UNIVERSITY OF OREGON

PERFECTING POLICY WITH PILOTS:

NEW MOBILITY AND AV URBAN DELIVERY PILOT PROJECT ASSESSMENT

APRIL 2020

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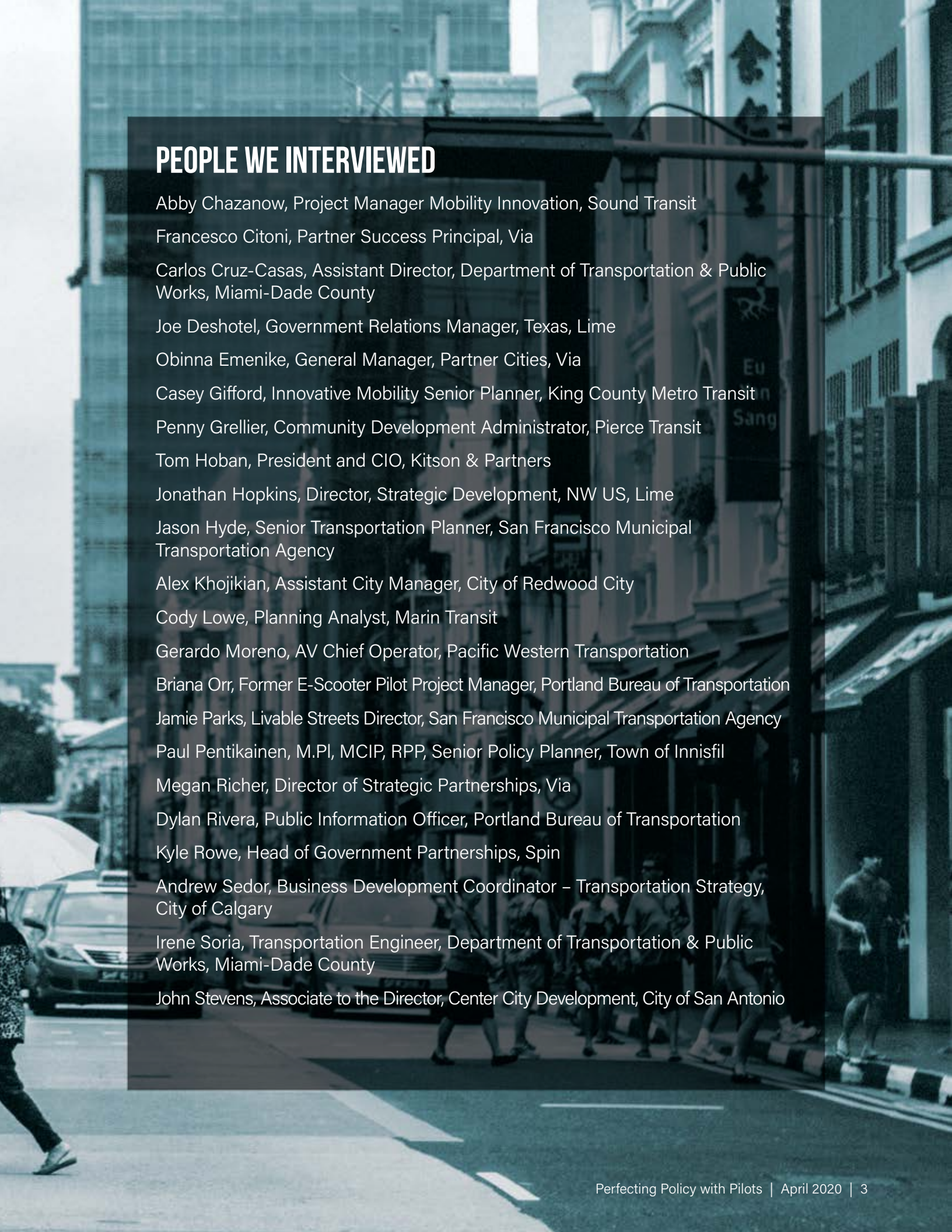

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URBANISM NEXT CENTER

The Urbanism Next Center at the University of Oregon focuses on understanding the impacts that new mobility, autonomous vehicles, e-commerce, and urban delivery are having and will continue to have on city form, design, and development. The Center does not focus on the emerging technologies themselves, but instead on the multi-level impacts — how these innovations are affecting things like land use, urban design, building design, transportation, and real estate and the implications these impacts have on equity, health and safety, the economy, and the environment. We work directly with public and private sector leaders to devise strategies to take advantage of the opportunities and mitigate the challenges of emerging technologies. Urbanism Next brings together experts from a wide range of disciplines including planning, design, development, business, and law and works with the public, private, and academic sectors to help create positive outcomes from the impending changes and challenges confronting our cities. Learn more at www.urbanismnext.org.

NUMO

NUMO is a global alliance that channels tech-based disruptions in transport to create joyful cities where sustainable and just mobility is the new normal. As an outgrowth of the Shared Mobility Principles for Livable Cities, NUMO's mission is to leverage the momentum of significant revolutions in mobility to address urban issues such as sustainability, equity, accessibility and labor. As an alliance consisting of partners — including cities, NGOs, companies, mobility service operators, community advocates and more — NUMO aligns the actions, investments and values of a growing community to achieve transformational, on-the-ground changes in transportation. NUMO is hosted by WRI Ross Center for Sustainable Cities. Learn more at www.numo.global.

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00 | EXECUTIVE SUMMARY

PURPOSE OF THIS REPORT

Over the past 10 years, new mobility and e-commerce has been changing buying habits and transportation behaviors. Communities want to better understand how these services impact the transportation system. Many public agencies conduct pilot projects that allow a limited number of commercially-operated vehicles (such as e-scooters, shuttles, or autonomous vehicles) on local streets to move people and goods. While there are efforts to track these projects and to analyze the impact by type of technology or mode, there is no study that has assessed multiple modes to better understand what we are learning from them collectively.

The purpose of this study is to go beyond cataloging pilot projects to determine the lessons learned, emerging trends and considerations, and examples of promising practices from pilot projects in the United States and Canada. This study was designed to help public agencies understand what activities are most likely to help them achieve their pilot project goals. Researchers describe 10 recommended actions for all pilot projects, regardless of the mode.

Researchers focused on pilot projects in the United States and Canada that involve testing of new mobility services and vehicles by mode:

Mobility of People

- Micromobility (shared bikes, e-scooters, and mopeds)
- Transportation Network Company Partnerships
- Microtransit
- Autonomous vehicles

Mobility of Goods

- Autonomous Delivery Devices and Vehicles

To better understand the relationship between pilot projects and implementation policies, researchers at the Urbanism Next Center at the University of Oregon conducted a literature and policy review, and assessed 220 pilot projects as well as conducting 11 in-depth case studies (approximately two to three per mode). The study resulted in 31 lessons learned organized by pilot goals, evaluation, implementation, outcomes, and policy and infrastructure implications.

RECOMMENDED ACTIONS

1. Define the pilot goals and outcomes at the beginning of the process and make sure *every* pilot activity is designed to achieve them.
The most successful pilots were those that had clearly defined goals or outcomes. By identifying what is most important, communities can ensure that these elements are included in all aspects of the pilot (and every recommended action described here), from the policy framework to what findings are analyzed in the evaluation report. This helps community leaders, the public, and the service providers understand what to expect and reduce conflicts.

2. Study what happened and put those findings into a final evaluation report.
Organizations that collected and analyzed data, surveyed participants, and reported on the outcomes were likely in the best position to learn from the pilots and incorporate those lessons into future pilots and deployments. In addition, evaluation reports are helpful for summarizing lessons learned and sharing information with other communities so everyone can learn from the experience.

3. Foster relationships and build trust.
Public agencies exist to maintain and enforce the public good. Ultimately, everything a public agency does is for the good of the residents that live and work within it's boundaries. It is important for public agencies to engage with residents to understand their needs and desires, especially as new technologies are deployed in the public right-of-way. In addition, public agencies should work directly with organizations and individuals that advocate for the most vulnerable populations to ensure that inequities are propagated or created through the introduction of new technologies. Finally, agencies should develop and foster relationships with the companies and their representatives to help guide them through the process and enable them to address issues as well as make it possible to support all players in achieving their goals.

4. Create a policy framework (i.e. regulations, contracts, agreements) for each pilot project that advances the public good and is easy to understand.
There is no one policy framework that is appropriate for all pilots — the level and type of regulation, contracting, or other formal or informal agreement

between the public and private sector will depend on the type of pilot initiated and the capacity and inclination of the public sector agency and leadership. The important point is that the agency focuses on the pilot goals and outcomes to ensure these are met through compliance of the policies and regulations enacted. Having a pilot may make it easier to experiment with different (temporary) forms of market entry.

5. Build in compliance mechanisms.
Public agencies should ensure that the private sector complies with the policies and regulations outlined in their policy framework. Some of the most successful compliance methods included both incentives and penalties. Data collection should inform compliance requirements so public agencies can track the most important outcomes of pilot activities.

6. Measure the impact on equity, health and safety, the environment, and the economy.
The introduction of new mobility and urban delivery services impacts equity, health and safety, the environment, and economic opportunities. If new mobility modes can overcome the technological, regulatory, and financial challenges they currently face, they could accelerate changes in transportation behaviors, including rates of personal vehicle ownership and use. In addition, new mobility has the potential to reduce the second most costly household expense after housing, but it remains to be seen if the benefits of these alternative modes of transportation outweigh the costs.

7. Measure the impact of the pilot project on transit.
Transit plays an important role in reducing congestion, providing equitable mobility, reducing greenhouse gas emissions, improving health and safety, and increasing access to opportunity and jobs. The ability of transit to deliver on these key livability outcomes cannot be overstated. Public agencies should examine how new technologies impact transit during pilot projects and consider how their policies and programs can be modified to support transit.

8. Collect the information needed to ensure the public good (while protecting privacy) and produce useful information to make relevant policy decisions.
It is difficult for community leaders to make good decisions if they don't have the information they need about impacts and outcomes of pilot projects. Data requirements should be designed to provide (1) operational data that reports almost realtime data to understand what is happening on city streets and if service providers are complying with the regulations; (2) analytical data to understand the demand and utility of the service; and (3) pilot evaluation data such as coordination with the local health authority on health data or public surveys. This information is critical for community leaders to make informed decisions during and after the pilot. To the extent that raw (anonymized) data can be made openly available, it would generate greater transparency and opportunities for independent analysis of the pilots.

9. Apply these lessons learned and recommendations to AV and other types of pilots.
The recommended actions are applicable to all types of pilots, not just existing technologies. While AV pilot projects are currently focused on learning about and testing the technology, at some point very soon, communities and companies will want to move beyond testing technology to understand a variety of case uses. Communities should use the lessons learned and apply the recommended actions in this study to AV and other future pilot projects.

10. Plan for volatility.
It is important to note the rapidly changing new mobility space and uncertainty of these markets. There was volatility in the market before the outbreak of Covid-19, and some of the companies that participated in pilot projects were already out of business by the time we finished the report. In addition, some companies that rapidly deployed their services in communities exited the market just as quickly. The industry will likely continue to be volatile as companies attempt to figure out the business case for operating in different communities across the country. The public health crisis presented by the Covid-19 pandemic has further exacerbated the volatility of the market and it will take ingenuity and resiliency to continue conducting successful pilot projects as we emerge from this crisis.


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01 | INTRODUCTION

BACKGROUND AND PURPOSE

Over the past 10 years, new mobility and e-commerce apps have been changing buying habits and transportation behaviors, and those changes have the potential to impact communities in new and profound ways. The smartphone makes it easy for people to order dinner from their favorite restaurant and have it delivered, or to rent an e-scooter, or to get a ride in someone else's car. Given the changes impacting communities today, transportation planners want to better understand how these services impact the transportation system. Many public agencies conduct pilot projects that allow a limited number of commercially-operated vehicles (such as e-scooters, shuttles, or autonomous vehicles) on local streets. To the best of their ability, they track the use and impact of these services on communities. Several organizations, such as the Shared Use Mobility Center and Bloomberg Philanthropies Autonomous Vehicles in Cities, catalogue pilot projects. While there are efforts to track these projects and to analyze the impact by type of technology or mode, there is no study that has assessed multiple modes to better understand what we are learning from them collectively.

The purpose of this study is to go beyond cataloging pilot projects to determine the lessons learned, emerging trends and considerations, and examples of promising practices from pilot projects in the United States and Canada. This study was designed to help public agencies understand what activities are most likely to help them achieve their pilot project goals. Researchers describe 10 recommended actions for all pilot projects, regardless of the mode.

Specifically, researchers focused on projects that involve testing of new mobility services and vehicles by mode:

Mobility of People

- Micromobility (shared bikes and e-scooters)
- Transportation Network Company Partnerships
- Microtransit
- Autonomous vehicles

Mobility of Goods

- Autonomous Delivery Devices and Vehicles

To better understand the relationship between pilot projects and implementation policies, researchers at the Urbanism Next Center at the University of Oregon analyzed a smaller number of pilot project case studies for each mode.

SOURCE: Andi Kernel, Unsplash

DEFINITIONS AND CRITERIA FOR INCLUSION OF PILOT PROJECTS IN THIS STUDY

There are hundreds of completed and on-going transportation pilot projects in the United States and Canada. One of the first steps of this project was to determine which projects to focus on. For the purposes of this study, a pilot project is generally defined as a limited duration, small-scale implementation of a new transportation technology or service. General or open-market deployment of a service is not considered a pilot project for the purposes of this study.

Urbanism Next then defined which types of new mobility pilot projects to research by mode. We needed to determine which projects should be defined as pilot projects and included in the study, and which should not. The second half of this section defines the characteristics considered to include a project in this study. Ultimately, the characteristics were used as guidelines, as we were expansive in our definitions to better understand the wide-range of projects being conducted in communities across the United States and Canada.

DEFINITIONS OF NEW MOBILITY PROJECTS BY MODE

Pilots allow the public sector to make informed choices about the adoption and regulation of these services. Urbanism Next considered Society of Automotive Engineers International (SAE), Federal Transportation Authority (FTA) and other organization definitions to define each mode. Ultimately, Urbanism Next chose to write more expansive definitions of the modes to ensure the study captured the largest number of pilot projects.

MICROMOBILITY

Micromobility describes a category of small (<100 kg) vehicles including docked and dockless bicycles, electric bicycles (e-bikes), and electric scooters (e-scooters) that are shared using app-based technology. Commercial micromobility vehicles are frequently referred to as shared mobility devices (SMDs). This study includes shared micromobility pilot projects as identified by local governments, not deployment of services in general.

TRANSPORTATION NETWORK COMPANIES (TNCS)

A TNC is a company that exclusively uses an online or app-based platform to connect passengers with drivers (it cannot pickup street hails). TNC services are often referred to as ride-sourcing, ride-hailing, and individual demand-responsive transport. However, TNCs are distinct from other ride-hailing services such as taxis, limousines, and microtransit, because TNCs use individually-owned vehicles to provide service, rather than a dedicated fleet. TNCs are sometimes referred to as shared-use mobility service providers. This study assesses TNC partnerships with public agencies and other organizations, not deployment of TNCs in general.

