
First Mile and Last Mile Delivery for Oil and Gas Distribution

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About the Client

Coextrix Technologies is an innovative information technology and services firm providing offshore software development, product engineering, analytics, infrastructure and consulting services since 2009. The company is located in the technology hub of Bangalore, India. Large scale first mile procurement and last mile delivery for oil and gas distribution is one of strongest service offerings from Coextrix.

Motivation

Gyan Data was chosen as the core analytics and technology partner for procurement and delivery analysis services by Coextrix Technologies. First mile and last mile delivery continues to be one of the most challenging problems due to its massive combinatorial complexity.

First mile delivery involves decisions regarding procurement of products from various locations so that total cost of procurement and travel time are minimized. In contrast, last mile delivery involves decisions regarding distribution of finished products to various demand locations such that the total profit is maximized.

Finding an optimal solution to first mile and last mile problems improves distribution efficiency, resource utilization, channel organization while ensuring product availability at all supply and demand points.

Problem

The objective of the project was to recommend a distribution strategy of oil and gas products to several outlets located across different parts of the country.

This translated to scheduling of trucks and drivers for last mile delivery of oil and gas products. Specifically, the project aimed at minimizing the total cost incurred towards procurement of fuel including the freight charges, based on actions borne out of the following strategic decisions

- The right supplier to be chosen for each demand point amongst a set of available suppliers
- Estimation of delivery window in order to meet demands varying with time
- The assignment of drivers and trucks to a planned route while considering the schedule of drivers, working hours, fatigue, place and time of start

The challenge was to formulate the problem in such a manner that the computational time required for solving the problem was under half-an hour since supply/demand patterns were fluctuating at said time-scale.

Furthermore it was mandated by our client that the solution had to be developed using only open-source tools keeping in line with their requirements.

Solution

Reference databases were developed to reflect the original scale of the problem, having massive complexities in terms of demands, supplier information, volumes in gallons, purchase and freight charges, truck types, driver information, time varying demands, and prices.

The reference databases were then used to model the problem to generate mathematical constructs for objective functions and constraints in Python and the problem itself was solved using the open-source solver CBC. Depending on the complexity of each of the reference datasets, several heuristics were developed whenever a solution was not obtained within the required run time.

For an actual distribution scenario, the field data was analyzed and multiple pre-processing steps were constructed in a pipeline to improve the data quality while solving the problem. Various practical pre-checks were developed after interactions with the client for the field database so that the problem provided feasible solutions in all scenarios. Subsequent to the proof of concept stage, Gyan Data supported the client in field implementation and assessment of the solution thereby ensuring a profitable return on investment and large improvements in supply chain efficiency.