META-HEURISTIC ALGORITHMS FOR A MULTI-ATTRIBUTE VEHICLE ROUTING PROBLEM IN EXPRESS FREIGHT TRANSPORTATION

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Freight transportation industry is characterized by several decisional problems that operations managers have to cope with. Not only vehicle routes must be planned before their execution, but also other types of decisions must be taken, in order to answer events that may dynamically occur during operations, as for instance road network congestion or vehicle failures. Trans-Cel, a small trucking company in Padova (Italy), has developed different decision support tools interconnected through a data sharing system. These tools rely on an algorithmic engine that includes a routing optimization algorithm and artificial intelligence systems to support routes operations. The optimization engine solves a Multi-Attribute Vehicle Routing Problem inspired by the Trans-Cel context. Trans-Cel operates a fleet of heterogeneous trucks and offers an express service for requests including multiple pickup and multiple delivery positions spread in a regional area, with associated soft or hard time windows often falling in the same working day. Routes are planned on a daily basis and re-optimized on-the-fly to fit new requests, taking into account constraints and preferences on capacities, hours of service, route termination points. The objective is to maximize the difference between the revenue from satisfied orders and the operational costs. The problem mixes attributes from both intercity less-than-truckload and express couriers operations, and we propose a solution approach based on a two-level local search heuristic. The first level assigns orders to vehicles through a variable neighborhood stochastic tabu search; the second level optimizes the route service sequences. Results have been compared to bounds obtained from a mathematical programming model solved by column generation. Experience on the field and test on literature instances attest to the quality of results and the efficiency of the proposed approach. Computational tests on real instances show that the proposed approach: provides, on average, feasible solutions within 1% from optimal bounds certified by the mathematical model; runs in less than one minute; allows an improvement between 2.2% and 15.3% (9.3% on average) with respect to the operations managers' current practice.

This is a joint work with Prof. Luigi De Giovanni *(Dipartimento di Matematica "Tullio Levi-Civita", Università di Padova) and* Filippo Sottovia *(Il Mio Responsabile Tecnico).*

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