MICROTRANSIT

Microtransit, also known as demand-response transit (DRT), Dial-a-Ride transit (DART), flexible micro transport services (FMTS), or flexible transport services describes flexible routing and/or scheduling services of minibus vehicles and shuttles (generally 9 to 12 seat vehicles). It includes both the provision of the software to transit agencies to provide on-demand microtransit, as well as microtransit service provision. Microtransit vehicles are fleet-based and owned by the operators (private companies or transit agencies) as opposed to individually owned TNC fleets. Again, the study focused on pilot projects, not microtransit deployment in general.

AUTONOMOUS VEHICLES

Autonomous vehicles (also known as self-driving cars, driverless cars, and robot cars) are vehicles that have at least some automated functions following the SAE Levels of Automation shown in Table 1-1. Pilots included in this report operate at Level 4 of the SAE Levels of Automation. Because there are limited numbers of pilot project partnerships between private companies and public agencies, we also chose to include some projects that only involved a private company. Not surprisingly, there is limited information about private company testing of AVs. We included as many AV pilot projects as we could find with available information online.

GENERAL CHARACTERISTICS OF PILOT PROJECTS CONSIDERED FOR INCLUSION IN THIS STUDY

Urbanism Next included and assessed pilot projects with most (if not all) of the following characteristics (with a few caveats):

- **Specified time frame (limited duration).** While almost all pilots fit this characteristic, we also included several pilot projects that didn't have specified end dates.
- **Capped operation of service.** Micromobility and microtransit pilot projects usually cap the number of vehicles while autonomous vehicle (AV) and TNC pilots generally did not. Instead, TNC pilot programs often limited the number of participants, used geographic area, or individual subsidy amounts to control amount of use. The number of vehicles used in AV pilots were typically limited due to project budget constraints.
- **Some form of agreement between public agencies and private companies.** Common types of agreements between public agencies and private companies are contracts for service or operating permits. Less common are informal programs where the service provider and the agency or jurisdiction discuss aspects of the pilot, but there is not a legal agreement. We did not include pilot project partnerships that were primarily marketing agreements or partnerships. Marketing partnerships can be further identified by the absence of a money exchange between the public agency and the TNC and their very limited duration (usually between a couple days and one week). Note that AV pilot projects were less likely to have a formal partnership than the other modes.
- **Specified geographic area.** Most pilot programs define the geographic area for the pilot. Pilot projects are generally confined to a portion or all areas within a city limits. Less common are multi-city or region-wide pilots.
- **Public use/involvement.** The public use and pay for new mobility services in most of the pilot projects. The exception is that participants in AV passenger pilots may or may not pay a fee, and the participants in AV goods delivery pay for the goods being delivered and may or may not pay an additional fee for the delivery service.
- **Evaluation and lessons learned incorporated into policies and regulations.** Generally, pilot projects are evaluated to learn about new mobility and inform policy that will allow communities to achieve long-term goals.

In addition to the criteria above, some pilot projects include data sharing requirements, public engagement and feedback activities, and

TABLE 1-1: SAE LEVELS OF AUTOMATION

LEVEL	TITLE	DESCRIPTION	TECHNOLOGY
LEVEL 0	*No Automation*	*Driver needs to perform all driving tasks. The vehicle provides no assistance to the driver.*	*Lane departure warnings.*
LEVEL 1	*Driver Assistance*	*Vehicle is controlled by the driver but there is one driving assist feature (e.g., car assists speed or steering),*	*Adaptive cruise control, lane-keeping assistance.*
LEVEL 2	*Partial Automation*	*Vehicle has multiple driving assist features, such as speed-control and steering. Driver needs to remain engaged with the task of driving and monitor the environment at all times.*	*Adaptive cruise control AND lane-keeping assistance (GM Super Cruise, Tesla Autopilot).*
LEVEL 3	*Conditional Automation*	*Driver does not need to monitor the environment, instead the vehicle detects challenges that require driver intervention. Driver needs to be able to take control of the vehicle at all times.*	*Car lets you know when you need to start driving.*
LEVEL 4	*High Automation*	*Vehicle is capable of performing all driving functions under certain conditions. Driver may or may not have the option to control the vehicle.*	*"Driverless" except have certain conditions (speeds over 25, no rain/ snow/fog, in a certain neighborhood)*
LEVEL 5	*Full Automation*	*Vehicle is capable of performing all driving functions under all conditions. Driver may or may not have the option to control the vehicle.*	*Completely driverless in all conditions (does not exist yet).*

SOURCE: SAE International, 2019.

(sometimes) have clearly defined goals. They are usually designed to shed light on the potential positive and negative consequences of innovative solutions and to help solve problems related to environmental, equity, and other public policy-based issues. While many pilot projects are explicit about the goals and/or the desired outcomes they are trying to achieve, many others do not list goals or formally describe what was learned or how policies or programs were changed as a result of completion of the pilot project (such as the creation of an evaluation memorandum or report).

METHODS

Urbanism Next used the following methods to complete this study.

- **Creation and feedback from a technical advisory committee (TAC).** Representatives from NUMO and a number of other public agencies and private companies (see Acknowledgements on page 1) comprised a TAC for this project. The TAC gave feedback on all phases of the project, from scope creation to selection of case studies as well as conclusions in the final report.
- **Literature and policy review.** We conducted a literature and policy review of new mobility services and assessments of pilot projects to better understand the most up-to-date thinking and research on these topics. The focus of this work was to understand what others are learning from pilot projects.
- **Online scan of pilot projects.** We collected information on approximately 220 pilot projects across the United States and Canada. Most of the information was readily available online and included basic information about pilot projects, including: online reports, government agency and private company web pages, news articles, etc. This information is available at www.urbanismnext.org/the-nexus.
- **Case studies.** Out of the 220 pilot projects reviewed for this report, Urbanism Next selected two to three case studies per mode for in-depth review. The case studies were selected based on geographic diversity, available information, and/or the policy and regulation issues being tested.
- **Interviews.** We interviewed government agency and private company representatives from case study pilot projects to inform the case studies.

SOURCE: Jump Bike

LIMITATIONS

This report represents significant new knowledge about pilot projects in the United States and Canada. That said, there are a number of limitations of the research in this report:

- **All research and pilot projects were conducted before the COVID-19 pandemic.** As we finalized this report, the COVID-19 pandemic was drastically changing how people and goods move. It remains to be seen how the pandemic will impact companies, the services they provide, as well as transportation generally. That said, we believe that the lessons learned from this study will still be valuable to transportation planners and others interested in pilot project implementation and management.
- **Pilot projects were limited to communities in the United States and Canada.** In order to limit the total number of pilot projects reviewed, we only reviewed pilots in the United States and Canada. Many other communities around the world are conducting new mobility and urban delivery pilot projects that could inform this work.
- **Limited information online.** Urbanism Next found approximately 220 pilot projects online. However, the amount of information available for each pilot varied widely. If there was very limited information (beyond identification that a pilot project happened), we did not include the pilot in our study. Older pilot projects were more likely to have less information available, especially older microtransit and TNC partnership pilots. Given the nature of AV pilot projects (that often look more like testing with fewer formal relationships between public and private partners), there is limited information online. Micromobility pilots tended to have the most publicly available information.
- **Urbanism Next's scan of pilot projects only went through October 1, 2019.** One broad limitation of this study is that many pilot projects were still underway or had not yet begun by the time the scan was complete. As a result, there were not yet reports to review. Additionally, many pilots have undoubtedly started since we completed our scan and those researched may have been amended since their inclusion in this study.
- **Lack of formal evaluations of pilot projects.** There are inconsistencies in evaluation of pilot projects across jurisdictions. Some produce formal evaluations while others do not. In particular, AV and microtransit pilot projects were less likely to be formally evaluated than other types of projects.
- **Lack of publicly available information online for AV passenger and goods delivery pilot projects.** Given that autonomous vehicles and automated delivery robots are still in their nascence, publicly available information about them remains limited. We collected the information we could, but the sections on AVs in this report are necessarily more limited than the other modes we studied for which more information is readily available.
- **Private sector caution in answering questions.** While public agency representatives were generally forthcoming with their responses to interview questions, private company representatives were slightly more reserved and cautious about their responses.
- **For micromobility pilots we did not interview all the companies involved in our case study pilots.** The private sector insights and opinions shared may not reflect those of other companies involved in each pilot or the industry as a whole.
- **The new mobility space is changing quickly.** Some of the people we spoke with during this study may no longer work for the same entities they previously represented or be involved in the same public-private partnerships, and some of the information gathered may no longer be the most current.
- **This report is a study of relatively new modes of transportation.** As a result, further research is needed on the long-term implications of new mobility.

ORGANIZATION OF THIS REPORT

The rest of this report is organized into the following chapters:

- **Chapter 2 - Literature Review** is a brief overview of other studies, articles, and reports about pilot projects or emerging technologies.
- **Chapter 3 - 220 Pilot Projects** presents an overview and key findings from the pilot projects reviewed, organized by mode.
- **Chapter 4 - 11 Case Studies** provides an in-depth look at two or three key pilot project case studies for each mode.
- **Chapter 5 - Findings and Recommended Actions** lists the lessons learned and examples of those lessons organized by pilot goals, evaluations, pilot implementation, outcomes, other policy and infrastructure implications.
- **Appendix A - Annotated Bibliography** summarizes the documents included in the creation of this report.
- **Appendix B - Bibliography** lists all sources of information for this report.
- **Appendix C - List of 220 Pilot Projects** lists each of the pilot projects reviewed for this report.

SOURCE: Uber


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02 | LITERATURE REVIEW

INTRODUCTION

This chapter broadly summarizes some of the most current research and thinking on new mobility services with a focus on new mobility pilot projects. It provides a summary of what the literature has found about these new services in terms of their characteristics, as well as both the opportunities and challenges they present. Urbanism Next specifically looked for research on adoption rates, mode share impacts, equity concerns, environmental impacts, governance and funding structures, and integration into existing transportation networks, among other topics.

To date there is a limited body of peer-reviewed studies and professional sources specifically on new mobility pilot projects, but alongside the technology, the literature is growing (see Appendix A for an annotated bibliography of literature related to new mobility). Given the relative lack of literature on pilot projects, this chapter relies heavily on works that analyze new mobility more broadly. To collect studies and reports, Urbanism Next consulted online-accessible transportation and peer-reviewed databases.

This literature review is organized by mode and covers new mobility services that move passengers as well as goods. The key findings are summarized at the end of each section.

SOURCE: Jump Bike

LITERATURE REVIEW

NEW MOBILITY (MULTIPLE MODES)

Governance and Funding Structures: Historically, publicly available transportation services such as buses and light rail systems have been financed and operated by the public sector. Private transportation services, such as taxis, have only been available in limited quantities. In contrast, many new mobility services today are typically privately funded and operated. Taylor et al. noted one exception to this trend are docked bikeshare systems, which are often publicly subsidized (2016).

Transportation network companies (including ridesharing, carsharing), bikesharing, and microtransit, are changing mobility for millions of travelers. Such services could reduce congestion and emissions from surface transportation if regulated wisely to encourage concurrent, rather than sequential, ride sharing. Government agencies demonstrate varying levels of involvement in implementing new mobility services. In some cases, transit agencies contract out to new mobility providers for a specific service, while in others, local governments provide public subsidies to new mobility providers. Sometimes governments choose to not be involved at all. Before engaging in long-term contracts, committing to permanent service offerings, or subsidizing new mobility services, transportation agencies and local governments often choose to conduct pilot projects.

In October 2019, the Eno Center for Transportation published "Contracting for Mobility," a report detailing the contracting process of public agencies in the regions of Los Angeles and Puget Sound. The report focuses on aspects of the contract that are uncommon in many transportation contracts but are becoming increasingly common in contracts with new mobility providers including statements of work, nondisclosure agreements, and data sharing provisions (Grossman & Lewis, 2019).

Pilot Characteristics: Pilot projects are used to test and gain information about new mobility modes. Researchers at the American Public Transportation Association (APTA) found that pilots are particularly useful to "generate revenue, encourage compliance, and ensure that mobility companies help to serve the public interest" (Feigon & Murphy, 2016, p. 36). Learning how new mobility services impact existing transportation services, such as fixed-route buses and light-rail, has been a focus of many transit agencies.

Mode Share Impacts: Feigon and Murphy studied the relationship between shared mobility and public transportation (2016). A key finding from a survey conducted as a part of the APTA study is that greater utilization of shared modes including bikeshare, carshare, microtransit, and ridesourcing "is associated with greater likelihood to use transit frequently, own fewer cars, and have reduced transportation spending" (Feigon & Murphy, 2016, p. 1). However, not everyone can reap these benefits equally as there are currently barriers prohibiting certain groups from using new mobility.

Equity Concerns: Multiple sources revealed that one of the most prominent barriers to the widespread adoption of new mobility is the dependence on smartphones and information technology for use (Feigon & Murphy, 2016, Taylor et al., 2016). While technology has made it easier for some users to pay for and use new transportation modes, Feigon and Murphy found that people who are elderly, lower-income, and disabled are less likely to use new technology (2016), limiting their capacity to adopt technology-reliant new mobility services.

New Mobility Key Findings:

- Traditional governance and funding structures are changing, and government agencies are increasingly contracting for service or issuing permits to new mobility providers.
- Data sharing provisions and non-disclosure agreements are becoming increasingly common.
- Pilot projects are often used to learn about how new mobility services impact existing transportation services, with a specific focus on whether they can shift trips to non-automobile modes.
- Greater utilization of some shared modes may be associated with higher rates of transit use and lower rates of car ownership.
- Technology is sometimes a significant barrier to equitable access.

MICROMOBILITY

Adoption Rates: Populus, a data analysis firm, published a study focused on the adoption and perceptions of e-scooters in the United States in 2018. Populus noted that the rate of adoption of e-scooters has been faster than the adoption rates of other new mobility services such as bikesharing and carsharing (Clewlow, 2018). Populus attributed the rapid spread of e-scooters to the following factors: an increase in smartphone use, increase in congestion and the desire to avoid it, and large private financing which led to large supplies of e-scooters and widespread access to the vehicles. Populus reported that many people view e-scooters favorably with over 70% of respondents in a multi-city survey having a positive view of e-scooters. Additionally, Populus found that the gender gap between male and female scooter riders is smaller than the gap observed in bikeshare systems (Clewlow, 2018).

Pilot Characteristics: More and more communities are pursuing pilot projects as an intermediary tool before permanently implementing shared micromobility services. The first e-scooter deployments and pilot projects began in late 2017 and so far, communities across the United States and Canada are taking a different approach to e-scooter deployment than bikeshare. After the initial launch of e-scooters in Santa Monica and San Francisco, California, many communities are implementing pilot projects to better understand the impacts of e-scooters and craft informed public policies. A report published by the National League of Cities found that pilot projects can be particularly useful for cities to "regulate overzealous providers from deploying too much too soon, control the local mobility landscape and create a long-term plan using testing and gradual rollout" (DuPuis, Griess, & Klein, 2019, p. 17).

