

Planning in the Digital Public Realm: Understanding E-Scooter Usage and Planning Implications in Denver, Colorado

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Capstone Executive Summary, May 2020

This capstone project conducts an in-depth analysis of Denver's e-scooter travel data from a transportation planning perspective. It helps address the city's current e-scooter challenges and provides recommendations for how Denver's planning initiatives should account for growing usage of new micromobility transportation modes.

Problem Statement and Background

Beginning in late Spring 2018, dockless e-scooters were deployed throughout Denver by private mobility companies. Between this 2018 starting point and April 2019, over 1.3 million scooter rides were completed, and the numbers continue to grow—with another 1.6 million scooter rides taken between July 2019 and January 2020 (DOTI e-scooter ridership data). E-Scooters and other emerging mobility options are providing a completely new way to get around in Denver, which has major implications on city planning and policy initiatives, and the residents these initiatives support.

Despite the convenience of e-scooters, cities are just beginning to understand how micromobility will impact transportation mode share, safety, equity and other factors. From a transportation planning perspective, e-scooters and other emerging modes present new challenges on both the macro and micro scales. At the macro scale, the emergence of new travel modes means that urban planners have a blind spot in understanding how people are moving around urban areas. Without this information, forecasting transportation mode share and ensuring transportation infrastructure matches these mode shifts is nearly impossible. At the micro scale, e-scooters and other smart transportation options are reshaping how our roadways, bike lanes and sidewalks are used. This will have a powerful impact on how urban spaces are used and shaped, which presents a new sort of challenge for urban planners.

Research Summary

This project contains four major elements: Background Research, Project Methodology, Data Analysis and Findings, and Recommendations/Implementation.

Background Research

This section begins by defining micromobility and the different types of 'shared micromobility' transportation options commonly seen in cities today, including e-scooters. Shared micromobility focuses on corporate or publicly-owned micromobility fleets that are available for the public to rent. It does not refer to private individuals' use of micromobility technologies, including scooters, motorized skateboards, One Wheels, or other modes. Micromobility solutions are typically enabled by smartphone apps and have rapidly expanded transportation choices by allowing city residents to quickly and easily rent bikes or scooters for travel through metropolitan areas (National Institute for Transportation and Communities, 2020). Next, this section summarizes recent e-scooter ridership trends and user demographics, identifies key challenges related to e-scooter usage, and discusses perceptions of e-scooter usage from residents in several US cities. City policies related to bike lane expansion, parking, equity, sustainability, and emerging technology are then discussed. Finally, several policy-related case studies are identified around equity challenges, e-scooter permitting, and the legal challenges associated with e-scooter data.

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Project Methodology

For this capstone project, the Denver Department of Transportation and Infrastructure (DOTI) provided ridership data for all e-scooter trips taken between July 1, 2019 and January 23, 2020. The original ridership dataset provided by DOTI included 2,173,018 total trips. Two key data cleaning steps were completed to remove inaccurate or erroneous trips, leading to a total of 1,652,277 trips to for analysis. This equates to about 230,000 e-scooter trips per month over the almost 7-month study period. This data and several different analysis techniques were used to answer the following research questions:

