

INTRODUCTION AND MOTIVATION

Changing urban land use, demographics, and consumer behaviors continue to alter the challenge of providing “last-mile” freight services in already active and densely trafficked metro settings. As a response, freight carriers are exploring the use of nontraditional freight vehicles such as cargo cycles or light electric vehicles (LEVs). Both the operating characteristics and infrastructure requirements of these alternative vehicles vary considerably from the motor vehicles typically used in urban freight service.

Thus, planners and policy-makers face two inherently interconnected questions: (1) How do urban environmental characteristics influence fleet mix decisions? and (2) How do individual firms’ cost-driven fleet mix decisions impact urban system performance?

While little research into the use of LEVs as a tool for urban freight delivery exists, several companies are currently employing LEVs or other emerging vehicles to fulfill urban freight delivery needs. Moreover, several innovative international companies have developed vehicles (e.g., Twizy Cargo and Arcimoto Deliverator) and operating procedures in urban contexts. For example, Gnewt has focused solely on serving last-mile freight needs in Europe using innovative electric vehicles along with innovative techniques, like micro-hubs and mobile-crossdock facilities. B-Line in Portland, Oregon uses electric trikes and has made over 35,000 deliveries, avoided 82 metric tons of CO₂ emissions, and avoided over 90,000 delivery miles since it’s founding in 2008.¹ Other delivery companies around the United States such as UPS and Sol Chariots are employing bicycles, electric trikes, and golf carts to assist in delivery of packages, especially during peak delivery seasons.²

Extensive additional research into the role of Light Electric Vehicles as tools for urban freight delivery is still needed. Foremost among these is the need to investigate the benefit of using LEVs as opposed to traditional delivery vehicles in terms of cost, safety, reliability, efficiency, and environmental impact.

Investigation into the role of public policy to promote LEV usage, ensure safety, provide adequate facilities for larger LEVs, include LEVs in urban freight planning, and provide incentives for using LEVs as an alternate to replace heavier trucks is required. Feasibility studies are also critical in order to determine the optimum land use, roadway design, density, and consumer demand requirements for different urban freight delivery models, including studying the scenarios that are best for traditional delivery vehicles and which are best for LEVs.

RESEARCH PROGRAM

Our proposed research response (summarized in Figure 1) contains three components.

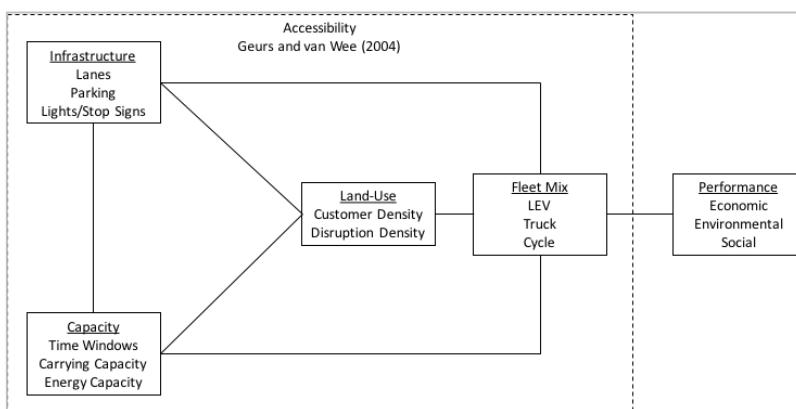


Figure 1: Research framework

INVENTORY EMERGING VEHICLE TYPES AND CAPABILITIES

First, we will carefully describe nontraditional freight vehicles, their operating (cost) characteristics, and their performance in varying urban/metro environments. Operating characteristics include, but are not limited to vehicle dimensions, operating speeds, carrying capacity, power sources, and operator requirements. This aspect of the research will rely heavily on existing academic and commercial literature on vehicle specifications and will identify urban typologies where such vehicles are likely to be the most appropriate technology to support urban freight needs.

URBAN DESIGN AND POLICY OBJECTIVES

Next, based on this understanding, the study will catalogue the various environmental characteristics that transportation planners and policy-makers can readily influence. By examining how different urban system level infrastructure components impact vehicle accessibility, transportation planners and decision-makers can configure these components to align each individual firm's optimal fleet mix with a mix that also enhances urban system performance. Here, we will focus on urban design characteristics, including land use and transportation infrastructure. We will also include softer policies, particularly those related to parking, loading facilities, complete street initiatives, and peak hour freight limitations.

EMPIRICAL ANALYSIS OF US-BASED APPLICATIONS

We will work with freight partners and researchers to conduct empirical analyses on urban freight delivery systems using alternative vehicles. We will partner with two research groups at Portland State University and City University of New York to assist in data collection and model validation of empirical studies. We will also partner with urban freight pioneer B-Line in Portland, who deliver urban freight via electric trike. They are industry partners of our Light Electric Vehicle Education and Research (LEVER)

Initiative and have offered to allow us to use data loggers to investigate their urban delivery operations

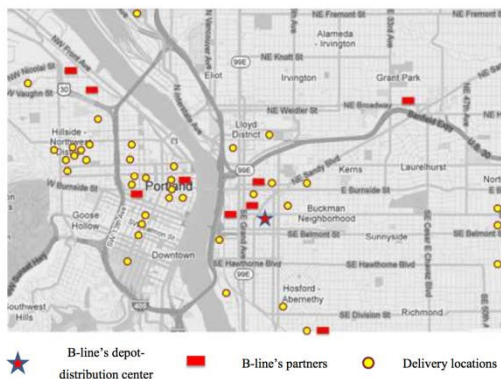


Figure 2: B-line operations geography

to provide empirical examples of where alternative vehicles work well, and also provide counter-examples where alternative vehicles do not work well. This aspect of research will rely on smartphone-based data logging for all trips for at least one month. This will draw on previous work from partners at Portland State University but extend the work to provide added insight into costs and savings of such vehicle strategies (Figure 2). We will also rely on examples from Southern states. UPS is operating innovative urban delivery services using emerging vehicles during the holiday season that we hope to explore through our LEVER partners,

Hummingbike.

APPLICATION OF EXISTING BEST PRACTICES TO TENNESSEE'S URBAN AREAS

We will explore the attributes of Tennessee's four largest urban areas (Nashville, Memphis, Knoxville, Chattanooga) and assess the potential for emerging urban freight vehicles and operating conditions in their urban cores, as well as special cases of peak holiday delivery. For this analysis, we will interview urban transportation managers and identify their perceived urban freight challenges, we will assess the urban built environment variables following urban typology development by the research team, and from those data, coupled with real-world operations data, determine appropriate urban logistics technologies for last-mile freight that could reduce overall negative impacts on urban safety, air quality, noise, and operations.

SCHEDULE, BUDGET, AND DELIVERABLES

Dr. Chris Cherry will serve as the overall Principal Investigator for this proposed research component. He will partner with Drs. Mark Burton and John Bell on the individual activities. A task-specific budget, schedule, and indication of deliverables, are provided in the tables that follow. All dates are based on a start date of October 1, 2016, but may be adjusted as necessary.

¹ B-Line: Sustainable Urban Delievery: <http://b-linepdx.com/>

² The Guardian: <http://www.theguardian.com/money/us-money-blog/2013/dec/22/drone-ups-bicycles-golf-carts>