Mode Share Impacts: Through mapping and analysis of survey data in the United States, Elliot Martin and Susan Shaheen of the University of California, Berkeley, found that while there is a tendency for (docked) bikeshare trips to replace public transportation trips, it largely depends on the size and density of a city (2014). In larger and denser cities bikeshare trips often replaced trips taken on public transportation. However, in small to mid-size cities, low-density cities, and cities with spread out rail lines, the researchers found that bikeshare facilitated trips to public transit by providing first- and last-mile connections to bus stops and rail lines (Martin & Shaheen, 2014).

Surveys of e-scooter riders in Portland, Oregon and Raleigh, North Carolina suggest that e-scooters most frequently replace walking and biking trips. After walking and biking trips, e-scooter trips most commonly replace car trips, leaving the fewest number of trips replaced being those taken on transit (Hollingsworth et al., 2019; Portland Bureau of Transportation, 2019).

Equity Concerns: A frequently cited study published by the Mineta Transportation Institute found that bikeshare users are likely to have a higher income and level of education and are more likely to be male, younger, and Caucasian than the average person where the bikeshare system is located (Shaheen, Martin, Chan, Cohen, & Pogodzinski, 2014). Findings from this study suggest that bikeshare systems disproportionately improve the mobility of individuals who already have access to more mobility options to begin with.

Environmental Impacts: A more recent study published by Susan Shaheen et al. identified the impacts of bikeshare systems on cities. The authors reported that documented impacts of bikeshare systems include "increased mobility, reduced greenhouse gas emissions, decreased automobile use, economic development, and health benefits" (S. Shaheen, 2019, p. 1). Additional impacts that Shaheen et al. identified were reduced congestion and fuel use (S. Shaheen, 2019).

After performing a life cycle assessment, researchers at North Carolina State University found that shared e-scooter systems can have less of an environmental impact than some other transportation modes however, the researchers found that per passenger-mile traveled, dockless e-scooters have higher life cycle global warming impacts than buses with high ridership, personally owned bicycles, and electric bicycles. (Hollingsworth et al., 2019) and marketed for short-distance travel. Using life cycle assessment, we quantify the total environmental impacts of this mobility option associated with global warming, acidification, eutrophication, and respiratory

impacts. We find that environmental burdens associated with charging the e-scooter are small relative to the materials and manufacturing burdens of the e-scooters and the impacts associated with transporting the scooters to overnight charging stations. The results of a Monte Carlo analysis show an average value of life cycle global warming impacts of 202 g CO2-eq/passenger-mile, driven by materials and manufacturing (50%). Additional research is needed to better understand the GHG emissions of e-scooters.

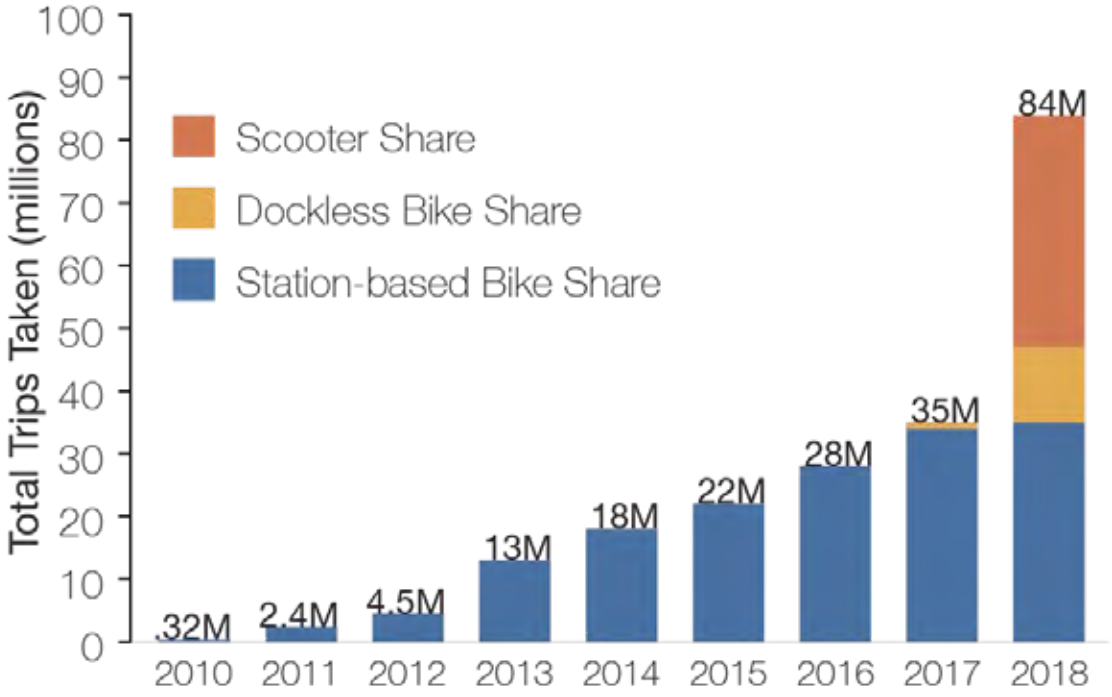
Challenges: DuPuis et al. also identified common issues that arose during shared micromobility pilot programs (2019). These issues include pedestrian safety (riding on sidewalk), scarce helmet use, insufficient bike infrastructure; curb space management (inappropriate parking); and data reporting (DuPuis, Griess, & Klein, 2019). The literature on micromobility pilots revealed that addressing the lack of helmet usage, in particular, is a challenging issue for communities and service providers. Studies on compulsory helmet laws and bikeshare systems found that these laws contributed to low use of bikeshare systems (Fishman, 2015; S. A. Shaheen et al., 2014).

Several themes have begun to emerge from studies examining bikeshare. Convenience is the major motivator for bikeshare use. Financial savings has been found to motivate those on a low income. The distance one lives from a docking station is an important predictor for bikeshare membership. In a range of countries, it has been found that just under 50% of bikeshare members use the system less than once a month. Men use bikeshare more than women, but the imbalance is not as dramatic as private bike riding (at least in low cycling countries.)

Opportunities: To encourage the use of shared micromobility and reduce the number of bikes and e-scooters ridden on sidewalks, cities are updating road infrastructure by creating bike lanes and creating physical barriers between existing bike lanes and automobile lanes (DuPuis et al., 2019, p. 15).

To address data reporting issues, some cities have begun to include datasharing requirements in their operating contracts or request for proposals (DuPuis et al., 2019; Hauf & Douma, 2019). Numerous cities use the Mobility Data Specification (MDS) APIs created the by the City of Los Angeles to make it easier for companies to collect and share real-time data (DuPuis et al., 2019).

FIGURE 2-1: 84 M TRIPS ON SHARED MICROMOBILITY IN 2018



Source: NACTO

Local governments and micromobility providers are trying different strategies to reduce the number of improperly parked dockless bikes and e-scooters. Some e-scooter providers have added a feature to their apps that require users to take a picture of the vehicle after it has been parked. This feature allows providers to monitor parked vehicles and hold users who frequently park vehicles incorrectly accountable. Numerous cities have tried to address the issue of improperly parked vehicles by creating designated parking zones, often on sidewalks or along curbs, for e-scooter and bicycle parking, as shown in Figures 2-2 to 2-5. The City of Santa Monica, for instance, installed in-street e-scooter parking corrals to indicate where they should be parked (Linton, 2018). In Washington, D.C. and Ann Arbor, Michigan e-scooter provider Spin partnered with Swiftmile to install electric docking stations in a 60-day pilot (Holley, 2019). And in San Francisco, the city required that e-scooter providers integrate locking mechanisms into their devices to ensure that they are properly parked (Dickey, 2019).

Micromobility Key Findings:

- Adoption rates of shared e-scooters have risen quickly compared to other shared modes.
- Common challenges associated with micromobility devices include safety concerns, insufficient helmet usage, sidewalk riding, lack of available infrastructure, and improper device storage. Cities have also expressed frustration related to data sharing.
- E-scooter pilot projects are common and are often used by cities to test the service before creating a permanent program.
- Mode share impacts of micromobility appear to be mixed. Research findings suggest that e-scooters most commonly replace walk and bike trips, but this may depend on local context. Bikeshare trips may replace transit trips in more dense areas but may help to facilitate first- and last-mile connections in less dense areas.
- There is evidence to suggest that micromobility programs may be increasing the mobility of groups that already have access to multiple mobility options.
- Some local governments are adding parking facilities to better accommodate micromobility devices, and private sector companies are working to address safety and parking concerns.

FIGURE 2-2: SANTA MONICA

Source: Carter Rubin

FIGURE 2-3: ANN ARBOR

Source: Swiftmile

FIGURE 2-4: WASHINGTON, D.C.

Source: Arlington DES

FIGURE 2-5: SAN FRANCISCO

Source: Scoot

TRANSPORTATION NETWORK COMPANIES

Governance Structures: Transportation network companies (TNCs) first entered the United States transportation market in 2010, and companies Uber and Lyft quickly made a name for themselves by providing inexpensive, on-demand, personal rides. It was not until 2016 that transit agencies and local governments began engaging in partnerships with TNCs, often subsidizing rides for certain groups (Westervelt et al., 2017). Urbanism Next found that many groups have researched and analyzed the use of TNCs by individuals, but there is very little research on the use of TNCs by the public sector. The existing research is conflicted about the success of such partnerships.

Pilot Characteristics: The most comprehensive report on TNC-transit partnerships was "Partnerships Between Transit Agencies and Transportation Network Companies" written by Terra Curtis et al. in 2019. Transportation agencies pursue TNC partnerships for a variety of reasons. According to the 2019 study, researchers analyzed twenty pilot partnership case studies and found the most common use cases for partnerships to be, in order: first- and last-mile connections, on-demand paratransit and dial-a-ride service, transit for low-density areas, late-night transportation service, and occasional trip needs (Curtis et al., 2019). Curtis et al. also found the most common public-private partnership with TNCs involved transit departments or agencies directly subsidizing TNC rides for certain user groups (Curtis et al., 2019).

Equity Concerns: Multiple studies identified that complying with the Americans with Disabilities Act (ADA) and Title VI of the Civil Rights Act has proven to be a challenge for transit agencies partnering with TNCs (Curtis et al., 2019; Lader & Klein, 2018; Westervelt et al., 2017). While transit agencies are subject to ADA and Title VI regulations, TNCs are not because they are classified as technology companies rather than transportation providers (Lader & Klein, 2018). For early pilots and partnerships, the interpretation of these acts presented great challenges. Westervelt and others noted that in early partnerships and pilots, different transit agencies had different interpretations on how to apply Title VI, ADA, and other federal regulations to their partnerships with TNCs. The lack of clear guidelines at the federal level made it challenging to approach and apply regulations to pilots (Westervelt et al., 2017). Once the Federal Transit Administration (FTA) clarified the meaning of these acts, the laws themselves created a challenge for TNC-transit partnerships (Curtis et al., 2019). Lader and Klein found that when TNCs do not provide sufficient data from pilots and partnerships with transit agencies, the transit agency can be at risk of not complying with their reporting obligations to the FTA (2018).

Environmental Impacts: Researchers at the Coalition for Urban Transitions modeled the environmental impacts of TNC-transit agency partnerships in three cities: London, Mexico City, and San Francisco. The partnerships involved transit agencies subsidizing shared TNC rides for first- and last-mile connections. Their model found that TNC-transit partnerships can reduce GHG emissions and local air pollutants by 55-80%, so long as the partnership complements existing public transportation, and that shared rides would increase public transportation use and reduce personal vehicle use (Canales et al., 2017, p. 5). The researchers mentioned that if TNC trips substituted public transit or walking trips, the impacts on GHG emissions and pollutants would be reversed, and their environmental burden would increase (Canales et al., 2017).

Consulting firm Fehr & Peers collaborated with TNCs Uber and Lyft to analyze the VMT produced by TNCs in six metropolitan regions in the United States. Fehr & Peers found that between 54% and 62% of VMT generated from a TNC trips occurs "in-service" when a passenger is in the vehicle. Between 38% and 46% of VMT of a TNC trip occur when a TNC driver is waiting for a passenger to request a trip and to drive to pick up a passenger (Balding et al., 2019).

Challenges: Researchers at the Chaddick Institute for Metropolitan Development at DePaul University concluded that a significant barrier for transit agencies looking to develop new partnerships with TNCs is the "lack of analysis and formalized reporting of previous partnerships" (Schwieterman

et al., 2018). Curtis et al. (2019) reaffirmed this idea in their report "Partnerships Between Transit Agencies and Transportation Network Companies." The report analyzed numerous active and completed TNC partnerships and found only 27% of the transit agencies had developed a formal evaluation process for the partnerships. Furthermore, the researchers found that the lack of planning for formal evaluations led to insufficient datasharing requirements during the procurement process (Curtis et al., 2019).

Insufficient data reporting appears to be a recurring trend in TNC-transit partnerships. Planners in Westchester County, NY hesitated to engage in a partnership with TNCs because they found that "TNCs have displayed reluctance or have even refused to share data with transit agency partners, claiming the information they compile is proprietary. It may be a challenge to structure a TNC partnership that requires TNCs to provide information for federal reporting purposes" (Lader & Klein, 2018, p. 4).

Opportunities: One of the most important questions surrounding TNC-transit partnerships in the literature reviewed is whether these partnerships can effectively complement public transportation and lead to increased ridership and/or improved service and mobility. The answer to this question is not yet known and existing research on the results of partnerships is not conclusive. However, answering this question is quite important as different answers imply drastically different economic, environmental, and service impacts. That said, multiple reports on pilots thus far have concluded that for the most part, partnerships have served as a complement to transit services (Blodgett et al., 2017; Lader & Klein, 2018).

In their review of case studies, researchers at the University of Minnesota found that public-private partnerships between transit agencies and TNCs have thus far been successful. For example, they found that for alternative paratransit service, TNC-transit partnerships were cost-effective and the on-demand nature greatly improved service. Additionally, the researchers found that in low-density areas TNC-transit partnerships can be more cost-effective than traditional fixed-route public transit (Blodgett et al., 2017).

However, Robert Schaller of Schaller Consulting arrived at different conclusions on the viability of TNC partnerships. In the report "The New Automobility," Schaller found that replacing bus routes with subsidized TNC service does not work. Rather, Schaller proposed that partnerships "can be valuable extensions—not replacements—for fixed route transit" (Schaller, 2018, p. 34).

Transportation Network Companies Key Findings:

- While TNCs have been in the U.S. since 2010, partnerships between TNCs and transit agencies are a more recent phenomenon.
- The most common use cases for TNC and transit pilots include: first- and last-mile connections, on-demand paratransit and dial-a-ride service, and to fill existing service gaps such as late-night service.
- Transit agencies that partnered with TNCs were challenged to meet ADA and Title IV regulations since TNCs are not subject to the same regulations, creating equity issues. Partners created workarounds to try and address these issues.
- The environmental impacts of TNC partnerships with transit are circumstantial. Some researchers suggest that there may be positive impacts as long as TNCs complement transit. However, they could have negative impacts if TNCs replace trips that otherwise would have been made by walking or biking.
- A lack of analysis and formal reporting on the outcomes of these partnerships has created a barrier for transit agencies who may be interested in pursuing one.
- Datasharing has proven to be a significant challenge.
- While some researchers have found that partnerships between transit agencies and TNCs have been successful, not all researchers agree on this point. In general, there is agreement that the most promising application of TNCs is as complement fixed-route transit service rather than as a replacement to it.

