Unilever Pera-Rota Project

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Abstract

Pera-Rota is an in-house developed routing tool by Unilever that works over a given sales region and constructs the route of the salesperson responsible for that area based on the locations of the customers in the region and their required visit frequencies throughout the planning horizon.

Pera-Rota, in its initial state, manually groups the customers served and creates regions by taking into account the air distance between each other, assigns salespersons to these regions, and performs daily routing. However, since this system is operated manually, it causes inefficient routes to be formed, customers cannot be visited regularly, and fuel costs of vehicles increase.

This project focuses on designing the Pera-Rota application in such a way that it automatically performs the routing operations and takes into account the distances between the locations, instead of manually creating the routes with air distance and planning the places to be visited within that route.

To solve the problem in an integrated manner:

(1) assign customer visits to days taking into account the frequency of visits determined according to the demands of the retail outlets.

(2) identify a salesperson route per each day of the planning horizon that visits the customers assigned to that day.

Objectives

- Plan and monitor the field activities of Algida sales personnels.
- Define sales regions by grouping customer locations.
- Determination of the routes of sales personnel who serve regions over a multi-period planning horizon.
- Minimize the routing cost and customer waiting, and balance the daily workload over the planning horizon.
- Automation of the process of identifying predetermined regions to make the process more efficient.
- Reducing the diesel fuel usage rate by 3-5 percent as a result of the active use of the Pera-Rota application.

Project Details

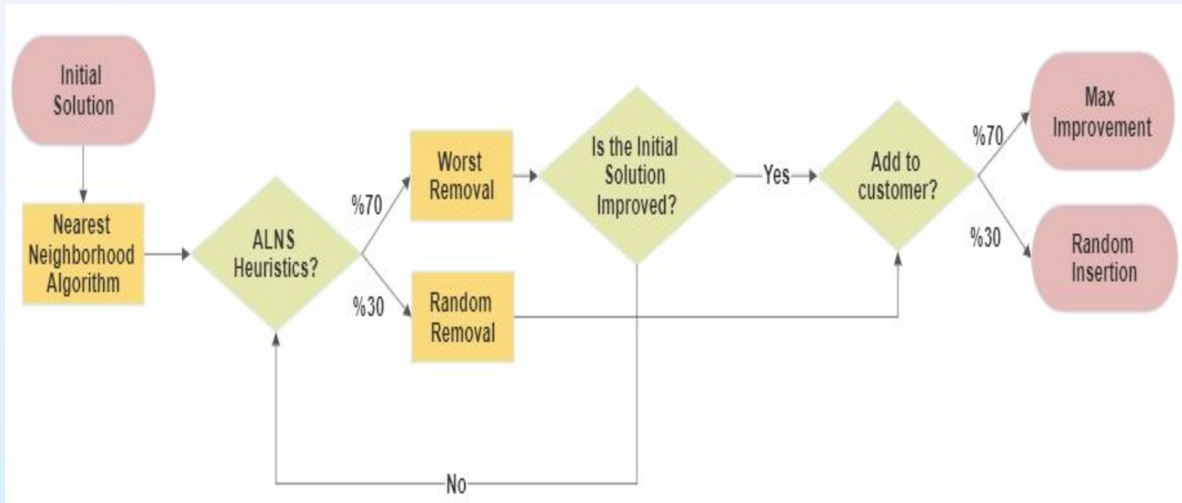
Figure1

In this project, we defined the problem as Periodic Vehicle Routing Problem. Initial feasible solution (Figure 1) is developed by Nearest Neighbourhood Algorithm and we used Adaptive Large Neighborhood Search Algorithms to solve this problem. Then, improvements were made to the problem by using the Destroy and Repair heuristics.

In this process, we made use of some assumptions while developing the code:

- The amount of fuel consumed by the vehicles
- Customers can be visited in any order (no precedence relations)
- Route conditions
- Time windows of the customers

Project Details II



- We created a multi-period VRP for the "Pendik" region. 81 customers in the Pendik region were assigned five days a week by Unilever teams and in a sense, they created a 5-period VRP.
- In order to create a route for each period without changing the day the customers are assigned, we first ensured that the routes start from the warehouse and end in the warehouse, then we turned these points into a route using the Nearest Neighbor Algorithm.
- Then, by applying the destroy heuristic for the route of the first day, it was decided which customer should be removed from this route and how much the resulting route would improve compared to the first route.
- Afterwards, a repair heuristic was created and it was decided which route should be taken to the point that was decided to be removed with the destroy heuristic.
- After finding the point to be removed from a period with the destroy heuristic, and the new period to add the point removed with the repair heuristic, the changes were applied to the periods.
- Afterwards, this subtraction-addition process was repeated 100 times in succession.

Conclusions

- Using the initial solution as a base point, we implemented our ALNS algorithm to increase the efficiency of the solution. The result shows that our ALNS algorithm created approximately 23% shorter route than the original solution.
- A solution that changes and improves both day planning and routes using real data and removes the system from manual has been obtained.
- When the developed algorithm is applied to all regions by adding a few more destroy and repair heuristics and selecting the method that gives the most improvement, it will be able to be compared with the routes from Unilever and the real "improvement" rate will be found.

References

Lutz, R. (n.d.). Adaptive Large Neighborhood Search (thesis).

Masson, R., Lehuédé, F., & Péton, O. (2013). An adaptive large neighborhood search for the pickup and delivery problem with transfers. Transportation Science, 47(3), 344–355. https://doi.org/10.1287/trsc.1120.0432

Praseeratasang, Pitakaso, Sethanan, Kosacka-Olejnik, kaewman, & Theeraviriya. (2019).

Adaptive Large neighborhood search to solve multi-level scheduling and assignment problems in Broiler Farms. Journal of Open Innovation: Technology, Market, and Complexity, 5(3), 37. https://doi.org/10.3390/joitmc5030037

Ropke, S., & Pisinger, D. (2006). An adaptive large neighborhood search heuristic for the pickup and delivery problem with time windows. Transportation Science, 40(4), 455–472. https://doi.org/10.1287/trsc.1050.0135