Operational Flexibility in the Truckload Trucking Industry

Extended Abstract

In this study, we consider a dynamic pickup and delivery problem with full truckload (DPDFL) for local operators. The main purpose of this work is to investigate the impact of potential factors on the operational efficiency of trucking companies (carriers). These factors, that can help to improve operational flexibility of carries, are diversion capability, re-optimization interval, and advance load information (ALI). ALI is considered because one of the least costly methods when freight transportation service clients and carriers collaborate with each other is to communicate timely load information (from clients to carriers) and pickup and delivery plans (from carriers to clients). Decisions regarding truck diversions and length of re-optimization intervals are usually controlled internally. Although having access to ALI is not under the full control of carriers, there are some opportunities for carriers to build the relationship with their clients. The presentation of this research study is structured as follows. First, an explanation is provided regarding how the proposed model is formulated and handled in a dynamic environment. Next, the process of developing a quality benchmark is briefly explained. Finally, we focus on the numerical experiments and statistically test the benefit of operational flexibility in the local truckload operations.

The optimal DPDFL solution specifies the carrier's cost minimization decisions concerning (i) whether to accept or subcontract new load(s), and (ii) the sequence of accepted loads that each truck will serve. The main approach is to design a mathematical model for the static version of the problem and apply it in the dynamic context using a rolling horizon approach. The computational efficiency of the proposed mathematical model is improved by adding a feature named the pre-processing stage. Using this feature, it is possible to reduce the dimensionality of

the problem by eliminating some infeasible solutions. Moreover, we introduced a special case of the model where lateness is not allowed. This formulation is more computationally efficient since all time-based are handled outside the mathematical model.

It is important to develop a quality benchmark not only to compare different policies (as a result of various flexibility levels) against each other, but also to check how far they are away from the best case scenario. The best case scenario is the cost of the static version where all information is available for the entire planning horizon. We propose an efficient method, based on discretization of time windows, which can easily handle medium sized problems. This algorithm has been proven to converge to the optimal total cost. The efficiency of the proposed algorithm is further improved by incorporating the special version of the problem formulation, which was previously developed.

Our investigation of the academic literature and empirical reports suggested the potential influence of the following factors on a carrier's operational costs: trip length, load density, and subcontracting cost. These factors are not easily controlled by trucking companies and are often dictated by the market conditions. Thus, we controlled the impact of these factors while conducting the statistical analyses. The obtained results illustrate that neither diversion capability nor its two-way interactions with other control factors has significant impact on the total cost. However, both ALI and the re-optimization interval significantly influence the total cost (i.e., more ALI and shorter re-optimization intervals reduce total cost). The findings also show that the margin of the re-optimization interval depends on the subcontracting cost and level of advance load information.

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