MICROTRANSIT

Environmental Impacts: Canales et al. modeled the economic and environmental impacts of replacing diesel buses operating on underperforming routes with on-demand electric minibuses (microtransit) (2017). They found that the implementation costs of a microtransit program along four routes in London (excluding infrastructure changes such as EV charging stations) would be between $2 million and $4 million USD. The authors found through their analysis that microtransit service "impl[y] a break-even period of three to four years, after which the service becomes profitable at current ridership levels" (Canales et al., 2017, p. 24). The environmental impacts were modeled in the three different cities and the model suggested that in all three cities there would be significantly lower nitrous oxide and greenhouse gas emissions. Even when changing the vehicle type from electric-powered to gas-powered minibuses, the model still resulted in improved environmental performances (Canales et al., 2017).

Challenges: Feigon, Murphy, and McAdam observed that numerous microtransit companies, some of which ran as part of pilot programs with cities and transit agencies, ceased operations rather suddenly (2018). The authors believe that some challenges are unavoidable and are inherent in the existing microtransit business model. These challenges include: high capital costs, low demand, and not enough differentiation with traditional public transportation (Feigon et al., 2018). These challenges may prohibit microtransit from becoming a widely adopted mode of transportation.

"UpRouted: Exploring Microtransit in the United States," written by the Eno Center for Transportation in 2018 analyzed three microtransit pilots in the United States. Two of the case studies examined were ultimately discontinued due to low ridership and high operating costs. The authors identified common mistakes made and challenges faced by transit agencies during these pilots, which included: prioritizing technology over customer needs, lack of a flexible contract, insufficient marketing, and vendor inability to meet goals of transit agency (Westervelt et al., 2018).

The Schaller Consulting Group found that in general "trip volumes tend to be quite low […] and unless there are common origins or destinations like a transit hub, relatively few trips are shared between passengers" (Schaller, 2018, p. 2).

Opportunities: The TCRP Synthesis 141 report, prepared by Joel Volinksi, draws from 22 transit agencies' experiences with planning and implementing microtransit programs (referred to as public demand-response transit and public microtransit in the report). Volinski concluded that the most successful application of microtransit was as an alternative to fixed-route buses in low-density areas (2019). In these areas, fixed-route buses either do not exist or might be removed due to low farebox recovery and high operating costs (Volinski, 2019).

Microtransit Key Findings:

- Micotransit vehicles could have positive environmental impacts depending on the types of vehicles they replace.
- The literature suggests that there are multiple challenges facing microtransit service providers. High capital costs and low ridership numbers have resulted in some providers ceasing operations. Unless there are significant changes to the business model, microtransit may have limited applications.
- Microtransit may prove to be most effective as an alternative to fixed-route buses in low-density areas.

AUTONOMOUS PASSENGER VEHICLES

Pilot Characteristics: A 2018 report by the National League of Cities, an organization representing over 19,000 cities and towns in the United States, found that autonomous vehicle testing thus far has been focused on single occupancy vehicles (Perkins, Dupuis, & Rainwater, 2018). However, the report also mentioned that there are a growing number of communities and universities beginning to test multi-passenger autonomous vehicles such as autonomous shuttles (Perkins et al., 2018).

Two organizations operating under the United States Department of Transportation worked together to publish a thorough state-of-practice report on low-speed automated shuttles (Cregger et al., 2018). The report identified the following characteristics of AV shuttles used in demonstrations and pilots: limited passenger capacity (between 4 and 15 passengers), limited speeds (less than 25 mph), and operating at Level 4 in the SAE Levels of Autonomy (Cregger et al., 2018).

Whether the technology being tested has an application for public transportation or not, many cities are hosting autonomous vehicle (AV) pilot projects. In addition to demonstrating that they appreciate innovation, cities believe that pilot projects allow officials to learn about infrastructure requirements and public opinion on autonomous vehicles. While some cities passively pursue AV pilot projects, many actively try to attract them. Common methods for attracting AV pilot programs include issuing executive orders, city council resolutions, and requests for proposals and information (Perkins et al., 2018).

Governance and Funding Structures: In terms of the structure and organization of AV pilots, the National League of Cities found that there is a lot of variation among cities (Perkins et al., 2018). Some pilots, such as one in Arlington, Texas, are completely city-led. In city-led pilots, the city assumes all financial and planning responsibilities. Other cities such as Tempe, Chandler, and Mesa, Arizona have a hands-off approach to pilot projects. Such cities have no formal agreements with technology companies, and do not have any financial responsibility for their implementation. While there are a few city-led and hands-off pilot programs, findings from the literature indicate that most pilots involve cities and companies working in collaboration (Perkins et al., 2018).

Current shuttle projects are sponsored by a range of entities including private sector actors such as technology and shuttle companies, public sector actors such as transit agencies and local governments, and nonprofit organizations including hospitals and universities (Cregger et al., 2018).

Challenges: In comparison to other new mobility modes, autonomous vehicles are in a nascent stage, with most autonomous vehicles still in preliminary testing phases. These tests involve operating a very small number of vehicles in select communities. As a result, there has not been an opportunity for researchers to evaluate the impacts of the technology. Use case are currently very limited. Key findings from the USDOT report on autonomous shuttles conclude that vehicle models are not yet suitable for use and that "appropriate use cases for low-speed automated shuttles are still somewhat unclear" (Cregger et al., 2018, p. 29). Further, the USDOT report stated that "existing pilots typically do not fill substantial transportation gaps." Rather than being motivated by public goals, pilots are currently being conducted to test AV technology.

Opportunities: Proposed applications of autonomous shuttles include: private circulators in parks, zoos, and closed campuses; group transit shuttle to and from transit stops, retail centers, and office parks; automated paratransit; and automated urban delivery (Cregger et al., 2018, p. 34). Although goods delivery is one proposed application of AV shuttles, pilots have focused on using AV shuttles for passenger use (Cregger et al., 2018).

Autonomous Passenger Vehicles Key Findings:

- Testing has involved passenger cars and low-speed autonomous shuttles.
- Common reasons that cities either allow for or seek out AV testing include learning about the infrastructure requirements, gauging public opinion, and being seen as open to innovation.
- While some cities have adopted a hands-off approach, many cities are working in collaboration with private companies to test different applications of the technology.
- Because the technology is still so new, there are very limited possible use cases and most pilots involve simple demonstrations that do not fill significant transportation gaps.

AUTONOMOUS GOODS DELIVERY

Pilot Characteristics: Urbanism Next identified a lack of formal reports and studies that evaluated autonomous goods delivery pilots. The lack of formal reports of autonomous delivery can be attributed to the fact that most tests began in the past year or two, as well as the private nature of the companies. Currently, pilots are generally conducted by companies who choose to evaluate the results of their tests and pilots in-house rather than working with consulting firms or universities. As with autonomous passenger vehicles, further development of the technology is required before large-scale pilots are conducted for deliveries.

Challenges: The literature brings up the following issues that might arise with an increase in autonomous goods delivery: curb space management, increased congestion, and loading zone access (Sonneberg et al., 2019). Research findings also suggest that there is still a lot of skepticism regarding the use of autonomous vehicles for last-mile delivery and that safety concerns, the security of goods delivered, and the privacy of customers were the primary issues raised by survey respondents (Gramatikov et al., 2019; Volinski, 2019).

Opportunities: Potential positive outcomes of autonomous delivery include the possibility of reducing last-mile delivery costs and improved speed/efficiency (Sonneberg et al., 2019). Autonomous drones, pods, and vans are the three types of vehicles currently used in pilots and tests for last-mile delivery.

Autonomous Goods Delivery Key Findings:

- There is limited information about autonomous goods delivery pilot projects involving cities or other public agencies. Testing is occurring, but it is mostly being done by private companies.
- Potential challenges with autonomous goods delivery include curb space issues, increased congestion, pedestrian safety, and security of the goods.
- Potential opportunities include reducing the costs of last-mile delivery and reducing congestion.

FIGURE 2-6: NURO DELIVERY SELF-DRIVING VEHICLE

Source: NURO

CONCLUSION

By and large, the existing literature on new mobility suggests important benefits, but there are also challenges that need to be considered. The potential benefits include the opportunity to improve access to mobility, to facilitate connections to transit and complement fixed-route lines, and to move towards less carbon-intensive modes. However, the literature suggests that ensuring equitable access to these new modes can be difficult for a variety of reasons, including the need to overcome technological and digital divides. New mobility modes are also presenting challenges regarding the management of the right-of-way, including the sidewalk and the curb. The literature findings also suggest that negotiating data sharing between public and private providers has proven to be challenging. Both public and private sector representatives are also struggling to identify the most appropriate use case for some of these new modes, including microtransit and AVs.

These findings informed our thinking as we conducted the pilot scan for Chapter 3 and the subsequent development of case studies. In particular, these findings informed the set of questions we asked during our case study interviews for Chapter 4.

03 | 220 PILOT PROJECTS

INTRODUCTION

This chapter summarizes the new mobility and goods delivery pilot projects scan that Urbanism Next conducted across the United States and Canada and summarizes key findings about each category/mode of pilot project. Only pilots with adequate information about them available online as of October 2019 were included in this report. Due to the rapidly changing nature of the new mobility space more pilots have likely begun since the publishing of this report.

Figure 3-1 shows how we defined the regions in this study as well as the number of pilots.

FIGURE 3-1: PILOT PROJECT HEAT MAP + REGIONS DEFINED IN THIS STUDY

Source: Free Vector Maps edited by Urbanism Next. Data visualized with RAW Graphs.

The chapter is organized into two main sections of pilots that fall into the categories of mobility of people and goods delivery. Each of these sections are further divided by pilot project mode and organized as follows:

Mobility of People

- Micromobility (bikes, e-bikes, e-scooters and mopeds)
- Transportation Network Company (TNC) Partnerships
- Microtransit
- Autonomous Vehicles

Goods Delivery

- Autonomous Vehicles

MOBILITY OF PEOPLE

MICROMOBILITY

BACKGROUND

For the purpose of this study, micromobility pilots include systems of shared docked and dockless bicycles, electric bicycles (hereafter referred to as e-bikes), electric scooters (e-scooters), and mopeds, collectively referred to as shared mobility devices (SMDs). Urbanism Next collected and recorded data on 78 micromobility pilots across the United States and Canada that were complete, in-progress, or scheduled to begin shortly, as of October 2019, as shown in Figure 3-2. Over half of all pilots were in communities with a population of 100,000 - 999,999, approximately 1/3 were conducted in West Coast cities (the Pacific region), over 75% were started in 2018 or later, and the vast majority ran for a year or less.

Micromobility pilot projects most commonly include e-scooters or a mix of e-scooters and bikes/e-bikes as shown in the table below. This is likely due to the fact that e-scooters are the newest micromobility transportation technology, having been first introduced in 2017 (Durbin, 2018).

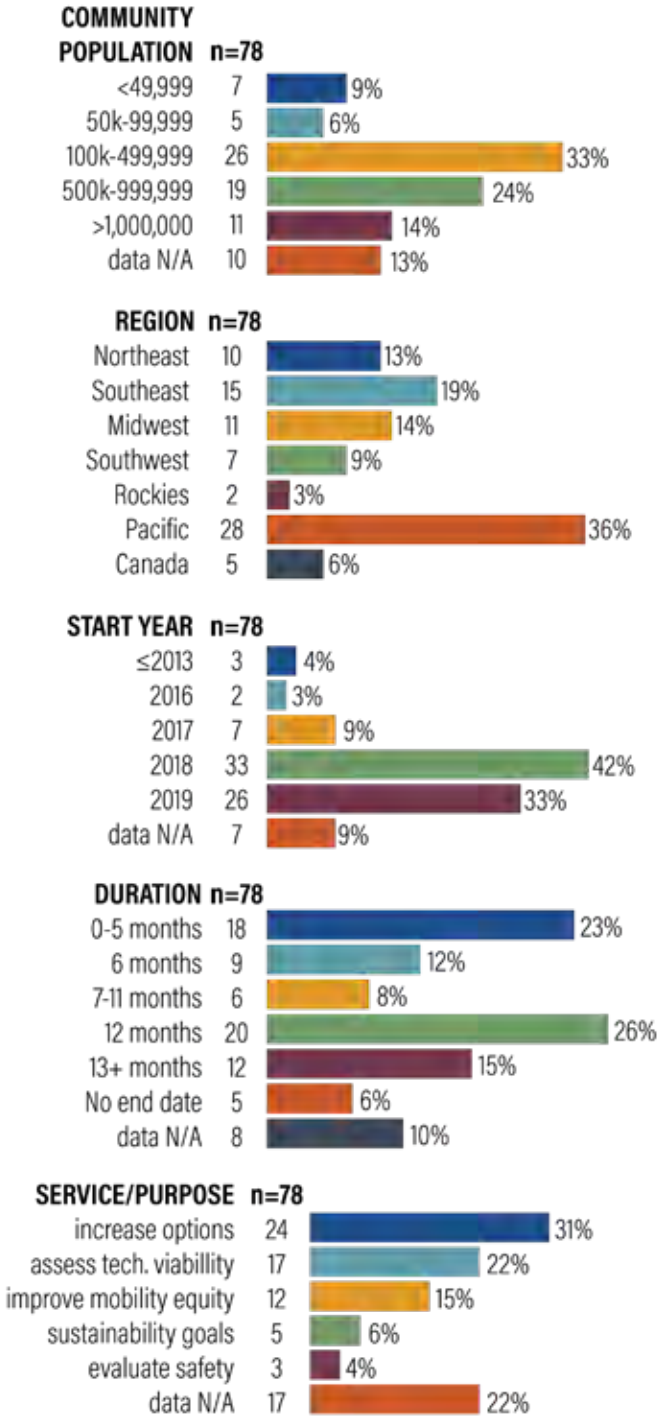
Another interesting thing to note about micromobility pilots is the number of technology companies involved in the shared micromobility space. The companies in the most cities with the largest number of deployed vehicles include Lime, Bird, Spin, JUMP, and Lyft. Bird and Spin solely provide e-scooters while Lime also provides e-bikes. JUMP and Lyft supply e-scooters, bikes/e-bikes, and ride-hailing services (JUMP is owned by Uber). The number of micromobility pilots JUMP and Lyft are already involved in shows their dedication to gaining market share across various transportation modes.

COMMON GOALS AND PURPOSES

The most common reasons cities, transit agencies, regional governments, and nonprofit organizations say they initiate micromobility pilots are to:

- Increase transportation options
- Assess the viability of new technologies
- Improve mobility equity and access
- Achieve environmental or sustainability goals
- Evaluate and improve safety outcomes

FIGURE 3-2: MICROMOBILITY - SUMMARY OF PILOT PROJECT DATA



Source: Compiled from multiple online sources by Urbanism Next Center, 2020.

Note: data N/A means that data was not available.

Pilots in the first category often include specific goals related to addressing the first- and last-mile problem and using micromobility to complement public transit. Pilot projects in the second category are generally either allowing new technologies such as dockless e-bikes or e-scooters to operate in their public right-of-way for the first time or are imposing regulations onto companies that have already begun operation.

