DRISI
Caltrans Division of Research, Innovation and System Information

Research Notes

Planning, Policy and Programming

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Project Title:
Coping with the Rise of E-Commerce Generated Home Deliveries Through Innovative Last-Mile Technologies and Strategies

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Coping with the Rise of E-Commerce Generated Home Deliveries Through Innovative Last-Mile Technologies and Strategies

Developing a Time-Dependent Stochastic Capacitated Vehicle Routing and Facility Location (TD-S-CVRP-FL) model to evaluate various last-mile strategies/technologies.

WHAT IS THE NEED?

During the COVID-19 pandemic, e-commerce increased to record levels by providing individuals with much-needed goods and supplies under stay-in-place orders, retail closures, and other pandemic impacts on consumer behaviors. However, this increased adoption of e-commerce by consumers likely exacerbates the already identified issues of congestion and emissions with residential deliveries.

To keep pace with the growing demands of e-commerce, last-mile operators and academics have developed, evaluated, tested, or implemented various last-mile strategies around the globe. These include the use of consolidation (e.g., urban consolidation centers, staging areas, delivery hubs) facilities and/or collection strategies (e.g., lockers, pick-up and drop-off centers) coupled with use of alternate fuel delivery vehicles, such as electric trucks, cargo bikes, autonomous delivery robots (ADRs) and unmanned aerial vehicles (UAVs or drones), or the use of new delivery services (e.g., crowd shipping). However, the literature has mostly focused on studying such technologies or strategies independently, and research is still needed to understand how these could work under an integrated system.

WHAT ARE WE DOING?

This project aims to connect space and time decisions to the assessment of different strategies and technologies to quantify the traffic impacts over the road network, the changes in vehicles miles traveled (potential VMT displacement by drones, ADRs, or bikes), and GHG emissions.

WHAT IS OUR GOAL?

We will develop a Time-Dependent Stochastic Capacitated Vehicle Routing and Facility Location (TD-S-CVRP-FL) model to evaluate last-mile strategies/technologies.

WHAT IS THE BENEFIT?

The findings would be of interest to the Caltrans Offices of Freight and Multi-Modal Planning, as well as the Research and Modeling Branches, and are consistent with the California Freight Mobility Plan, the California Transportation Plan (2050), other important efforts that seek to move goods more effectively and efficiently.

WHAT IS THE PROGRESS TO DATE?

Finalized the literature review. Defined the characteristics of the final model to develop. Scoped the different components of the optimization model and the solution algorithm. Inputted data for the case study. Developed the first phase of the model based on the dynamic and stochastic traveling salesman problem.

Worked on improvements of the solution algorithm. Developed simulations and graphical representations of the test case studies. Gathered additional instances to test the model's performance. Improved the model to include time dependencies. The next step is to finalize the model development.

IMAGE

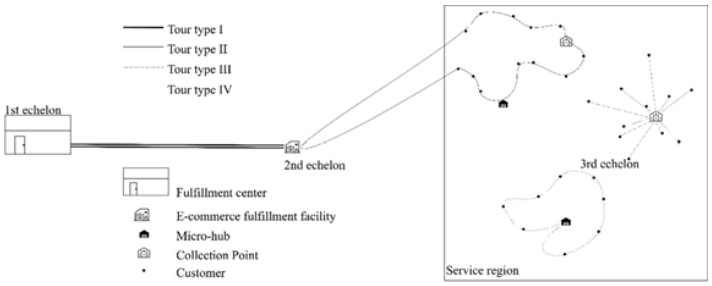

Image: Last-Mile Multi-Echelon Distribution Structure