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Distribution network design: a new model for open vehicle routing problem with multiple depots

Khosro Pichka*
Industrial Engineering Department, University of Tafresh
Tafresh, Iran
kh.pichka@gmail.com

Amin Ziaeifar
School of Industrial Engineering, University of Tehran
Tehran, Iran
aminziaeifar@ut.ac.ir

Behzad Ashjari
Industrial Engineering Department, University of Tafresh
Tafresh, Iran
ashied@aut.ac.ir

***Abstract*— This paper presents a new mixed-integer linear programming model for an open vehicle routing problem with multiple depots (MDOVRP) with limited number of vehicles. MDOVRP is a variant of classical VRP, but seeks to find a set of non-depot returning vehicle routes dispatching form several depots. In spite of the large amount of research on VRPs, the MDOVRP has received very little attention from the researchers. The proposed MILP model is encoded in LINGO11 software and randomly generated small size MDOVRPs are solved for validation and verification of the proposed model.**

Keywords- Distribution network; Multi-depot; Open vehicle routing;

I. INTRODUCTION

Distribution network design is a crucial problem that companies care about nowadays much more than the past. Vehicle routing problem (VRP) is a well-known combinatorial optimization problem in distribution management which analyzes efficient routs between distributer's depot(s) and costumers. open VRP (OVRP) is a variant of VRP in that each route is a sequence of customers with a given demand and known geographical location, that starts at depot and finishes at one of the customers to whom goods are delivered by available fleet (in contrast to classical VRP where it returns to the depot after serving customers). In practice, OVRP arises when supplier or producer does not have a vehicle fleet and prefer to employ an outside contractor to transfer goods between depot and customers. Indeed, it is much more economical for them to outsource the distribution of the goods or materials. In the OVRP, it is presumed that each customer is visited once by a single vehicle and the total demand of all customers assigned to a vehicle (route) does not exceed the vehicle capacity and the objective is usually minimizing the overall traveling cost (Liu et al., 2013).

Contrary to the VRP, the OVRP has only been studied by very few people.. Chiang et al. (2009) considered a similar case in a stochastic environment in which stochastic phenomena involve start time delivery, production rate, loading and unloading times and travel times. Mirhassani and Abolghasemi (2011) presented continues version of Particle Swarm Optimization (PSO) methodology to deal with OVRP.

Repoussis et al. (2010) proposed a population based hybrid meta-heuristic that utilizes the basic solution framework of evolutionary algorithm (EA) combined with a memory-based trajectory local search algorithm. Yu et al. (2011) applied a hybrid genetic algorithm (GA) and TS to minimize the number of vehicles and total distance. There are other researches that investigated OVRP and presented heuristics and meta-heuristics to solve this problem such as SA (Banos et al., 2013), and Ant Colony Optimization (ACO) (Tang et al., 2013).

In the OVRP, only one central depot exists and all vehicles start their route from this depot. However, in real-life applications for large companies, there is more than one depot to manage a large vehicle fleet (Liu et al., 2013). Moreover, using one depot may result in longer vehicle queues and waiting time. This may lead to unexpected delays in satisfying customer demands in-time. Multi-depot VRP (MDVRP) is introduced for VRP with more than one depot. MDVRP is also a complex