Equity- and access-related goals are common components of micromobility pilots regardless of whether they are its main purpose. Specific examples of equity and access components range from providing affordable transportation options and implementing adaptive bikeshare systems to regulating deployment to ensure adequate vehicles in low-income neighborhoods and providing access to underbanked users and those without access to smartphones.

Common themes related to environmental and sustainability goals include reducing single occupancy vehicle (SOV) trips and carbon emissions, increasing bicycle ridership, and providing environmentally friendly transportation options. Many pilots also include health and safety components with specific goals related to regulatory structures, public education about where to ride, how to park, and helmet use requirements.

GOVERNANCE STRUCTURES

The majority of micromobility pilots were initiated by local governments to manage and regulate the deployment of shared-use mobility devices and help achieve a number of public policy goals, as shown in Figure 3-3. In most cases, local governments have the legal authority to impose the rules and regulations for pilots but in some cases state legislation preempts or impacts what local governments can and cannot do. The box below shows examples of state regulations.

EXAMPLES OF MICROMOBILITY REGULATIONS ON A STATE SCALE:

The State of Colorado *signed HB19-1221 into law on 5/23/2019 authorizing local government to "regulate the operation of an electric scooter in a manner that is no more restrictive than the manner in which the local government may regulate an electrical assisted bicycle" (Colorado General Assembly, 2019). Prior to HB19-1221, scooters were considered toy vehicles in Colorado only allowed to operate on sidewalks.*

The State of Florida *authorizes the operation of motorized scooters and specifies that they have the same rights and responsibilities as bicycles as well as allowing local governments to regulate scooters with respect to streets, highways and sidewalks within their jurisdictions (Rosen & Ohr Law, 2020).*

The State of New York *banned e-bikes and e-scooters but a bill to allow legalization by cities passed the assembly and house but was subsequently vetoed by Governor Cuomo in late December 2019. In April 2020 , a budget agreement legalized e-bikes and e-scooters statewide (Colon, 2020).*

The State of North Carolina *classifies e-scooters as mopeds and regulates their use including setting a minimum age of 16 years old and requiring users to "wear a helmet meeting the FMVSS 218 (motorcycle) standard" (BikeWalk NC, 2019). Legislators are currently working on defining e-scooters separately from mopeds (The Associated Press, 2019).*

The State of Oregon *has ordinances in the Oregon Vehicle Code regulating the use of electric scooters, bicycles, and electric bicycles. Specifically, scooters and e-bikes have a minimum rider age of 16, helmets are required for all scooter riders and bicycle riders under the age of 16, scooter speeds are capped at 15 mph, sidewalk riding is prohibited by scooters and e-bikes, scooters may not ride in crosswalks, and DUI's are possible for each mode (Oregon Moped, Motorized Scooter, Pocket Bike Guide, n.d.).*

The State of Pennsylvania *regulates the use of e-bikes with a minimum age requirement for operation of 16 years old. There are also vehicle specs e-bikes must comply with including operable pedals 20mph or under, and a motor rated at 750 watts or less (E-BikeKit Staff, n.d.).*

The State of Virginia *has a law preventing cities from imposing helmet requirements on adult users (Murphy, 2019). In addition, HB27532 signed in March 2019 authorizes local governments to regulate shared mobility devices (SMDs), better defines them, authorizes their use on roadways, and beginning in 2020 authorizes use on sidewalks unless otherwise prohibited by local ordinances (Arlington County Government, 2019).*

DATA SHARING

Data sharing allows cities to regulate, enforce, and create policies based on use of micromobility vehicles. Forty-one (53%) of the pilots reviewed explicitly stated that they had data sharing requirements, often publishing them in online sources about pilots, as shown in Figure 3-3.

Among the pilots that have data sharing requirements, common requirements include providing anonymized, aggregated data on trip locations, start and end times, lengths and durations, and vehicle locations and maintenance status. Additional information often collected through MDS, surveys, and other means include real time and historical data for the following categories:

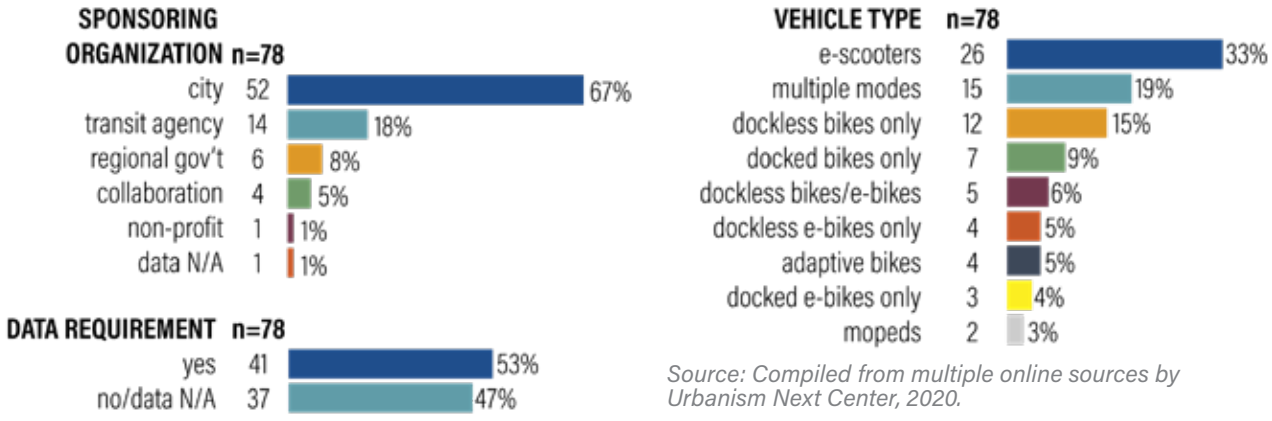
- Systemwide usage data
- Trip data
- Route data
- Availability/distribution of vehicles
- Anonymized user demographic data/trends
- Maintenance activities
- Live data on parked vehicles
- Collision and safety data
- Public comments and complaints
- Total users in system by month
- Trip revenue by day/week/month
- Hourly fleet utilization/device quantities
- Parking incidents
- Tow records

MOBILITY DATA SPECIFICATIONS (MDS)

The Los Angeles Department of Transportation (LADOT) developed the Mobility Data Specifications (MDS) in response to the deployment of e-scooters in the region in 2018. LADOT "designed MDS as a way for micromobility companies to send cities real-time location data about trips taken on each vehicle, along with information such as whether the vehicle is broken, running out of battery power, or in use" (Passenger Transport, 2020). Cities are using MDS to monitor and ensure compliance with vehicle fleet caps, the removal of improperly parked or broken devices, and to gain a better understanding of where individuals are traveling to plan and prioritize infrastructure projects.

LADOT is currently using MDS to manage e-scooters, bikes/e-bikes, and other modes. MDS, currently managed by the Open Mobility Foundation, is comprised of three distinct components for providers, agencies, and policies. Each of these components has an Application Program Interface (API) associated with it to enable seamless data sharing between companies and municipalities (Mobility Data Specification, 2018/2019). According to David Zipper, more than 50 cities currently "use MDS to manage their micromobility fleets, often with assistance from mobility data companies like Populus and Remix that convert the raw data into dashboards monitored by city staffers" (Passenger Transport, 2020). However, private micromobility companies are often hesitant to share all their data with public agencies citing privacy concerns as one of their main hesitations (Nelson, 2020).

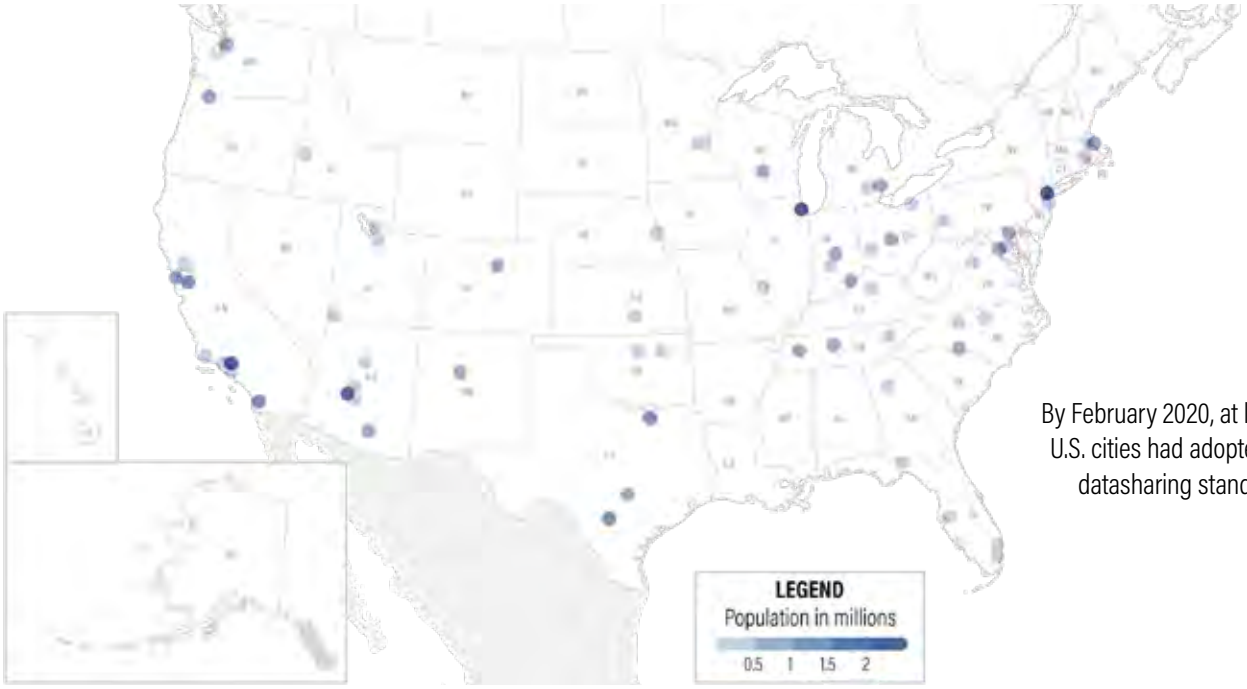
FIGURE 3-3: MICROMOBILITY - SUMMARY OF PILOT PROJECT DATA



Source: Compiled from multiple online sources by Urbanism Next Center, 2020.

Note: data N/A means that data was not available.

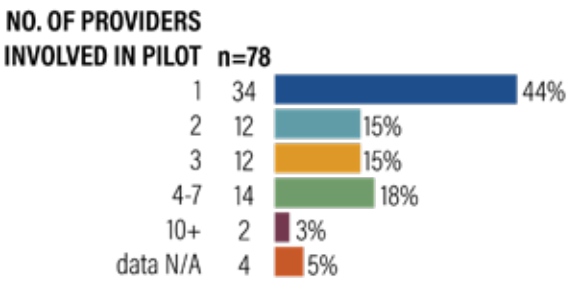
FIGURE 3-4. HEAT MAP OF CITIES USING MDS



By February 2020, at least 68 U.S. cities had adopted LA's datasharing standard

Source: Open Mobility Foundation, CityLab reporting, U.S. Census Bureau. Map from Free Vector Maps edited by Urbanism Next. Note: this map represents the best, most up-to-date information on U.S. municipalities that have adopted MDS and may not be a complete list. Counties that have adopted MDS were excluded.

FIGURE 3-5: MICROMOBILITY - SUMMARY OF PILOT PROJECT DATA



PROVIDERS BY NO. OF PROJECTS

Bicycle Transit Systems, Inc., Blue Duck, Bublr Bikes, Bunny, Clevr, CLOUD, Explore Bike Share, FordGo, Glide, Goat, Gotcha, Gruv, Kerr Bikes, Mobike, Ogo, Revel, RideKC, Roll, Scoot, Shared, Wheelhouse Detroit, Zip:	1
BCycle, Dropbike, Hopr, Ofo, Pace, Razor, Sherpa, Skip, VeoRide, Wheels, Zagster:	2-5
Bolt:	6-9
JUMP, Lyft:	10-14
Bird, Lime, Spin:	15+

Source: Compiled from multiple online sources by Urbanism Next Center, 2020.

Note: data N/A means that data was not available.
Note: some companies have acquired others in the past few years. Pace is now owned by Zagster, Motivate is owned by Lyft, etc. in the above table only the "parent" companies are included.

CONTRACTS AND PROCUREMENT

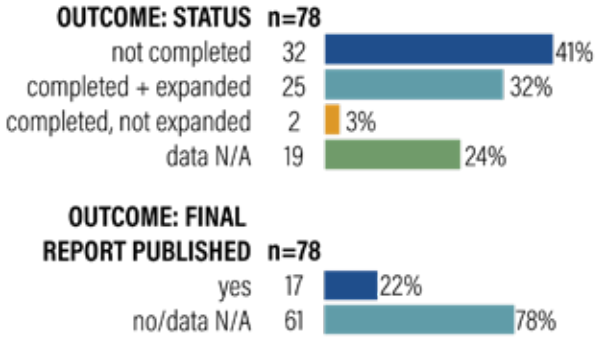
Most micromobility pilot projects use operating permits, memorandums of understanding (MOUs), policies, or agreements to codify the relationship between public agencies and private service providers. Micromobility services rely on access to the public right-of-way where a permit is required to conduct businesses (in most communities around the United States) (NACTO, 2019). Permits generally outline requirements related to the application process, operations and vehicle specifications, fees, insurance requirements, and deployment areas. In addition, many permits outline requirements regarding data sharing, parking, safety, education and outreach, and equitable access. It is less common for local government to issue a request for proposal, though several have, including the City of Golden, Colorado and the City of Pensacola, Florida.

EQUITY, HEALTH AND SAFETY, THE ENVIRONMENT, AND ECONOMY

Most micromobility pilot projects either have goals, requirements, or suggested operational standards related to equity, health and safety, the environment, and/or the economic impacts.

- Examples of equity-related requirements include: the provision of low-income plans, the ability for customers to book/use devices without access to smartphones and bank accounts, adaptive equipment such as seated e-scooters and tricycles, and distribution requirements that ensure that companies deploy a set number or percentage of vehicles in specifically designated underserved neighborhoods/areas.
- Examples of health- and safety-related requirements include: helmet requirements, speed limits (e.g., most e-scooters are capped at 15 mph), age restrictions, prohibiting scooter riding on sidewalks (for pedestrian safety), and a number of technical requirements for the vehicles themselves such as lighting, brakes, maintenance, etc.
- Examples of environment-related goals include: reducing vehicle miles traveled (VMT) and greenhouse gas (GHG) emissions, increasing transit ridership (by helping to address the first- and last-mile problem), and providing more alternatives to single occupancy vehicle (SOV) travel.
- Examples of economic goals include: increasing livability or tourism and using fees from technology companies to improve bike and pedestrian infrastructure and manage dockless vehicle programs. Additionally, some public sector agencies are taking labor considerations into account while evaluating company permit applications. For example, the San Francisco Municipal Transportation Agency required that companies submit a "labor harmony" plan.

FIGURE 3-6: MICROMOBILITY - SUMMARY OF PILOT PROJECT DATA



Source: Compiled from multiple online sources by Urbanism Next Center, 2020.

