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Using Zero-Emission Vehicles and Other Strategies to Improve Last Mile Deliveries

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Issue

The urban freight system (UFS) is an essential component of the greater freight system and is vital to the urban economy. While the UFS represents a small share of urban traffic, it generates a disproportionate amount of pollution and greenhouse gas emissions, and also has impacts on congestion, safety, and public health. The UFS is largely represented by last mile deliveries, which are characterized as trips that deliver products consumed, or used for other purposes. Last mile deliveries are part of the traditional business to business (B2B) commerce, and the rapidly increasing business to consumer (B2C) and consumer to consumer (C2C) commerce.

The UFS is complex and becoming increasingly so as on-demand delivery services proliferate. Online retail sales (B2C) accounted for \$394.9 billion or 8.1% of total retail sales in 2016, an increase of 15.1% from 2015ⁱ with residential deliveries serving as the main drop-off point for customersⁱⁱ. This trend exacerbates existing challenges for last mile deliveries (e.g., competition for parking, contending with truck size limits and truck technology requirements), and is also requiring a new configuration of the freight system as a whole, and last mile logistics in particularⁱⁱⁱ. If left unattended, the issues are expected to intensify.

Research Findings

The net effect of on-demand shopping on personal and freight trips varies. Shopping is a complex process, multiple variables and contexts trigger this activity, from the basic need of goods to social interactions, sensorial experiences, recreation, and more. Numerous studies show the existence of complementary and substitution effects^{iv} between on-demand shopping and traditional shopping trips. Overall, Omni-channel (i.e., online, in-store, combinations) shopping is expected to increase as customers can benefit from the perks of traditional and e-retail environments. Consumer preferences regarding delivery times, shipping costs, product return processes, and delivery points, are among the main factors driving the success or failure of retailers and marketplaces.

Moreover, the use of information and communication technologies (ICT) provide customers the flexibility of purchasing goods without restrictions of time and space^{v,vi}. This is creating a dynamic pull demand that impacts last mile supply chain and logistics. Due to the dominance of complementary trips (generation of both, shopping trip and residential freight delivery), in the short term, the net effect of on-demand shopping is an increased number of trips (personal and freight), and associated externalities.

Parcel and other specific Commercial delivery fleets are suitable for early adoption of low or zero-emission technologies but incentive programs will be needed. An analysis of commercial freight vehicle travel patterns (i.e., delivery route data) for different vocations^{vii} (e.g., beverage warehouse, parcel, linen, food and local) showed similar travel patterns, though parcel delivery fleets stood out by having shorter trips, higher number of stops, and lower driving average speeds. Most parcel delivery vehicles can satisfy more than 90% of their demand within a 100 mile range, which is the range of zero emission vehicle technologies currently available. However, to make these vehicles affordable and competitive against conventional technologies, the use of

KEY TAKEAWAYS

- The net effect of on-demand shopping on personal and freight trips varies.
- Parcel and other specific commercial delivery fleets are suitable for early adoption of low or zero-emission technologies but incentive programs will be needed.
- Programmatic freight demand management and land use planning strategies should also be considered to improve urban freight deliveries.
- Consumer behavior strategies show promise in improving efficiency on the demand side.

Findings (continued)

incentives is essential^{viii}. Moreover, there is a need to complement current financial based incentive programs (designed for the initial purchase of such vehicles) with other non-financial and operational performance based programs. This is because other incentives addressing the operational challenges and system inefficiencies faced by the fleets may help foster the adoption of such technologies.

Programmatic freight demand management and land use planning strategies should also be considered to improve urban freight deliveries^{ix}. There are a number of strategies that could mitigate the issues associated with last mile deliveries in both residential and commercial areas. Examples include:

- Voluntary off-hour delivery (foster freight activity in the off-hours) programs^x;
- Mode shift programs;
- Incorporating freight into land use planning;
- Parking, loading and unloading zone management^{xi};
- Establishing alternative delivery points can lessen impacts on residential areas^{xii, xiii, xiv, xv, xvi} and,
- Use of urban consolidation centers, if feasible, where the last mile can be delivered with local carriers including bikes and smaller zero and near zero emission vehicles^{xvii}.

