Data Driven Identification of COVID-19 Impacts on E-Commerce and Freight Movement

Project Number:

21ITSUTA03

Start Date:

08/01/2021

Principal Inverstigator(s):

Kate Hyun

The University of Texas at Arlington

Lead Institution:

The University of Texas at Arlington

Funding Source(s):

Tran-SET

The University of Texas at Arlington

Total Project Cost:

$ 108,000

Developing innovative and practical strategies for Covid-19 impacts on E-Commerce and Freight movement

Online shopping has grown rapidly worldwide for the past two decades. In the U.S., the share of online retail sales grew from 4% in 2009 to 9.8% for the third quarter in 2018. This growth generates significant freight movement demand. The American Transportation Research Institute (ATRI) reports a 17.7 % increase in urban truck VMT in the U.S from 2011 to 2016, which is drastically higher than rural truck VMT (2.2 % increase) for the same time period. The recent pandemic significantly accelerates this trend. Walmart grocery e-commerce increases over 74% during the pandemic, and consumer spending on Amazon between May and July 2020 increased by 60% from the same time in 2019. Researchers expect that e-commerce sales will reach $6.5 trillion by 2023 with a nearly 20% growth in 2020. Studies reported that people develop their new habit to use online shopping in their daily routine, which substitute and complement their shopping trips and activities permanently. This research will comprehensively explore the current trends of online and off-line shopping activities by utilizing data fusion and analytics to gain insight into how e-commerce might influence future passenger travel and freight movements. The study will investigate how lastmile operations have impacted network disruptions, air quality, and safety. Understanding the freight movements at micro-levels will provide valuable knowledge on effectively allocating resources and developing policy and planning strategies, such as adjusting parking policy, promoting off-peak delivery, and adjusting the capacities of roadway infrastructure, to properly control and manage increased shipment movements to preserve existing infrastructure, reduce congestion and air quality impacts, and enhance road safety.

Problem Statement

Despite a large consensus on how COVID-19 transforms the nature of e-commerce and consumers' shopping patterns, questions remain about the substitution and complementary relationship between delivery trips and shopping trips, and the introduction of additional air quality impacts and burdens on the roadway network and

infrastructure. Scant research has investigated how last-mile operations will evolve in the future to accommodate the increased amounts of freight movements. So far, most freight studies focus on developing operational strategies by solving vehicle routing problems to minimize VMT, operation costs for retailers or carriers, or deciding the optimal locations of depot/warehouses to maximize their profit. Although the optimization techniques provide cost-effective strategies to minimize the travel distance of last-mile operations, these studies do not provide or understand the inclusive implications and disruptions of urban logistics as a whole since the problem prioritizes profit maximization. Along with the surge of e-commerce, online retailers face increased competition, which creates new delivery service standards such as providing same-day delivery or free shipping/return to attract more customers. These customer-centered strategies not only attract more online shopping activities but also contribute to changes in delivery patterns. As the delivery operation becomes more fragmented and frequent, more vehicles – either trucks or passenger cars – deliver goods from distribution or fulfillment centers to final destinations. This delivery characterizes the last segment of the supply chain and is often referred to as the last-mile. The increased trips associated with last mile segments may cause significant disruptions on the transportation network including increased truck VMTs on highway and local corridors, higher congestion during peak periods, and more crashes and conflicts between passenger vehicles and light duty commercial vehicles especially in residential areas.

Objectives

The proposed project contributes to provide innovative and practical strategies for preserving the transportation network, enhancing the sustainability of freight transportation, preserving the environment, and improving safety in response to the new behavioral patterns caused by COVID-19. Specific research objectives include:

1) To develop synthetic household travel demand and e-commerce participation based on data fusion and mining
2) To evaluate network uses and disruptions of last-mile operations before and during the pandemic
3) To quantify the traffic impacts of last-mile movements on the overall VMTs of freight and passenger traffic, peak- and non-peak hour congestion due to freight movements in different geographical areas (urban vs. suburban) and socioeconomic groups (e.g., high vs. low income; transit-dependent vs. auto-centered)
4) To characterize the air quality impacts of e-commerce substitution and complementing consumer shopping trips.
5) To understand the implications on safety by estimating the number and severities of crashes at the location of high last-mile freight concentrations
6) To clarify differential impacts on e-commerce to under-served communities using digital divide data
7) To provide planning and policy strategies to enhance last-mile logistics for the region

Intended Implementation of Research

The research outcomes will be shared with practitioners, policymakers, universities and trucking industries through Workshops and Conferences to attract discussions from the transportation operation and management sectors, particularly from H-GAC, Texas Department of Transportation (TxDOT), and other regional MPOs.

Anticipated Impacts/Benefits of Implementation

The developed framework will provide emerging trends in lastmile strategies, and their impacts on congestion and safety to make practical and effective recommendations for stakeholders to reduce network disruptions while maintaining quality of last-mile delivery.

Web links
- Tran-SET's website
  https://transet.lsu.edu/research-in-progress/

Tran-SET

Tran-SET is Region 6's University Transportation Center. It is a collaborative partnership between 11 institutions (see below) across 5 states (AR, LA, NM, OK, and TX). Tran-SET is led by Louisiana State University. It was established in late November 2016 "to address the accelerated deterioration of transportation infrastructure through the development, evaluation, and implementation of cutting-edge technologies, novel materials, and innovative construction management processes".

Learn More

For more information about Tran-SET, please visit our website, LinkedIn, Twitter, Facebook, and YouTube pages. Also, please feel free to contact Dr. Momen Mousa (Tran-SET Program Manager) directly at transet@lsu.edu.