Note: 32 pilots (41%) are not completed and 19 pilots (24%) have unknown outcomes so a total of 51 pilots (63%) may still publish reports upon completion.

"WE ARE COMMITTED TO BOTH INNOVATION AND EQUITY IN ADDRESSING THE CRISIS OF MOBILITY IN OUR CITY AND OUR REGION AND TO PROVIDE THE BEST, MOST RELIABLE TRANSPORTATION OPTIONS AVAILABLE TO OUR COMMUNITY. THESE DYNAMIC COLLABORATIONS...WILL SUPPORT AND ENHANCE OUR VITAL PUBLIC TRANSIT SYSTEM AND HELP MEET THE TRANSPORTATION DEMANDS OF OUR COMMUNITY"

-Mayor Thomas Small, Culver City

Culver City Press Release, July 27, 2018

TRANSPORTATION NETWORK COMPANY (TNC) PARTNERSHIPS

BACKGROUND

A TNC is a company that exclusively uses an online or app-based platform to connect passengers with drivers who use their own vehicles to provide rides. For this chapter, Urbanism Next did not study the general deployment of TNCs, instead focusing on partnerships where TNCs and public or private organizations collaborated to fulfill specific purposes or meet unmet transportation needs. TNC partnerships allow public and private organizations to provide new transportation services without having to make large capital investments by coupling the resources of transit agencies or cities with TNC fleets and drivers.

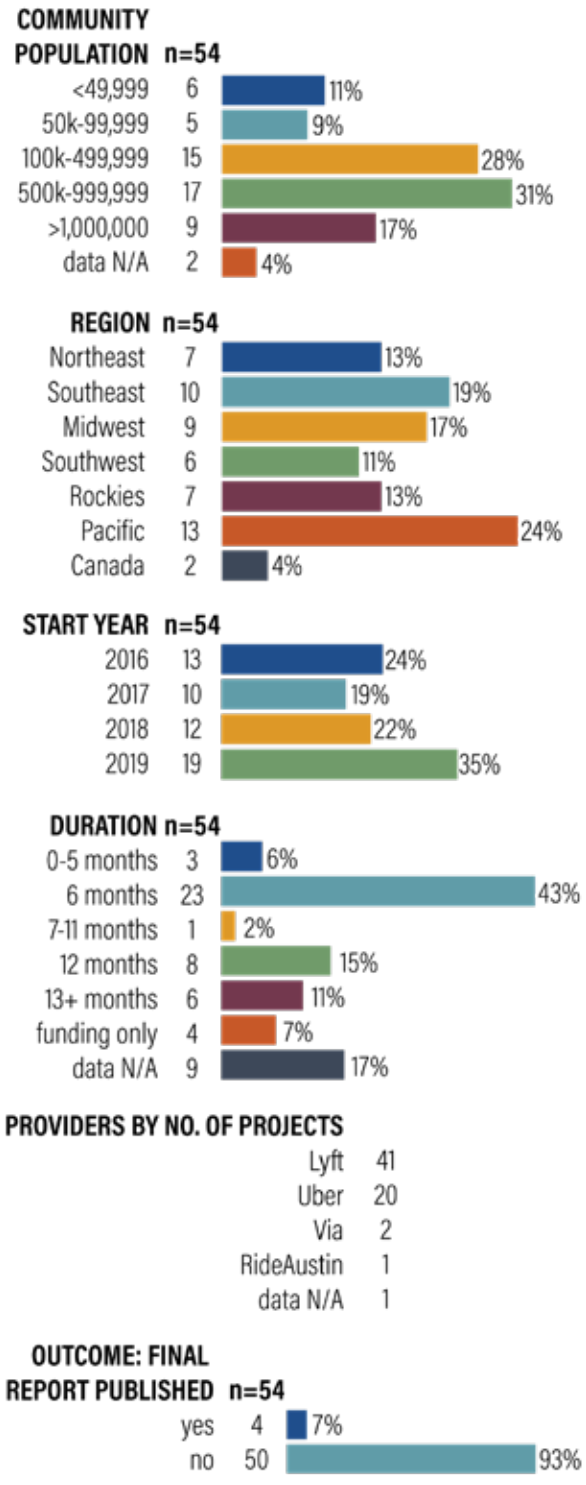
One of the first TNC partnerships in the United States was in Pinellas County, Florida in 2016. Since then, numerous TNC partnership pilots have occurred in all regions of the United States and in Canada. Urbanism Next identified 54 partnership pilots that have been completed (or in progress as of October 2019), as shown in Figure 3-7. Unsurprisingly, Lyft and Uber are the two companies engaged most frequently in this form of partnership.

COMMON GOALS AND PURPOSES

Table 3-2 shows the transportation network company pilot partnerships initiated by cities, transit agencies, and nonprofit organizations. The most common TNC partnership goals are to:

- Facilitate first and last-mile connection to transit stops
- Provide service for the elderly or disabled
- Fill gaps between regular service hours (late-night and off-peak transportation)
- Operate as a replacement for fixed-route buses or call-n-ride, especially in rural or sparsely populated areas
- Provide occasional, specialty trips to select groups. For example, trips to grocery stores, doctors appointments, and job interviews.

FIGURE 3-7: TNCS - SUMMARY OF PILOT PROJECT DATA



Source: Compiled from multiple online sources by Urbanism Next Center, 2020.

Note: data N/A means that data was not available.

GOVERNANCE STRUCTURES

In over 75% of pilot partnerships between local governments or transit agencies and TNCs, the local government or transit agency directly subsidized TNC rides for users. Less frequently, the partnership between the public agency and the transportation network company did not involve any exchange of funds. Instead of exchanging funds, the TNC offered a promotion to riders in exchange for a joint marketing campaign or advertising space. This style of TNC partnership pilot was more common in 2016 and 2017 when public-private partnerships with TNCs were new. Pilots beginning in 2018 or later more commonly involved a payment model where the public agency will subsidize all or part of a TNC ride. The three most common models for subsidies are:

1. Rider pays public transit fare and the public agency pays the price beyond this amount;
2. Rider and the public agency split the cost of fare by some percent (e.g., 50% of ride paid by user, 50% by public agency); and
3. Rider receives a dollar amount off, paid by the public agency (e.g. public agency pays $5 for every ride).

In none of the pilots did the customer pay the full price of the TNC ride. The budgets for pilots involving trip subsidies ranged from $9,802 spent in Boulder, Colorado's Door-to-Downtown pilot to $3.4 million allocated to Los Angeles, California's First and Last Mile Partnership with Via. Larger budgets are not always correlated with larger populations. The town of Innisfil, Ontario had a pilot budget of $790,000 between May 2017 and December of 2018, but only a population of 36,566. The city of Austin, Texas has a population of almost one million and spent only $24,500 on their pilot. In contrast to the pilot partnerships with the public sector, pilot partnerships between nonprofits and TNCs often involved the TNC paying for all of the ride subsidy. This is the case with Lyft's Grocery Access Pilot project.

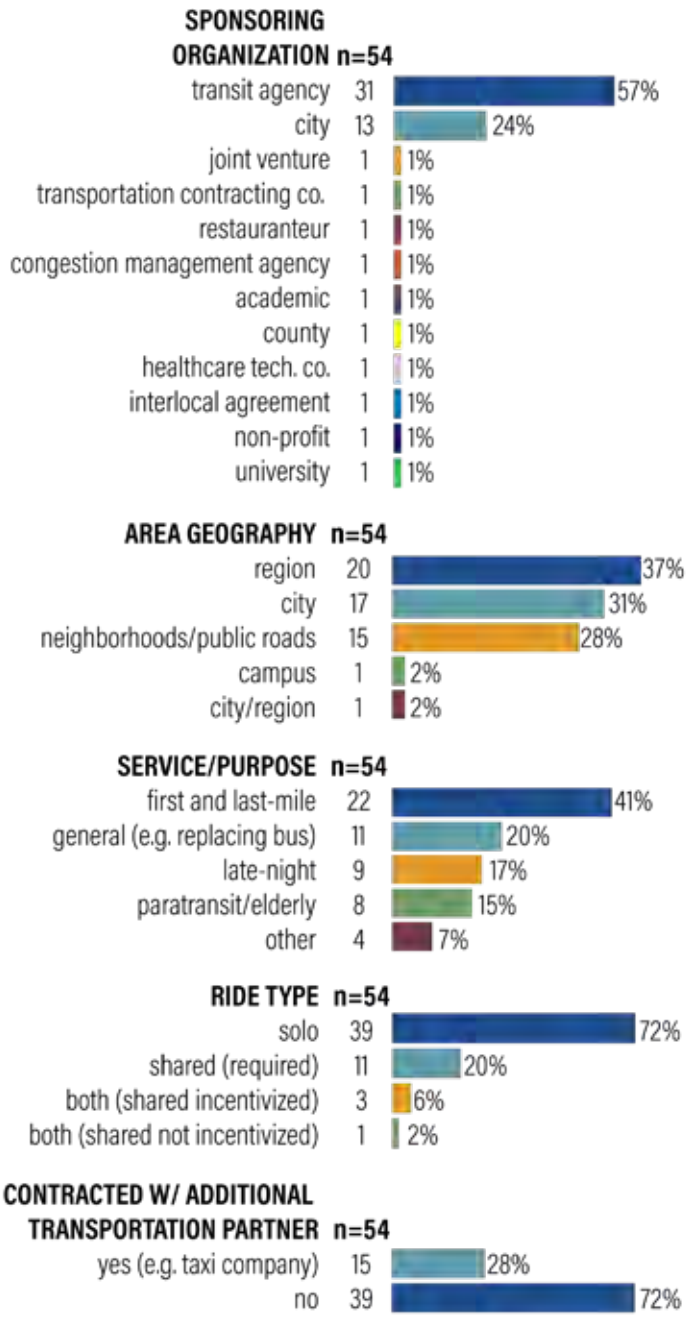
FEDERAL REGULATIONS AND TNC PARTNERSHIPS

Most states have preemption laws prohibiting local governments from imposing further fees and restrictions on transportation network companies, the result of extensive lobbying by Uber and Lyft (DuPuis et al., 2017; James, 2018). Four states, Hawaii, Louisiana, Minnesota, and Washington, only have laws requiring insurance and three states, Illinois, Nebraska, and South Dakota, do not have state preemptions. Oregon is the only state that has not passed any laws regulating transportation network companies. While there are no federal regulations related to TNCs, federal legislation relating to equity did affect the design of pilots. The two federal laws that impacted pilot partnerships are described below. (Americans with Disabilities Act, 2015), (Title VI of the Civil Rights Act of 1964, 2015).

Title VI of the Civil Rights Act of 1964. *Title VI prohibits discrimination in programs and activities that receive federal funding, including transportation agencies receiving grants from the Federal Transit Administration. To comply with Title VI during a TNC partnership pilot, equitable service must be provided to unbanked individuals and those that do not have smartphones. The most common adaptation to TNC services to ensure equity during pilots was to add a phone-in option to request rides and a pre-paid debit or gift card option for payment. For some pilots, an additional transportation provider was added to the pilot because the TNC could not provide a non-smartphone/cash option.*

Americans with Disabilities Act of 1990 (ADA). *The ADA prohibits discrimination against and guarantees equivalent opportunities for individuals with disabilities. This requires that the level of service provided to individuals with disabilities is equivalent (Americans with Disabilities Act of 1990, As Amended, 2009) to the level of service provided to individuals without disabilities. Equivalent service includes response times, fares, service areas, and service hours, (Federal Transit Administration, 2015) among others. To ensure compliance with the ADA, transit agencies and local governments often had to contract with multiple transportation providers, including taxi companies or paratransit providers, in order to accommodate those who need wheelchair accessible vehicles (WAVs). About 30% of pilots required a transportation provider beyond the TNC to provide rides for those needing WAVs.*

FIGURE 3-8: TNCS - SUMMARY OF PILOT PROJECT DATA



Source: Compiled from multiple online sources by Urbanism Next Center, 2020.

Note: data N/A means that data was not available.

DATA SHARING

Earlier TNC pilots, especially those that started in 2016 or 2017, often had limited or no data sharing provisions in their contracts. In some pilots including the Direct Connect pilot program in Pinellas County, Florida, the transit agency did not receive any information beyond the cost of the trip they were subsidizing. More recently, TNC operators became more willing to share data. Out of the pilots with known data sharing, the most common data points reported to the sponsoring organization are:

- Number of trips
- Trip cost
- Trip duration (actual minutes or range)
- Trip distance (actual miles or range)
- Pick-up and drop-off locations
- Pick-up and drop-off times

> **"WE HAVE TO EMBRACE RIDESHARE. I DON'T THINK WE MOVE FORWARD BY TURNING OUR HEADS AWAY FROM THE FUTURE."**
>
> -Mayor John Cranley, Cincinnati

Cincinnati Enquirer, January 30, 2018

CONTRACTS AND PROCUREMENT

Out of the public-sector partnerships, such as transit agencies and local governments, about 40% of the pilots were initiated with the release of a request for proposal (RFP), request for information (RFI), or similar. The RFPs often detailed the purpose and goals of the pilot, the project design (including service area, budget, duration, insurance requirements, and data/reporting requirements), and the planned pilot duration. In some cases, transit agencies directly approached transportation network companies. TNC representatives also approached local governments, transit agencies, or nonprofit organizations to initiate pilots, like in the case of the SEPTA-Uber Rideshare Partnership. Ultimately, over 75% of pilots used formal contractual agreements.

EQUITY

Increasing equitable service offerings was a common goal of TNC partnerships. Eight pilots, 15% of pilots researched, were created specifically to provide trips for elderly people or as an alternative to paratransit. One very successful example of such as a pilot was "The Ride" pilot created by the Massachusetts Bay Transportation Authority (MBTA). After a one-year pilot period with Uber, MBTA found that the number of paratransit trips increased overall and the per-trip subsidy decreased overall. Many pilots not created specifically to provide trips to individuals with disabilities and paratransit trips also had an equity component. Out of the 54 pilots Urbanism Next identified, 22 (41%) had an additional equity component. This equitable component ranged from having a phone-in option for individuals without smartphones, contracting with an additional service provider to provide rides to individuals in mobility devices, and having a non-credit card option for unbanked individuals. See the federal regulation and TNC partnership box on page 33 about the legislative influences that motivated these equitable service offerings.

HEALTH AND SAFETY

Nine pilots (17%) operated exclusively during off-peak travel times. Transit agencies most commonly created these pilots to provide an option for transit riders who end work after fixed-route public transportation service ended for the day. These pilots added a safer transportation option for people who ended work at night. Some of these late-night pilots involved more than the typical two parties (i.e. the public agency and the TNC). For example, the "UNT Pilot Program" was created as a three-way collaboration between the University of North Texas, Denton County Transportation Authority, and Lyft. The "Service Worker Access Program" was formed in collaboration between Lyft and Garrett Harker, a restaurateur in the Boston-area, in order to give his employees a safe ride home after late-night shifts at his restaurants.

By and large, drivers who provided rides as part of the pilot programs were not any different from the total pool of drivers in the area, meaning that drivers only had to undergo the usual background checks state or local laws required them to do so. Urbanism Next's assessment did not observe any additional safety requirements.

