# Solving railroad blocking problem using ant colony optimization algorithm

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## ARTICLE INFO

## ABSTRACT

The railroad blocking problem is one of the most important decision in freight railroads. The objective of this problem is to minimize the costs of delivering all commodities by deciding which inter-terminal blocks to build and specifying the assignment of commodities to these blocks, while observing limits on the number and aggregate volume of the blocks assembled at each terminal. This paper presents a metaheuristic algorithm based on ant colony optimization for solving this problem. To evaluate the efficiency of the proposed algorithm and the quality of solutions, experimental analysis is conducted, using several simulated test problems. The results on the test problems are compared with those of solution generated with CPLEX software. The results show high efficiency and effectiveness of the proposed algorithms. The solution method is applied to build car blocking plan in Islamic Republic of Iran Railways. By applying the presented model, Iran Railways can reduce the operational cost considerably and save the time in shipping the freights as well.

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## 1. Introduction

A pointer effort to place railroad modeling within a hierarchical structure is provided in [1]. The author offers a three-tiered hierarchy of models, including the strategic, tactical, and operational levels. Differences in these levels are about planning horizon, required investment, and modeling methods [1]. One of the main problem in rail transportation planning known as car blocking problem, which made in tactical level of railroad operation.

Central to railroad operations is the *operating plan* that dictates the movement of shipments (railcar loads), crews, and locomotives over the railroad's network. Each railroad company has a service-design department that is responsible for creating operating plans to enable efficient movement of shipments (Fig. 1) [2].

The blocking plan determines how to aggregate a large number of shipments into *blocks* of shipments as they travel from origins to destinations. Train scheduling consists of designing train routes, days of operation, timings, and routing of blocks on trains to minimize the total system wide cost; this cost includes car hire, crew, and locomotive costs. An operating plan dictates the flow of three important railroad assets: crews, locomotives, and railcars. A well-designed operating plan can reduce the costs of railroads significantly [2].

Mathematically, the railroad blocking problem is a multicommodity-flow, network-design, and routing problem. To solve it, we need to design the underlying blocking network and to route different commodities on the blocking network to minimize the system wide transportation costs [2]. Each set of railcars with the same origin-destination pair of nodes defines a separate commodity. Multicommodity flow and network-design problems are among the most difficult combinatorial problems in operations research [3–5].

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