Key Questions and Analysis Techniques for Denver E-Scooter Data

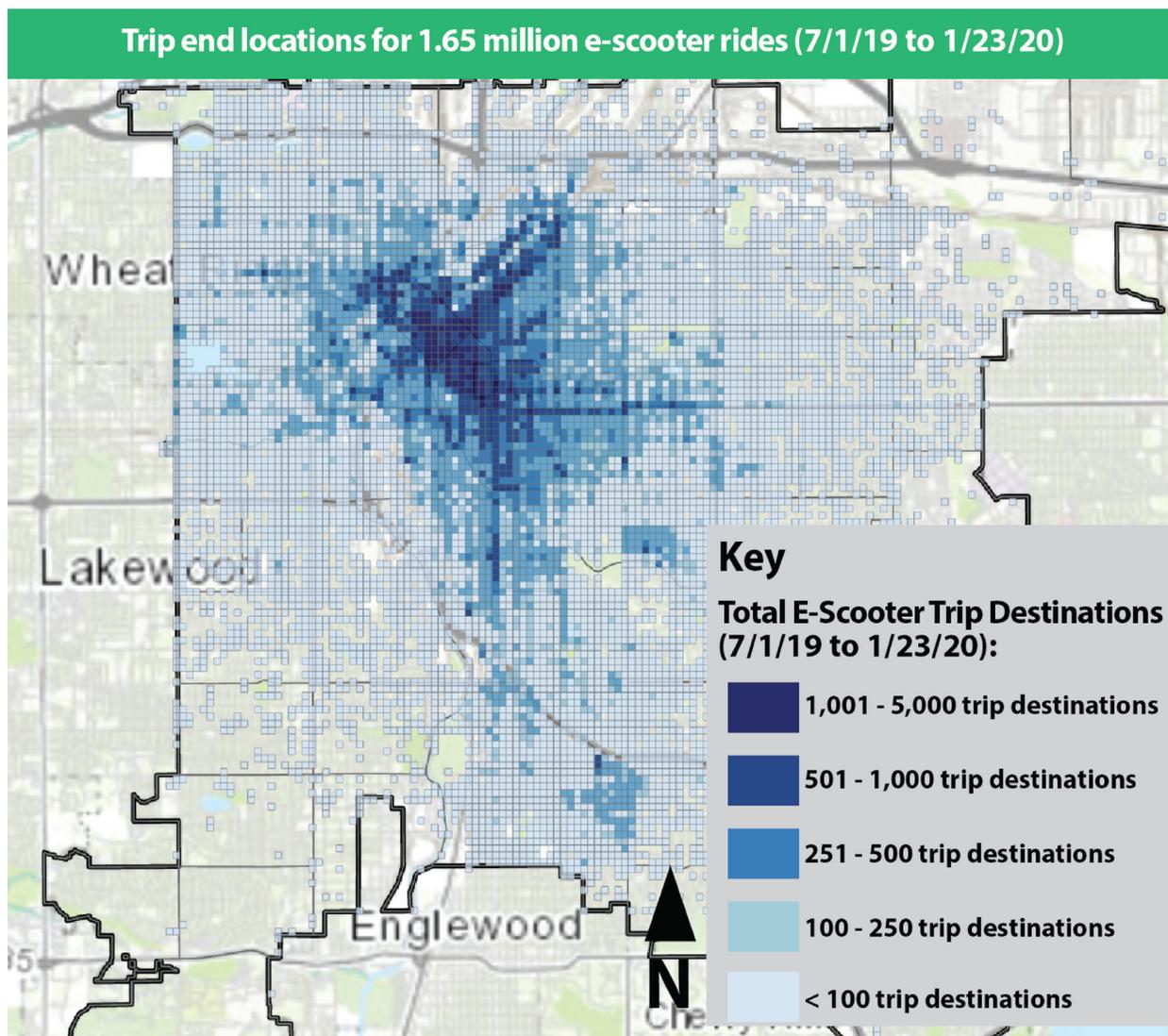
Overall Origins & Destinations	Analysis Technique
Where are clusters of scooter trip origins?	ArcGIS Spatial Analysis
Where are clusters of scooter trip destinations?	ArcGIS Spatial Analysis
Built Environment	
Which TODs are the most frequent trip destination?	ArcGIS Spatial Analysis
Which TODs are the most frequent trip origin?	ArcGIS Spatial Analysis
Which neighborhood transect types have the most ridership?	ArcGIS Spatial Analysis
How much ridership is happening in neighborhoods low on the Denver Equity Index?	ArcGIS Spatial Analysis
Transportation Infrastructure	
What are the key roadway corridors for ridership?	ArcGIS Spatial Analysis
What are the key bike facility corridors for ridership?	ArcGIS Spatial Analysis
What b-cycles station areas have the most trip starts/ends	ArcGIS Spatial Analysis
How many trip starts/ends are happening near future mobility hub locations?	ArcGIS Spatial Analysis
Based on origins/destinations, are there other areas to consider for mobility hubs?	ArcGIS Spatial Analysis
Scooter Usage Characteristics	
What is the average trip duration and length?	Statistical Analysis
How does trip duration and length vary across neighborhood transects?	Statistical/Spatial Analysis
How does trip duration and length vary for neighborhoods low on the Denver Equity Index?	Statistical/Spatial Analysis
On average, how many trips per day does a single e-scooter take?	Statistical Analysis
When are people most frequently using e-scooters? (time of day, weekday/weekend, etc.)?	Statistical Analysis
How does seasonality impact e-scooter ridership?	Statistical Analysis

