Decarbonizing the “Last Mile” of E-commerce in Shanghai

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Introduction of “Last Mile”

“Last Mile” refers to the delivery of a product to the customer, the final link in the supply chain. There are two types of delivery methods: “Door-to-Door” delivery and “Collection Points”.

- Door-to-Door is inefficient due to the “not at home” and the “empty run” syndrome. However, these delivery methods are widely used by courier services to remain competitive in their industry.
- Collection Points (CP) is more efficient since customers travel to CPs to pick up their parcels. This method is not widely used by courier services because the costs outweigh the business benefits.

Significance

Fast growth in the E-commerce industry brings huge demands for parcel deliveries, exacerbates air pollution and traffic congestion. Existing “Last Mile” optimization models focus on minimizing transportation costs to maximize the interests of courier services. Existing environmental protection measures, such as a central hub, have proven to be unsuccessful.

Objectives

This project tries to minimize carbon emissions of “Last Mile” delivery from different stakeholders’ perspectives.

- For express companies, a vehicle routing optimization model is proposed to tell couriers the sequence of visiting customers, routes that should be traveled and waiting time, if necessary, at each customer point. The optimized routes should generate less carbon emissions than currently ordinary routes.
- From the government’s perspective, the amount of carbon emissions generated by both delivery methods are compared to justify the widespread need for the Collection Points system. In addition, better locations for existing collection points have been suggested to maximize their service areas.

Methodology

The project consists of two simulation-based sections: vehicle routing optimization and CP service area optimization.

Vehicle Routing

The key of vehicle routing optimizations to allocate travel time to time intervals with low carbon emission rate:
- Routing and sequencing model building
- Design of Genetic Algorithm
- Potential waiting time model building
- Simulate

CP service area

The key of CP service area optimization is to include as much possible delivery tasks into walkable buffer:
- Generation of assumed customers
- Spatial analysis of existing CP service area
- Selection of CP competitors
- Production of new CPs

Findings

- The proposed optimization model reduces 4.7% carbon emissions and 3.2% travel time generated by the current routing strategy.
- The Collection Points System further reduces 19% carbon emissions and 20% travel time of the proposed optimization routes.

Recommendations

- 10 out of 22 existing collection points should be replaced by competitors.
- Grocery Stores are ideal competitors as long as courier services could provide subsidy.
- 5-minute-walking buffer defines suitable service area and evaluation of CPs’ effectiveness should be finished per year.