ECONOMY

Six pilots specifically mentioned increasing access to jobs in the sponsoring organization's stated goals. One such pilot is the "Workforce Mobility Program" created as a collaboration between the Regional Transportation Commission of Southern Nevada (RTC), Lyft, and Fanatics, a sports merchandising company. To make it easier for employees to get to one of Fanatics' distribution centers, RTC and Fanatics subsidized the cost of a Lyft ride to 13 RTC transit stops to or from the distribution center. Some pilots targeted workers who work shifts late at night, after public transportation ends for the day. One example is the "Woodward2Work" pilot in Detroit, Michigan. In this pilot, the Detroit Department of Transportation contributed $7 toward the cost of a Lyft ride originating from the Woodward bus route between the hours of 12:00 AM and 5:00 AM.

Beyond providing trips to workers, economic considerations were not emphasized in the materials reviewed. Notably lacking from many pilots was the mention of the number of people hired or drivers signed up by TNC companies to conduct the pilot.

MICROTRANSIT

BACKGROUND

Urbanism Next identified a total of 37 microtransit pilots across the United States and Canada between 2015 and 2020, as shown in Figure 3-9. Microtransit pilot duration is generally between three months and one year, and pilots are most commonly (81% of the time) sponsored by transit agencies. The companies most involved in microtransit pilots include TransLoc and Via, respectively involved in 12 and nine pilots each.

COMMON GOALS AND PURPOSES

Local governments, transit agencies, regional governments, universities, and nonprofit organizations initiate microtransit pilot projects for many unique reasons, but the most common reasons fall (shown in Figure 3-10) are:

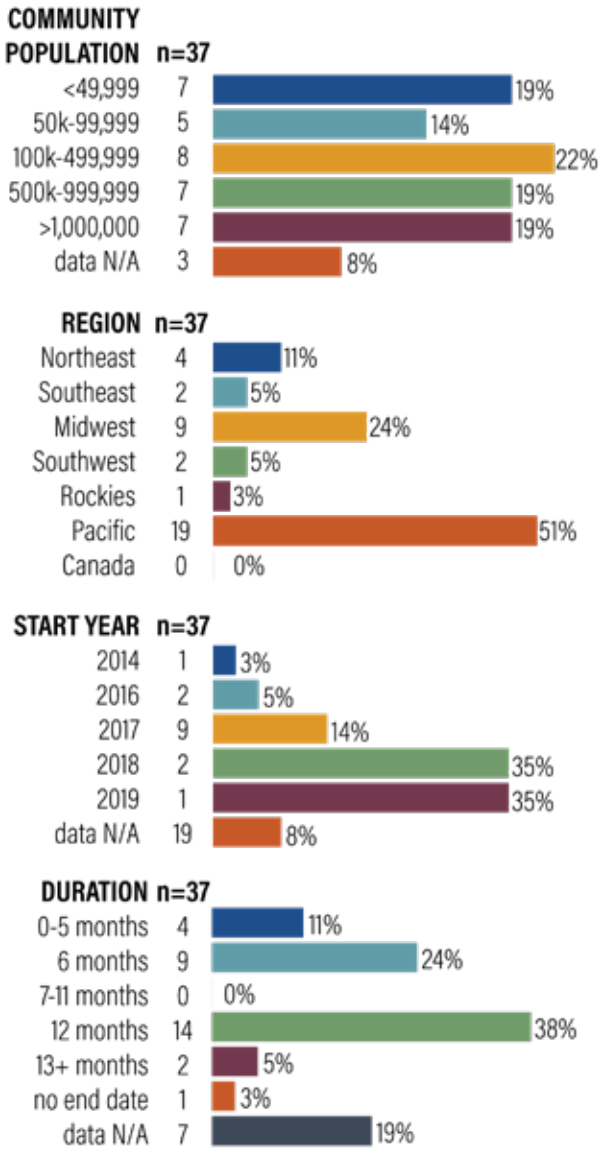
- Increase on-demand transportation options
- Assess the viability of microtransit technology
- Fill service gaps
- Improve mobility equity
- Increase transit ridership
- Achieve environmental or sustainability related goals

GOVERNANCE STRUCTURES

Unsurprisingly, transit agencies initiated 81% of all microtransit pilots studied (37), as shown in Figure 3-10. Many of the pilots specifically included equity and accessibility components in their design, with over half of the projects advertising that at least one of their vehicles was ADA accessible. However, the top three most common goals of microtransit pilots all relate to improving and expanding services, filling service gaps, and testing the viability of on-demand public transit.

Agencies that funded microtransit pilots include the Federal Transit Administration, cities, counties, states, councils of governments (COGs), downtown community improvement districts, business associations, transportation authorities, and hospitals/community partners.

FIGURE 3-9: MICROTRANSIT - SUMMARY OF PILOT PROJECT DATA



Source: Compiled from multiple online sources by Urbanism Next Center, 2020.

Note: data N/A means that data was not available.

DATA SHARING

While some microtransit pilots had data sharing requirements (e.g., Via to Transit in King County, WA and the Flex Service Pilot in Alameda-Contra Costa Counties, CA) it is much less common than with micromobility pilots. Data sharing requirements for microtransit pilots may include trip origin/destination data, travel time records, real-time location and stop-events per vehicle, and information such as registration and license info per vehicle. Via is providing further data in several cities including app download activity, accounts created, rides requested/performed, rider retention, pickup time estimates/on time performance, percent of rides shared, rides by fare types/discounts, and promo code usage (Marin Transit, 2019).

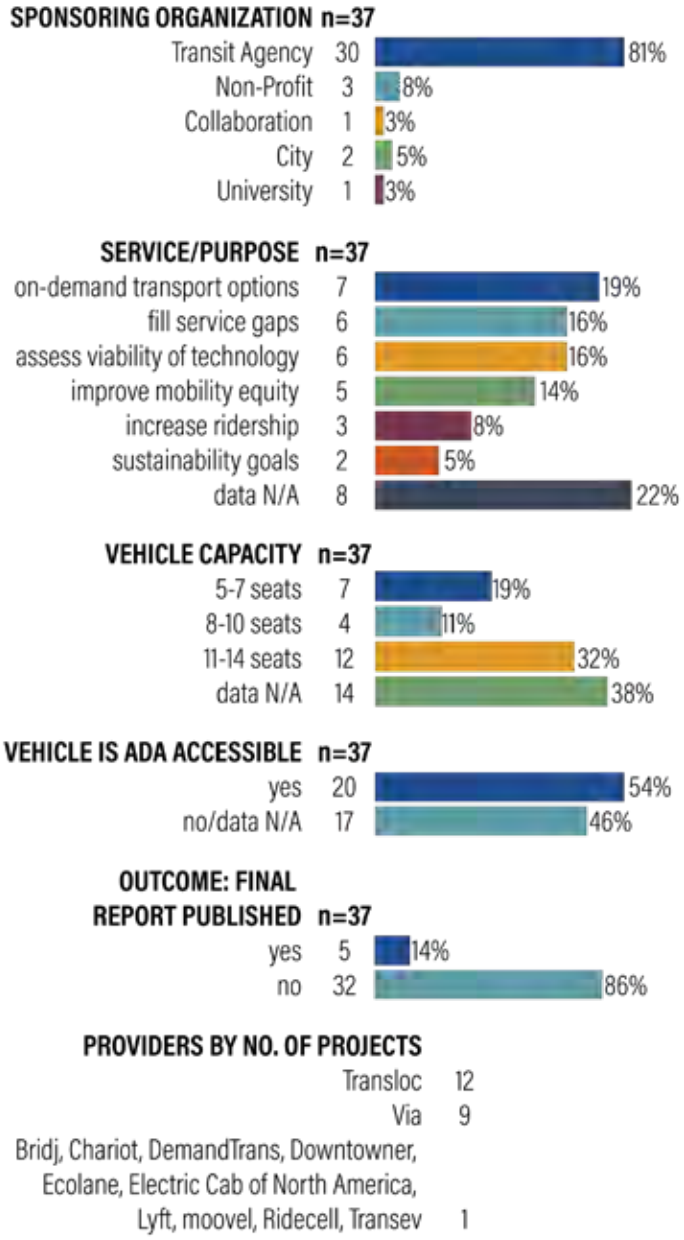
> **"THE WORLD IS CHANGING, PEOPLE ARE CHANGING, THEIR DEMANDS ARE CHANGING IN TERMS OF HOW THEY GET WHERE AND WHEN, AND STANDING ON THE CORNER WAITING FOR A BUS TO COME ISN'T THE WAY PEOPLE WANT TO MOVE ANYMORE"**
>
> -Jeanne Krieg, Tri Delta Transit CEO

East Bay Times, June 17, 2019

CONTRACTS AND PROCUREMENT

Transit agencies overseeing microtransit pilot programs often issue RFPs for the technology component of their services and either handle operations internally with their own vehicles and employees or contract operations to third parties. Contracts for service are more common than permits.

FIGURE 3-10: MICROTRANSIT-SUMMARY OF PILOT PROJECT DATA



Source: Compiled from multiple online sources by Urbanism Next Center, 2020.

Note: data N/A means that data was not available.

EQUITY, HEALTH AND SAFETY, THE ENVIRONMENT, AND ECONOMY

Examples of equity-related goals include improving service to areas with infrequent/insufficient public transit, for seniors and persons with disabilities, and services for other vulnerable populations. Many vehicles used in microtransit pilots are ADA accessible and pilots are being used to test whether microtransit could be a more effective service than alternatives such as dial-a-ride vehicles and paratransit. In addition, some microtransit pilots are ensuring that customers can utilize services without access to smartphones/bank accounts.

Urbanism Next found very few health and safety implications associated with microtransit pilots, but one example was transit agencies screening vehicle operators for criminal offenses and driving incidences. An example of environmental outcomes includes microtransit being offered in suburban and low-density areas as an alternative to single occupancy vehicle (SOV) use.

Examples of economic outcomes include many drivers being union-represented, subcontractors being paid a living wage, and nondiscrimination/ equal opportunity/and equal benefits requirements being written in contracts. In addition, the FlexLA pilot in Los Angeles solely employs military veterans as drivers and they receive salaries and benefits. Marin Transit is also paying their contracted operators for all scheduled driver hours instead of only revenue hours due to the unpredictable demand of the service.

> **"WE ARE AT THE BEGINNING OF AN EXCITING TRANSPORTATION TECHNOLOGY REVOLUTION. AND ARLINGTON'S VIA RIDESHARE PILOT PROGRAM IS THE LATEST EXAMPLE OF OUR CITY'S WILLINGNESS TO EXPLORE INNOVATIVE TRANSPORTATION TECHNOLOGY SOLUTIONS FOR OUR RESIDENTS, EMPLOYEES, STUDENTS, AND VISITORS"**
>
> -Mayor Jeff Williams, City of Arlington

City of Arlington Press Release, December 11, 2017

Microtransit will likely require long-term subsidization similar to what traditional transit services in the United States rely on. It's unclear whether fare revenues earned from microtransit could be enough to cover the costs of microtransit pilots or long-term service offerings, but so far the majority of pilots have been funded by limited-term grants and funding sources. This model raises further debate about whether on-demand services such as microtransit should be subsidized at the same level as traditional transit services. Microtransit pilots generally aim to complement fixed-route transit options and fill specific service gaps, helping to provide greater public transportation options. However, finding sustainable subsidy models that can be justified based on locations and populations served will continue to provide challenges to microtransit programs.

VIA TO TRANSIT

Source: Via + SDOT

AUTONOMOUS VEHICLES

BACKGROUND

Many automobile, technology and OEM (original equipment manufacturer) companies are developing and testing AVs (Level 4). These companies are conducting tests and pilots to test autonomous technology operations. For this report, Urbanism Next researched 33 autonomous passenger vehicle pilots, as shown in Figure 3-11. Beyond the pilots studied in this report, additional cities and transit agencies have announced their intent to launch autonomous vehicle pilots in the future.

Of the 33 autonomous passenger vehicle pilots studied, 24 (71%) used low-speed shuttles (e.g., EasyMile) and the remaining 10 (29%) used cars or minivans (e.g., Waymo). The characteristics of AV pilots are strongly correlated to the type of vehicles used, with shuttles primarily operated on fixed-route loops. All AVs are still in experimental stages, so the majority have been deployed in limited or geofenced areas (79%). Nineteen (56%) of the pilots provided shuttle bus services along fixed-route loops in restricted areas or along pre-determined routes. Seven pilots provided first- and last-mile services. Two shuttle projects deployed vehicles on campuses and five projects provided city-wide service, out of which four were launched by Waymo in Arizona and one was launched by Aptiv in Nevada.

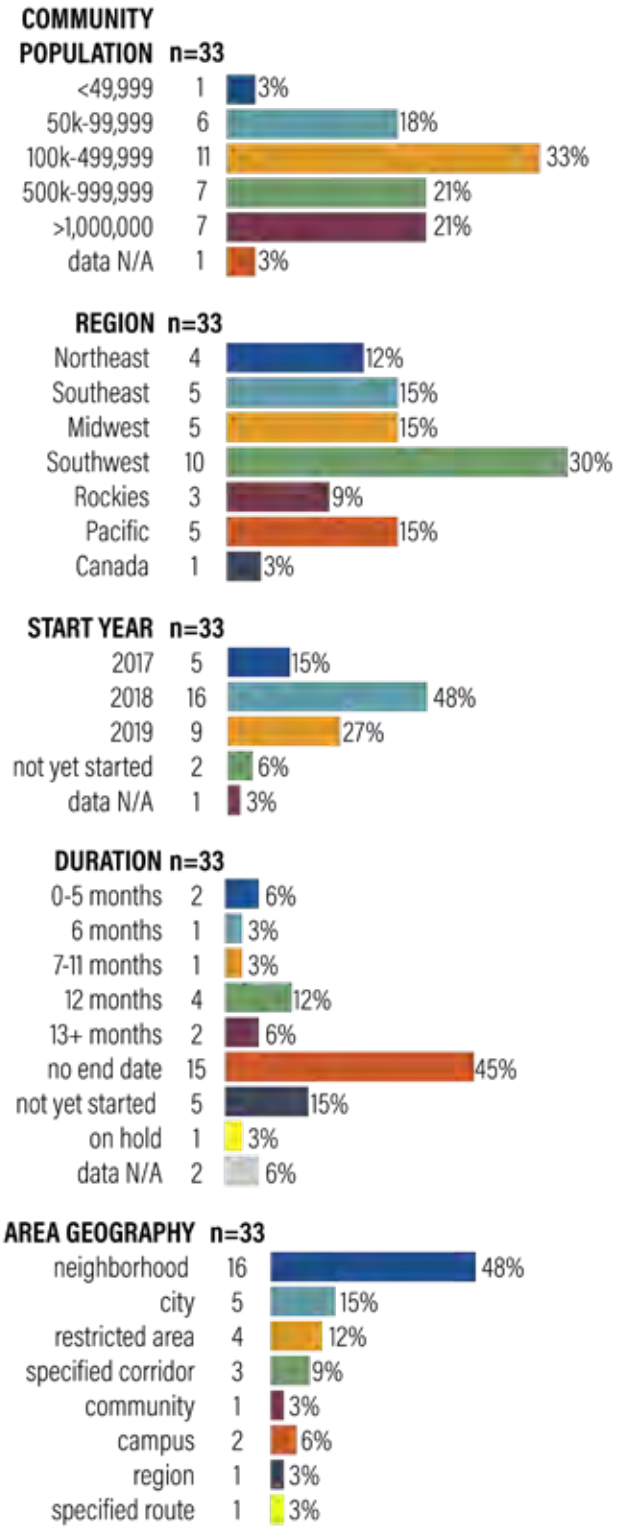
The main purposes of passenger AV pilots to date is to gain experience with new technology and familiarize the public with the vehicles. Due to this, most of the pilots provide services to customers free of charge. Out of 33 pilots studied only six projects (18%) charge users.