In addition to this research, three specific high-ridership corridors were identified for demographic and in-person observational analysis of e-scooter ridership behavior. Unfortunately, the in-person analysis did not happen due to Denver’s Covid-19 stay at home order. To supplement this lost research section, analysis of ridership during the stay at home order was completed.

Analysis and Findings

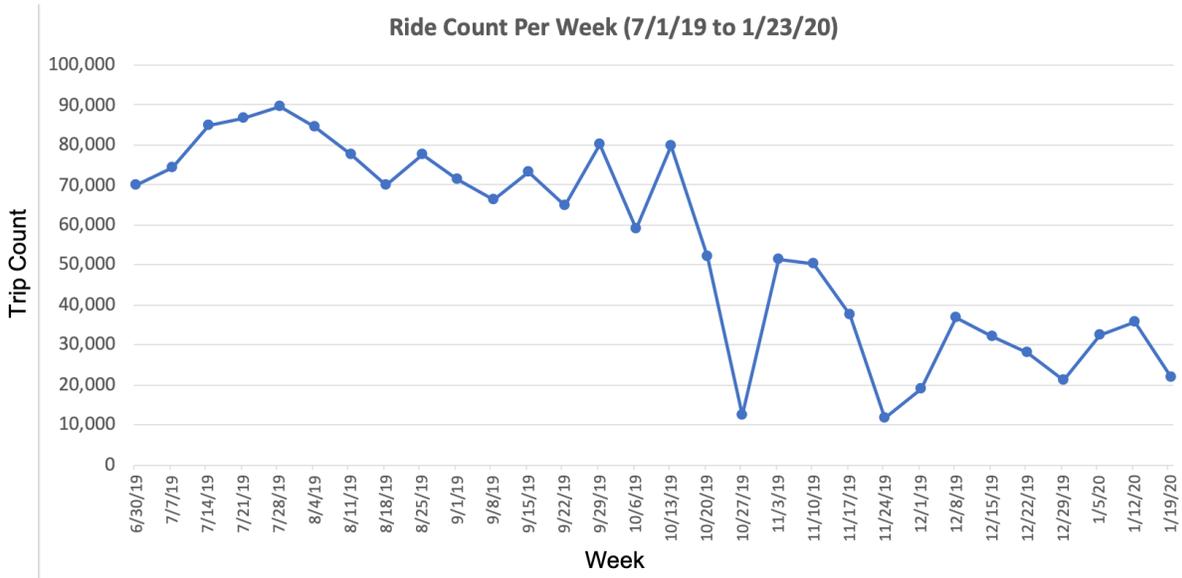
This section identifies hot spots of high ridership throughout the city and analyzes changes in ridership throughout the seven-month study period. Some of the key data points are summarized in the series of figures below. First, the map shows a hot spot analysis of all 1.65 million e-scooter trip destinations for the whole study period timeline (July 2019 to January 2020). Trip destinations are concentrated primarily in the downtown core and then along some of the major roadway corridors to the north, east and south of downtown.

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Second, the figures below show total weekly ridership trends between July 2019 and January 2020, along with additional ridership insights from this timeframe. Average weekly ridership from July to mid-September 2019 was over 70,000 rides per week before fall and winter weather led to reduced trip numbers. The average number of e-scooter trips per day during the study period was 8,020. The most trips completed in a single day was 18,160 trips on 8/3/19 and the least trips completed in a single day was 22 trips on 10/29/19 (when it was a high of 18 degrees and snowing).