Consumer behavior strategies show promise in improving efficiency on the demand side^{xviii}.

Changing consumer behavior is probably the most difficult task, and while preliminary results offer insights, further research is still needed to determine the appropriate strategies, such as:

- Providing consumer incentives for consolidating purchases, picking alternative delivery points, or choosing non-expedite delivery services;
- Reducing product returns by informing customers about their purchase history, the environmental implications of returns, or rethinking return processes and costs; and
- Informing consumers about the environmental impacts of shopping processes.

ⁱU.S. Census Bureau (2017). "Quarterly Retail E-commerce Sales 4th Quarter 2016." Posted: 2017, from https://www.census.gov/retail/mrts/www/data/pdf/ec_current.pdf.

ⁱⁱUPS (2016) *UPS Pulse of the Online Shopper TM: Tech-savvy shoppers transforming retail*. A UPS White Paper.

ⁱⁱⁱJaller, M., L. Pineda, and D. Phong (in press). *Spatial Analysis of Warehouses and Distribution Centers in Southern California*. *Transportation Research Record (TRR), Journal of the Transportation Research Board*

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^vCoudelis, H. (2004). "Pizza over the Internet: e-commerce, the fragmentation of activity and the tyranny of the region." *Entrepreneurship & Regional Development* 16(1): 41-54.

^{vi}Mokhtarian, P.L. (2004). "A conceptual analysis of the transportation impacts of B2C e-commerce." *Transportation* 31(3): 257-284. 10.1023/B:PORT.0000025428.64128.d3

^{vii}Walkowicz, K. K., K.; Duran, A.; Burton, E (2014). "Fleet DNA Project Data." Posted: from <http://www.nrel.gov/fleetdna>.

^{viii}Air Resources Board (2017). "California HVIP" Posted: from <https://www.californiahvip.org>.

^{ix}Holguín-Veras, J., J. Amaya-Leal, J. Wojtowicz, M. Jaller, C. González-Calderón, I. Sánchez-Díaz, X. Wang, D. Haake, S. Rhodes and S. D. Hodge (2015). "NCFRP report 33—Improving freight system performance in metropolitan areas: A planning guide." *Transportation Research Board of the National Academies: Washington, DC*.

^xJaller, M., and J. Holguín-Veras (2013). *Comparative Analyses of the Stated Behavioral Responses to Off-Hour Delivery Policies*. *Transportation Research Record (TRR), Journal of the Transportation Research Board*. (2379): 18-28.

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^{xii}Morganti, E., L. Dablanc and F. Fortin (2014a). "Final deliveries for online shopping: The deployment of pickup point networks in urban and suburban areas." *Research in Transportation Business & Management* 11: 23-31. <http://dx.doi.org/10.1016/j.rtbm.2014.03.002>

^{xiii}Morganti, E., S. Seidel, C. Blanquart, L. Dablanc and B. Lenz (2014b). "The Impact of E-commerce on Final Deliveries: Alternative Parcel Delivery Services in France and Germany."

Wang, X., L. Zhan, J. Ruan and J. Zhang (2014). "How to choose "last mile" delivery modes for E-fulfillment." *Mathematical Problems in Engineering* 2014.

^{xiv}Wygonik, E. and A.V. Goodchild (2016). "Urban form and last-mile goods movement: Factors affecting vehicle miles travelled and emissions." *Transportation Research Part D: Transport and Environment*. <http://dx.doi.org/10.1016/j.trd.2016.09.015>

^{xv}Joerss, M., J. r. Schröder, F. Neuhaus, C. Klink and F. Mann (2016) *Parcel delivery: The future of last mile*. *Travel, Transport & Logistics* 32

^{xvi}Jaller, M., X. Wang, and J. Holguín-Veras (2015). *Large Urban Freight Traffic Generators: Opportunities for City Logistics Initiatives*. *Journal of Transport and Land Use (JTLU)*, 8.1, 1–17.

^{xvii}Holguín-Veras, J. et al., (2015)

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