Discriminatory revenue management policies in rail freight transportation

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Abstract.

In this paper, the implementation of discriminatory revenue management (RM) policies in rail freight transportation with the aim of revenue maximization is observed. Regarding capacity control, one of the fundamental decision is either accept or reject an arriving booking request, and at the same time taking into account the possibility of arriving more valuable demand in subsequent time. Considering uncertainty and variation of demand in rail freight transportation, the existence of booking system is imposed. The RM system developed is used in order to dynamically accept or reject arriving booking requests, at the operational level, with the aim of revenue maximization.

The special focus is on Serbian national railway company. The process of reform have recently begun by creation of three independent companies for infrastructure management, and passenger and freight transport. Considering that the creation of an open market and reconstruction of railway network on Corridor X will inevitably lead to increased demand, the newly established rail freight operator will be forced to implement new and effective RM methods, in order to successfully deal with competition and allocate its capacity in the most profitable way.

The current practice implemented by the Serbian national railway company is similar to the traditional practice widely present, where the transportation requests are accepted on a first-come first-served (FCFS) basis, with the only limitation of free capacity existence. Considering great differences between national rail industry organizations regarding the acceptability of the principle that the transportation demand can be rejected in practice, and taking into account that the railway transportation is of general social interest, the assumptions made in this paper may not be acceptable in all contexts. Observing current regulations and practice at Serbian Railways, this paper aims to analyze potential benefits of implementation of aggressive RM policies, in conditions with scarce capacity compared to available capacity.

While the rail and airline industry share some similarities regarding passenger transportation, the implementation of RM policies in rail freight transportation represents much more complex problem. This is a consequence of variable capacity and unpredictable demand characterizing rail freight transportation. An overview of the published literature regarding passenger and freight rail transportation RM is provided in Armstrong and Meissner (2010), where the complexity of rail freight transportation is emphasized.

Bilegan et al. (2015) analyzed the implementation of accept/reject policies in intermodal transportation, where the interactions between possible future requests are taken into account explicitly. The developed model is solved separately for the situation when the certain request is accepted, as well as when it is rejected, and potential benefits in terms of revenue obtainable are compared.

The problem analyzed in this paper is inspired by the model „Periodic Train Capacity Allocation (independent periods)" developed in Campbell (1996). We consider the problem of railway freight operator providing a scheduled, cyclic services on a linear network of yards on a given discrete time

horizon. In this paper, multiple trains service is introduced, thus enabling possibility of block swaps, shipment switching and connections. Each transportation request is characterized by its origin and destination, volume (freight cars), earliest and latest departure time on a given discrete time horizon, and revenue obtainable by satisfying the demand. By explicitly taking into account network structure, constraints regarding trains, blocks and legs capacity are imposed.

Compared to Bilegan et al. (2015), where the bid-price based policy is observed, this paper employs different approach. The proposed methodology is similar to that seen in truck transportation industry (Guerriero et al, 2012), adapted to the characteristics and specifics of railway service considered in this paper. For solving the problem observed, the deterministic mathematical programming (DMP) approximations are used (de Boer et al., 2002). Implementation of DMP approximations provide development of relatively simple and easy to solve models.

The proposed approach is tested on scheduled services operating on Serbian national network. Using simulated data, bottlenecks are created in order to assess potential benefits of proposed policy implementation. Models are developed and all computational experiments results have demonstrated promising benefits in terms of potential revenue compared to the standard FCFS practice currently implemented by Serbian rail freight operator.

The methodology proposed can easily be extended and applied to intermodal transportation problem, as well as including fare classes based on different criteria, and integration of revenue and operations (traffic flow) management.

Keywords: Rail transportation; Revenue management; Booking policy.

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