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RIDERSHIP STATISTICS

1,652,277
E-SCOOTER TRIPS IN DENVER
BETWEEN JULY 2019 AND JANUARY 2020

- 8,020** AVERAGE TRIPS PER DAY
- 18,160** THE MOST TRIPS IN ONE DAY (8/3/19)
- 22** THE LEAST TRIPS IN ONE DAY (10/29/19)

- 1.2 MILES** AVERAGE TRIP DISTANCE
- 12.6 MINUTES** AVERAGE TRIP DURATION

COVID-19 RIDERSHIP IMPACTS

TRIPS/DAY

STAY AT HOME ORDER 3/24/20

BAR/RESTAURANT CLOSURE 3/17/20

TYPICAL WEEKDAY AND WEEKEND RIDERSHIP PATTERNS

TRIPS/HOUR

E-SCOOTERS AND EQUITY

BETWEEN JULY 2019 AND JANUARY 2020:

- 848 TRIPS PER 1,000 RESIDENTS** IN DENVER'S 21 'LOW EQUITY' NEIGHBORHOODS
- 3,071 TRIPS PER 1,000 RESIDENTS** IN ALL OTHER DENVER NEIGHBORHOODS

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Recommendations/Implementation

Based on the analysis and key findings, five groups of recommendations were developed around permitting process, e-scooter safety, equity requirements, e-scooter parking, and targeted locations for upgraded e-scooter/bicycle facilities. These recommendations are summarized below, while the full capstone provides more details and an implementation timeline.

RECOMMENDATIONS FOR AN IMPROVED E-SCOOTER EXPERIENCE IN DENVER				
PERMITTING	SAFETY	EQUITY	PARKING	E-SCOOTER & BIKE FACILITIES
Update Denver's e-scooter permitting with new requirements related to equitable access, parking, data privacy, scooter durability, and reporting	Develop a partnership between the City and County of Denver and e-scooter providers to encourage helmet use	Alternative cash payment options should be implemented to serve all residents, regardless of whether they have a bank account	Require that e-scooter providers warn and possibly suspend accounts of users who repeatedly park e-scooters improperly	Improve on-road bike facilities near the proposed Carla Madison Rec Center mobility hub to make e-scooter and bicycle riders more comfortable riding to and from these areas once the mobility hubs open. Specifically, north-south bike facilities in this area are lacking
	Study if active enforcement of intoxicated scooter riders is needed in areas with high concentrations of bars (this won't start until bars reopen after Covid-19 closures)	Conduct micromobility-related community outreach (or incorporate this into the city's ongoing Neighborhood Planning Initiative) in low-equity areas to identify how e-scooters can best address resident transportation needs	Focus the development of e-scooter new parking locations in high ridership areas that also have many pedestrians (LoDo, Broadway, Colfax, Larimer)	Analyze B-Cycle ridership data to prioritize high-use docking stations for conversion to e-scooter and e-bike parking and charging
	Require e-scooter providers incorporate GPS map guidance into their apps that suggests the safest, highest-comfort routes to take	Require e-scooter providers to redistribute vehicles into low-equity neighborhoods if a high percentage of scooters become concentrated in locations outside of the low-equity priority areas throughout the day	Develop and test a pilot program that requires all e-scooters in high usage/dense urban areas to be parked in permitted racks, docks or corrals	Upgrade existing unprotected bike lanes and sharrows along the following high ridership corridors: High Street near the University of Denver Light Rail Station, portions of 1st Avenue, Galapago Street and 12th Avenue, and Sherman Street and 21st Street downtown (see recommendations section for specific locations)
		In low-equity neighborhoods, identify & develop new high-comfort bike lanes so residents feel safer while riding e-scooters and bicycles		

Understanding e-scooter ridership is critical to the City and County of Denver's mobility goals related to mode choice (goal of reducing single-occupant vehicle (SOV) commuters from 73 percent to 50 percent by 2030), safety (Denver Vision Zero seeks to eliminate bicyclist and pedestrian deaths by 2030), and equity (providing a connected multi-modal network that allows everyone in Denver to get around safely and reliably) (Denver Mobility Action Plan, 2017). Findings from this project will also be useful as DOTI and Community Planning and Development begin to implement the new Denveright suite of plans. This project is an important first step towards meeting these goals and improving the e-scooter experience in Denver for riders and non-riders alike.