Proceedings of the World Congress on Mechanical, Chemical, and Material Engineering (MCM 2015)
Barcelona, Spain – July 20 - 21, 2015
Paper No. 263

Two-Echelon Capacitated Vehicle Routing Problem: A Case Study in a Textile Company

Semih Onut, Mehmet Rıfat Kamber, Abdulsamet Dumanlı
Yıldız Technical University, Mechanical Faculty, Department of Industrial Engineering
34349, Besiktas, Istanbul, Turkey
onut@yildiz.edu.tr, mkamber@yildiz.edu.tr, samet.dumanli@gmail.com

Extended Abstract

Nowadays, companies value every attempt to increase efficiency and decrease costs, since there exists severe competition among companies and it is hard to survive in this competitive environment. Distribution systems are significant cost elements for the companies which are highly involved in transportation activities. The main goal in distribution system problems is of generating a sequence of routes for distribution of goods considering a given set of constraints to serve a number of customers with minimum cost. This type of problem is called Vehicle Routing Problem (VRP) and was first introduced by (Dantzig and Ramser, 1959).

There are some exact methods in the literature such as branch and bound, and branch and cut. However, since VRP is an NP-Hard combinatorial optimization problem, finding optimal solution becomes more difficult in polynomial time by exact algorithms. So meta-heuristics such as simulated annealing, tabu search, and ant colony algorithms have been widely used in the literature. One another solution methodology for VRP is Two-Phase algorithms that combines clustering and routing.

Multi-echelon VRP (MEVP) is a variant of VRP in which goods are distributed from the main depot to the customers through intermediate depots which are called satellites. According to (Perboli et.al., 2011), multi-echelon systems are quite common in supply-chain and logistics and they are used by public administrations in their transportation and traffic planning strategies, as well as companies, to model own distribution systems. Multi-echelon transportation systems naturally originate from many different real-world industries, such as newspaper and press distribution, e-commerce and home delivery service, and express postal service (Lin et. al., 2014). Two-echelon VRP (2EVRP) is the most common variant of MEVRP studied in literature which is also called cross-docking (Lee et. al., 2006, Liao et. al., 2010, Wen et. al., 2009, Lin et. al., 2014). There are two level links; first link is between depot and satellites, and the second link is between satellites and the customers (Lin et. al., 2014).

In this study, the distribution problem of a reputable confection company is investigated and modelled as a Two-echelon Capacitated Vehicle Routing Problem (2ECVRP). The company distributes manufactured ready-to-wear clothing to retail stores through intermediate depots. We use real-world data for demands of the customers, and the capacity constraints. The objective is to minimize the total length of the route considering vehicle capacities. The solution answers the questions that which intermediate depot is assigned to each retail store and in what route the cars distribute confection goods. We obtained better results than the company's current routing.

Dantzig, G. B., & Ramser, J. H. (1959). The Truck Dispatching Problem. *Management Science*, 6, 80–91.

Lin, C., Choy, K. L., Ho, G. T. S., Chung, S. H., & Lam, H. Y. (2014). Survey Of Green Vehicle Routing Problem: Past And Future Trends. *Expert Systems with Applications*, 41, 1118–1138.

Lee, Y. H., Jung, J. W., & Lee, K. M. (2006). Vehicle Routing Scheduling For Crossdocking in the Supply Chain. *Computers & Industrial Engineering*, 51, 247–256.

Liao, Ch.-J., Lin, Y., & Shih, S. C. (2010). Vehicle Routing With Cross-Docking In the Supply Chain. *Expert Systems with Applications,* 37, 6868–6873.

Perboli, G., Tadei, R., & Vigo, D. (2011). The Two-Echelon Capacitated Vehicle Routing Problem: Models and Math-Based Heuristics. *Transportation Science,* 45, 364–380.

Wen, M., Larsen, J., Clausen, J., Cordeau, J. F., & Laporte, G. (2009). Vehicle Routing With Cross-Docking. *Journal of the Operational Research Society,* 60, 1708–1718.