

Joint optimization using a leader-follower Stackelberg game for coordinated configuration of stochastic operational aircraft maintenance routing and maintenance staffing

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Abstract

The flight delay-based operational aircraft maintenance routing problem (OAMRPFD) and the maintenance staffing problem (MSP) are interrelated and interdependent. Despite this interdependency, each problem is solved separately. Therefore, the optimal plan specified by each problem is not executed as planned, which consequently increases the operating cost of each aspect of the problem.

The present research paper studies OAMRPFD in addition to MSP, with two main objectives. The first is to develop an OAMRPFD model that appropriately reflects the flight delay and, accordingly, a new stochastic framework of a scenario-based OAMRPFD (SOAMRPFD) is put forward. The second is to handle the interdependence between SOAMRPFD and MSP, by proposing a coordinated configuration of SOAMRPFD and MSP that is formulated like the leader-follower Stackelberg game, with SOAMRPFD as the leader and MSP as the follower. A bi-level optimization model is used to present this game and is solved by a bi-level nested ant colony optimization (ACO) algorithm. The viability and potential of the proposed model are established using a major airline and a maintenance company, which are based in the Middle East, as a case study. The results demonstrate significant cost savings for both the airline and maintenance company.

Keywords: Aircraft maintenance routing problem, Maintenance staffing problem, Stackelberg game, Bi-level optimization.

1. Introduction

Airlines have used the aircraft maintenance routing problem (AMRP) as an efficient method for determining feasible aircraft maintenance routes (Haouari et al., 2012). Nevertheless, some challenges, due to increased flight delays, have appeared in the last decade. As a result, airlines have incurred increasing operating cost due to their inability to operate the generated aircraft routes as planned. For instance, Liang et al. (2015) stated that the operating cost of the U.S. airline industry in 2011 increased to about US$7.7 billion due to over 100 million minutes of delay. In the coming years, air traffic is expected

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