Tiered-Facility Vehicle Routing Problem with Global Cross-Docking

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Abstract

The collection and delivery of pathological specimens within the transportation network of a national laboratory service requires several novel model features that are not usually considered in the vehicle routing literature. One such feature is the processing capabilities of the pathological laboratories, which are segregated into several tiers based on their associated processing capabilities.
Another novel feature arises due to the often rural locations of clinics and the large distances between these clinics and laboratories capable of processing the pathological specimens. These difficulties may be alleviated by the incorporation into the vehicle routing model of the possibility of cross-docking of pathological specimens at certain locations.

The aforementioned features, along with several other features, lead to the introduction of a new type of vehicle routing problem, referred to as the *tiered-facility vehicle routing problem with global cross-docking* (TVRPGC). A formal mathematical model for this problem is formulated and validated in the context of a small-hypothetical test instance using a mixed integer linear programming solver.

Although conceived within the context of pathological specimen collection, the model also has several alternative applications such as that of a national postal service and other organisations that incorporate consolidation centres within their distribution network.

The combinatorial complexity of the mathematical model calls for the development of an approximate solution methodology. Two approximate solution methods are described and the results obtained via these methods are compared within the context of a real problem instance pertaining to the operations of the National Health Laboratory Service of South Africa.

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