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POLICY BRIEF

Last-Mile Delivery Innovations and Best Practices in the Age of E-commerce

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Issue

E-commerce has become a fundamental part of the shopping experience. It has transformed how consumers shop and, in many cases, it has improved accessibility to goods and services. Another benefit is the substitution of personal shopping trips with consolidated deliveries, which can significantly reduce transportation-related negative externalities from urban goods movements.

However, the recent trend towards consumer-focused services in last-mile distribution has adversely impacted the economic viability, environmental efficiency, and social equity of urban goods movements. Frequent less-than-truckload last-mile deliveries can lead to increased freight distribution costs and associated externalities, including increased greenhouse gas and criteria pollutant emissions.

Opportunities and challenges associated with alternate last-mile distribution strategies were studied by researchers at the University of California, Davis. The study examined ways that companies might adapt to increasingly consumer-focused trends in e-commerce towards rush delivery within strict time windows (expedited logistics). Paradigms of economic viability, environmental efficiency, and social equity were considered. The team developed an explicit dynamic and stochastic location-routing model to assess the performance of several distribution initiatives.

Key Research Findings

Freight sustainability with last-mile delivery using electric trucks can support efficient, economically viable, and socially equitable urban freight distribution. However, the higher upfront cost of electric delivery vehicles can deter e-retailers when they need additional vehicles on short notice to cope with demand uncertainties.

E-retailers can crowdsource last-mile delivery for a cost-effective and flexible last-mile distribution structure resistant to demand uncertainty. However, using independent contractors may result in a less reliable performance than company-owned delivery vehicles. The e-retailer may need to offer incentives to drivers to improve reliability. Thus, the e-retailer must carefully consider tradeoffs in flexibility, reliability, and costs of crowdshipping for last-mile distribution. The e-retailer must also consider potential impacts of crowdshipping on environmental efficiency and social equity associated with urban goods movements.

Consolidation facilities coupled with light-duty delivery vehicles are less cost-effective and more reactive to demand uncertainties than other distribution strategies. This is because additional handling and transportation are required to move packages between consolidation facilities and final delivery locations. Using cargo bikes for last-mile delivery can substantially reduce exposure to harmful criteria pollutants for individuals living in such dense urban environments.

E-retailers can establish cost-effective goods flows and resist demand uncertainties with collection-point pickups. Customers traveling to self-collect necessitate vehicle travel, however, increasing negative externalities in the flow of urban goods. To address this, the e-retailer can co-locate collection points near major traffic generators to mitigate the need for customers to travel further to collect a package.

For last-mile delivery, drones perform better than terrestrial delivery robots owing to faster operations. The potential for autonomous delivery robots and unamanned aerial delivery vehicles deployed from a delivery van acting as a mobile micro-hub was evaluated. This distribution strategy can increase certainty in last-mile distribution. Nonetheless, issues about theft, damage, privacy, and—more importantly—limited operational range remain. These factors narrow the use case of these new and innovative distribution strategies.

Policy Implications

Incentivizing zero-emissions vehicles and other new technologies for last-mile distribution.

In California, policies such as the Advanced Clean Truck and Fleet rules promote the adoption and use of zero-emission by fleets. Incentive programs that allow companies of all sizes to adopt cleaner vehicles, build the required supporting infrastructure, and help further develop vehicle technologies will bolster these policies. Last-mile delivery operations are well-suited for using zero-emission vehicles such as battery electric trucks and vans, though charging infrastructure is presently a challenge.

Considering freight distribution in local land-use planning

To achieve climate goals, land-use planning and policies must consider changes in the last-mile distribution patterns. Tailored land-use and zoning systems are critical for the implementation of last-mile strategies. Examples include micro-consolidation centers and staging areas, parking availability, and loading/unloading zones. These features can improve distribution efficiency to mitigate negative impacts.

Fostering the sharing economy

The sharing economy offers consumers flexibility, independence, and access to more goods and services. Policies that recognize and facilitate new distribution systems related to the sharing economy can take advantage of new smart, connected, and automated technologies as well as the flexibility of crowdsourced deliveries. As with any emerging technology or strategy, environmental and infrastructure impacts and the effects of automation and outsourcing to independent contractors on equity and labor must be weighed.

More Information

This policy brief is drawn from "Coping with the Rise of E-commerce Generated Home Deliveries through Innovative Last-mile Technologies and Strategies," a report from the National Center for Sustainable Transportation, authored by Miguel Jaller and Anmol Pahwa of the University of California, Davis. The full report can be found on the NCST website at https://ncst.ucdavis.edu/project/coping-rise-e-commerce-generated-home-deliveries-through-innovative-last-mile-technologies.

For more information about the findings presented in this brief, contact Miguel Jaller at mjaller@ucdavis.edu.

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