Analytical Modeling Framework to Assess the Economic and Environmental Impacts of Residential Deliveries, and Evaluate Sustainable City Logistics Strategies

Develop an analytical modeling framework to assess the economic and environmental impacts of residential deliveries.

WHAT IS THE NEED?

In the last decade, electronic commerce has grown substantially, increasing business-to-business, business-to-consumer, and consumer-to-consumer transactions. As a result, there has been a continuous growth in last mile operations, especially deliveries to residential areas, bringing along externalities such as congestion, air and noise pollution, and energy consumption. This project aims to develop an analytical framework to model last mile operations based on continuous approximation techniques.

WHAT ARE WE DOING?

This study further develops the understanding of the impacts of city logistics strategies to contend with the negative consequences of these delivery trends. The analytical framework can be used in different geographic locations, especially in dense urban areas, to estimate the various impacts (under a different set of inputs). The research team is conducting experimental analyses with the modeling framework.

WHAT IS OUR GOAL?

The model helps estimate the economic and environmental impacts of residential deliveries, from a growth perspective, and through comparative analyses between consumer decisions (e.g., trip complementarity and substitution, trip-induced demand). The model estimates impacts for freight operators.
They wrote another article and submitted it to the Transportation Research Board Annual Meeting. The team gathered additional data for the simulation scenarios. In parallel, the team have been developing a routing algorithm to compare the continuous approximation results and updated the model to reflect the changes made to the framework. Using the algorithm, the team has evaluated some numerical instances.

**WHAT IS THE BENEFIT?**

The objective of this research is to develop an analytical modeling framework to assess the economic and environmental impacts of residential deliveries. The researchers have identified the most important factors from electronic commerce and residential delivery strategies, and incorporated them into the framework. Considering the complexity to explicitly model these factors, the analytical framework is based on continuous approximation techniques.

**WHAT IS THE PROGRESS TO DATE?**

The team conducted a literature review on the impacts of residential deliveries and developed a preliminary version of the modeling framework. The team submitted a journal article with the results of the comparative assessment between e-shopping and retail.

The team made changes of the modeling framework. Specifically, updated the methodology to incorporate the impacts of facility location. Improved the explicit consideration of delivery time windows and developed empirical analyses to test the framework. The team also received and addressed comments from the submitted article.

**IMAGES**

![Image](image.png)

Figure 1: Comparison of Omni-channel with In-store Shopping (% change)
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Figure 2: Comparison of Online with In-store Shopping (% change)

Figure 3: The Cost Trade-offs and Impact of Time-windows

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