Solving vehicle routing problem with mathematical programming

The Industrial Problem
Every day the company has to detremine the routes of the vehicles that serve the customers with different fuel types. The goal is to find a route plan that minimizes the total distance run by the vehicles.

Research group

Széchenyi István University

SZÉCHENYI
EGYETEM
UNIVERSITY OF GYŐR

Optimizing industrial problems by mathematical programming.

Company

MOL HUNGARY

MOL

Transporting fuel to hungarian clients by vehicles by road

SZÉCHENYI 2020

Európai Unió
Európai Strukturális
és Beruházási Alapok
MAGYARORSZÁG
KORMÁNYA   BEFEKTETÉS A JÖVŐBE

Solving vehicle routing problem with mathematical programming

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Challenges & Goals

- To find the route of the vehicles for the next day.

- To guarantee that the solution satisfies special constraints.

- To minimize the total distance run by the vehicles.

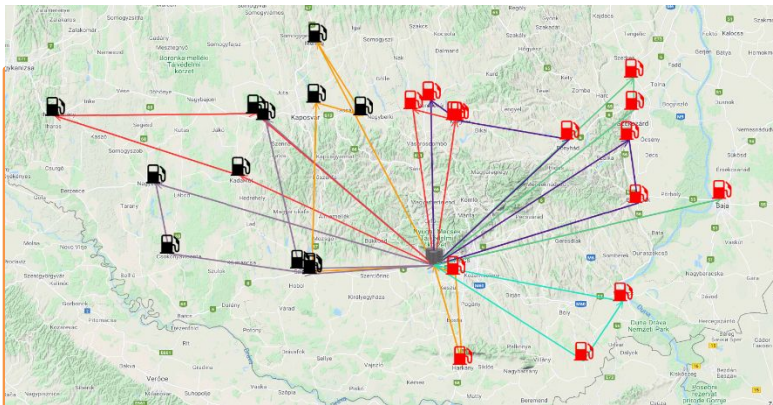- To test the solution method on problems of the company.
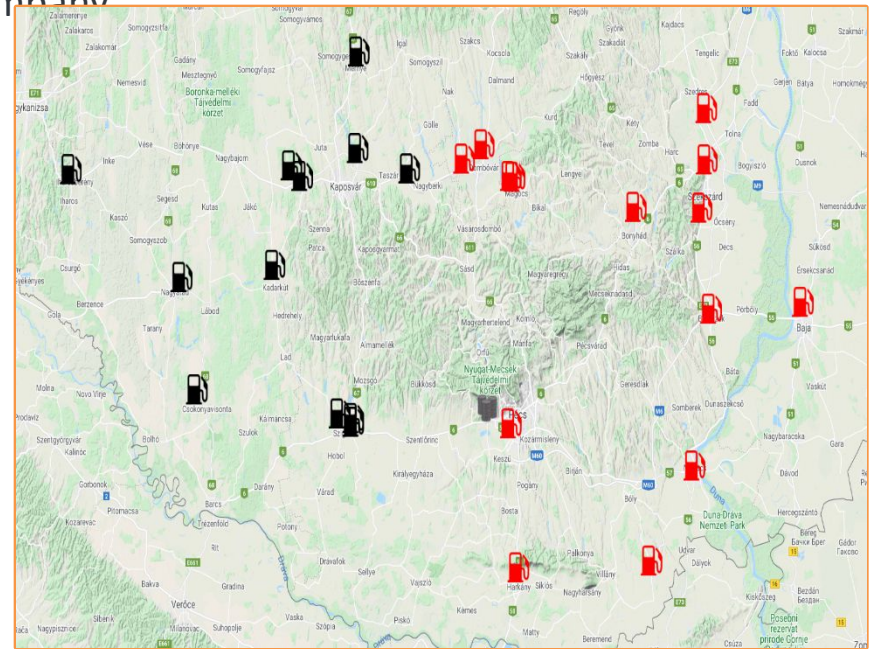
*Location of the orders for one shift in Hungary and in the Pécs region.*

Solving vehicle routing problem with mathematical programming

Mathematical and computational methods and techniques applied

- The problem is modeled as a mixed integer linear programming (MILP) problem.

- To reduce the size complexity of the MILP models customers were clustered by machine learning.

- Parameters of the MILP model were calculated by scripting OpenStreetMap.

- Real world problems were solved by solving their MILP models with Express-MP.

Solution with 2 clusters for one shift in the Pécs region.
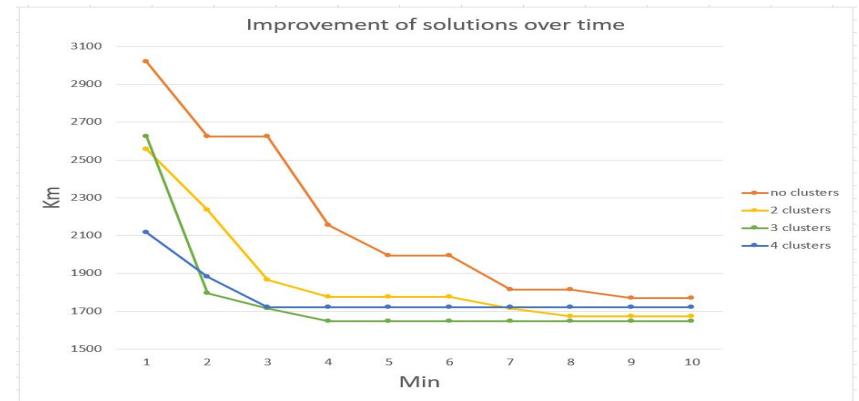
The MILP model is solved with 1,2,3,4 clusters and the changes of the solutions over time are compared.

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Results & Benefits to the company

- Results
- A MILP based approach combined with clustering is developed.
- The new method is tested on problems of the company.

- Benefits
- Optimal solution were found in several shifts.
- In 10 cases our method gave better result than software the company uses.
- Our method gives a lower bound on the optimum.

case	1.	2.	3.	4.	5.	6.	7.	8.
SZE-KPI	0.7	0.68	0.6	0.7	0.57	0.51	0.82	0.6
MOL-KPI	0.66	0.73	0.68	0.6	0.53	0.47	0.74	0.54

case	9.	10.	11.	12.	13.	14.	15.	
SZE-KPI	0.68	0.48	0.38	0.55	0.57	0.86	0.52	
MOL-KPI	0.58	0.55	0.5	0.45	0.59	0.67	0.49	

Comparing the results of the new method with results of the company (KPI: transported litre/km).

The MILP based method can be improved by clustering the active clients.