COMMON GOALS AND PURPOSES

The main reasons that AV pilot projects have been undertaken by government agencies, private companies, transit agencies, and others include:

- Learn about AV technology and both the opportunities and the challenges it could present
- Gauge public perception and interest
- Learn how city processes, policies, and programs may need to be adapted for AV deployment

FIGURE 3-11: PASSENGER AVS - SUMMARY OF PILOT PROJECT DATA



Source: Compiled from multiple online sources by Urbanism Next Center, 2020.

Note: data N/A means that data was not available.

> "ARIZONA WELCOMES UBER SELF-DRIVING CARS WITH OPEN ARMS AND WIDE OPEN ROADS. WHILE CALIFORNIA PUTS THE BRAKES ON INNOVATION AND CHANGE WITH MORE BUREAUCRACY AND MORE REGULATION, ARIZONA IS PAVING THE WAY FOR NEW TECHNOLOGY AND NEW BUSINESSES. IN 2015, I SIGNED AN EXECUTIVE ORDER SUPPORTING THE TESTING AND OPERATION OF SELF-DRIVING CARS IN ARIZONA WITH AN EMPHASIS ON INNOVATION, ECONOMIC GROWTH, AND MOST IMPORTANTLY, PUBLIC SAFETY. THIS IS ABOUT ECONOMIC DEVELOPMENT, BUT IT'S ALSO ABOUT CHANGING THE WAY WE LIVE AND WORK. ARIZONA IS PROUD TO BE OPEN FOR BUSINESS."
>
> -Governer Doug Ducey, Arizona

Office of the Governor Doug Ducey Press Release, December 22, 2016.

- Test potential use cases
- Become part of the new economy
- Test hardware and software and identify needed improvements
- Drive economic development and culture of innovation
- On this last point, some government officials have been particularly outspoken on their views of AVs and their interest in allowing testing and development. For instance, Arizona Governor Doug Ducey released the following statement in December 2016:

GOVERNANCE STRUCTURES

In the past 20 years there have been significant developments in autonomous vehicle legislation. In the U.S., their operation was first allowed in Nevada in 2001 and since then an additional 28 states and the District of Columbia have enacted legislation on AVs. Governors in an additional 10 states have issued executive orders related to AVs (National Conference of State Legislatures, 2020). In 2017, the National Highway Traffic Safety Administration (NHTSA) published voluntary guidance to the industry regarding automated vehicles, titled "Automated Driving Systems (ADS): A Vision for Safety 2.0." It also provided recommended practices to States on the integration of Automated Driving Systems. Since then, U.S. Department of Transportation has published two additional guiding documents: "Preparing for the Future of Transportation: Automated Vehicles 3.0 (AV 3.0)" was released in October 2018 and "Ensuring American Leadership in Automated Vehicles (AV 4.0)" was released in January 2020.

Canada has also developed federal guidelines for AVs. In 2018, Transport Canada released "Testing Highly Automated Vehicles in Canada: Guidelines for Trial Organizations" in collaboration with the Canadian Council of Motor Transportation Administrators. The document is designed to provide guidance to provinces and territories in developing their own testing and deployment policies and regulations.

DATA SHARING

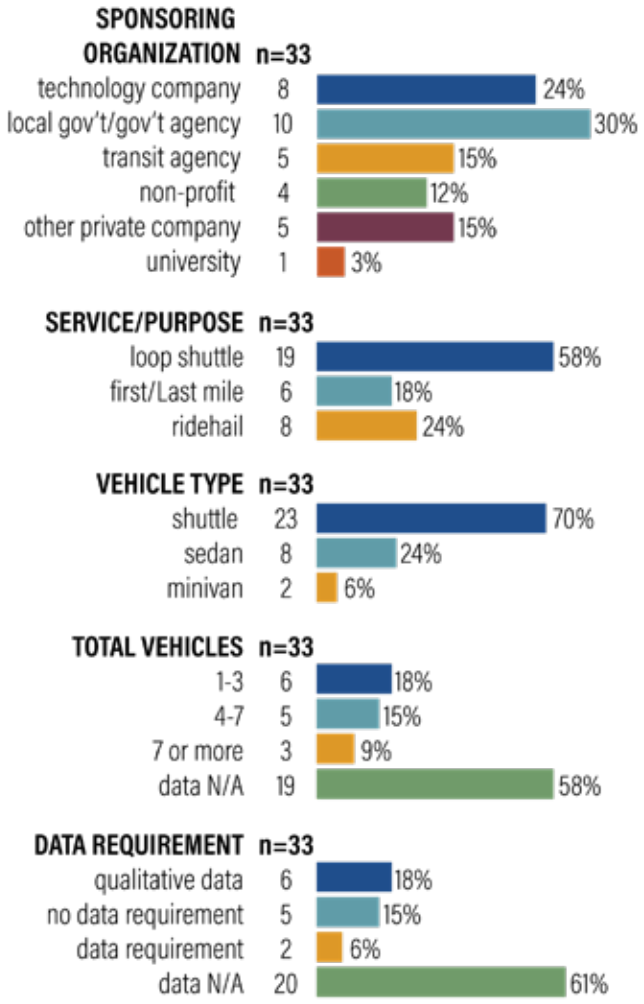
There is limited publicly available data on AV pilots. In the instances when a public agency has been involved in a pilot, some have compiled reports summarizing the results. At times, this may include user feedback if surveys were conducted. It may also include a limited amount of data regarding the number of trips, number of riders, and the route. When a private company is running the pilot on its own, such as Waymo One in Arizona, the publication of data is often limited. Waymo did publish a brief report on their Early Rider program presenting some rider characteristics and trip types (Waymo, 2018). The report indicated diverse rider engagement including senior citizens, parents with young children, and people with disabilities. Trips were most frequently taken for commuting purposes followed by restaurants, school, bars, and repair shops.

EQUITY, HEALTH AND SAFETY, THE ENVIRONMENT, AND ECONOMY

While most pilots did not explicitly state that safety was a goal of the project, improved road safety is a driving factor in the development of automated technology. For instance, it is a core part of Waymo's mission: "Waymo's mission is to make it safe and easy for people and things to get where they're going. The Waymo Driver can improve the world's access to mobility while saving thousands of lives now lost to traffic crashes" (Waymo, n.d.). The hope is that AVs will significantly improve road safety resulting in fewer crash-related injuries and fatalities. Safety drivers are currently required in most pilot projects in order to respond to unanticipated issues or equipment failures. However, removing safety drivers will be a key milestone for AV companies because it will help to reduce service and operational costs. Until federal or state governments require safety reporting and verification, it will be hard to determine how closely self-reported information matches actual experiences.

In terms of equity, some pilots were designed to help specific groups, such as older adults and people with disabilities. Others were meant to provide first- and last-mile connections to fill gaps in transit service. In addition to improving road safety, AVs also have the potential to improve mobility for people who have been traditionally underserved, although the price of service is an important factor that is yet to be determined.

FIGURE 3-12: PASSENGER AVS-SUMMARY OF PILOT PROJECT DATA



Source: Compiled from multiple online sources by Urbanism Next Center, 2020.

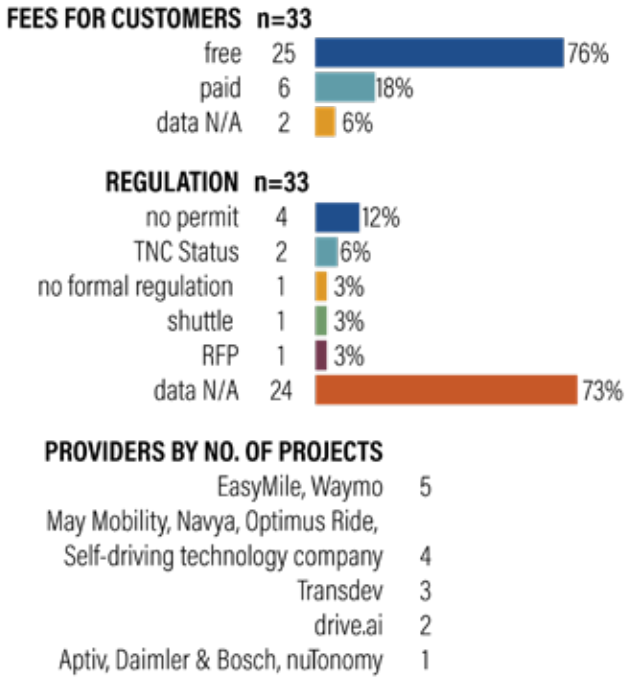
Note: data N/A means that data was not available.

COMMON PILOT CHALLENGES

Because AV technology is still being developed, most pilots have been very limited in application. A primary focus has been on testing the technology, and it is still unclear if AVs will eventually help to fill current transportation service gaps. Pilot projects have focused on the early stages of AV service including the limited deployment of vehicles and the establishment of initial regulations. Pilots are still exploring which form of service will best fulfill the potential of AVs and, based on current examples, it may be difficult to evaluate the impacts of AVs on travel behavior and transportation systems for some time.

The application of autonomous technology is not moving forward as quickly as originally anticipated for several reasons (Boudette, 2019). First, fully autonomous vehicles are still not readily available despite promises from technology companies and auto manufacturers. Timelines have been delayed and as Ford's chief executive said in April of 2019, "'We estimated the arrival of autonomous vehicles'" (Boudette, 2019). Most AVs still operate with a human safety driver or operator in the vehicle in case of emergency. They are also geofenced with a limited range. Second, a comprehensive regulatory regime has not been uniformly established. In addition, the business model is still evolving and most pilots provide services free of charge for users since the emphasis is on testing the technology. That is the case in California where the Public Utilities Commission is responsible for issuing permits for AV passenger service pilots. They have expressly prohibited monetary compensation in exchange for providing rides (California Public Utilities Commission, 2018).

FIGURE 3-13: PASSENGER AVS - SUMMARY OF PILOT PROJECT DATA



Source: Compiled from multiple online sources by Urbanism Next Center, 2020.

Note: data N/A means that data was not available.

EASYMILE SELF-DRIVING VEHICLE

Source: EasyMile

MOBILITY OF GOODS

AUTONOMOUS DELIVERY

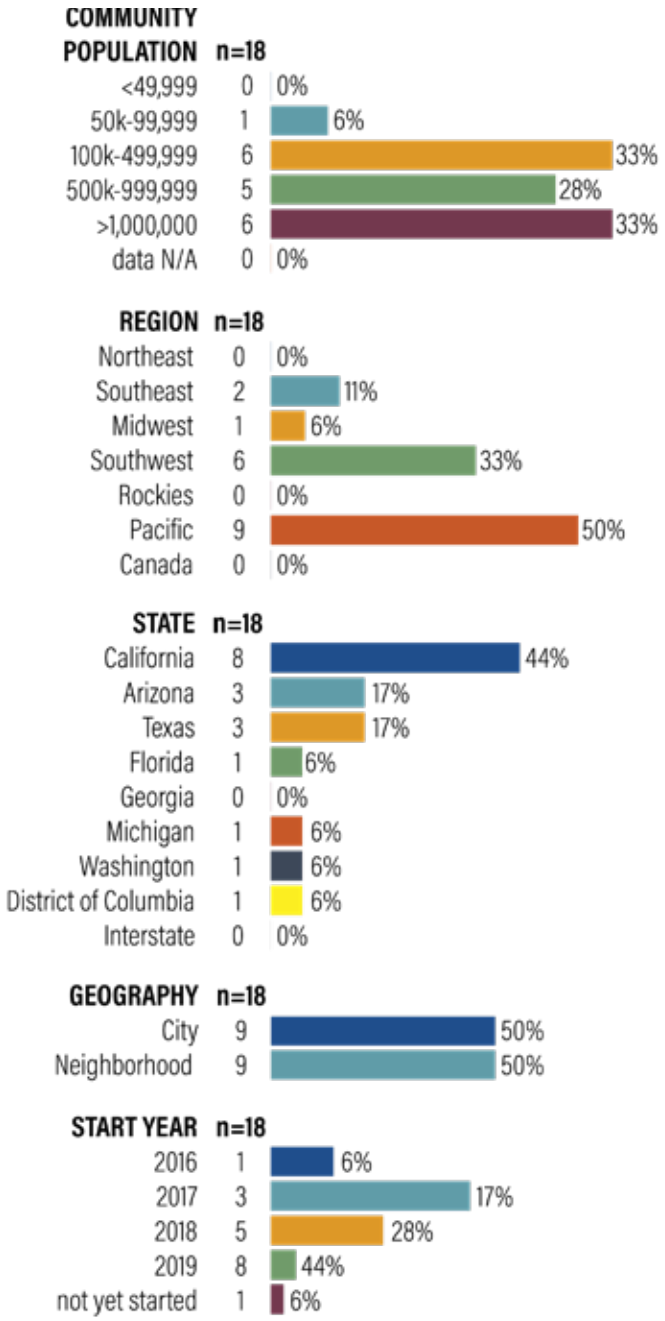
BACKGROUND

For this report Urbanism Next collected information about 18 autonomous delivery pilot projects, as shown in Figure 3-14. Out of these, eight projects used delivery robots (also referred to as drones) and five used cars and vans. Some of the delivery robots operate in the street, such as Nuro. Other smaller robots, also known as "personal delivery devices," such as Starship Technologies and Amazon Scout, operate on sidewalks. These robots may have handlers that accompany them for safety purposes, or they may be monitored remotely. The autonomous cars and vans, such as those operated by Ford and Udelv, operate in the street and have a safety driver present.

Autonomous delivery vehicles and robots are generally being tested as a means of providing last-mile delivery of meals and groceries. Package delivery is less common. There are a variety of reasons why there has been a push toward developing autonomous delivery vehicles. For one thing, last-mile delivery tends to be the most expensive part of the shipping process and is also labor-intensive. If labor costs can be reduced by eliminating the need for a driver, there is an opportunity for cost savings. Additionally, congestion is an important issue in last-mile delivery. Deliveries may be delayed if a vehicle is stuck in traffic—and the delivery vehicle is simultaneously contributing to increased congestion. Autonomous robots and personal delivery devices that can more easily maneuver in traffic or travel solely in bike lanes or on sidewalks may help decrease congestion while increasing delivery speeds.

It may be unsurprising that 44% of pilots are in California, as many of these companies are headquartered there. In addition, the lack of regulation in Arizona and Texas, and the favorable weather in all three states, may be why the majority of goods delivery AV pilots are happening in these states.

FIGURE 3-14: GOODS DELIVERY - SUMMARY OF PILOT PROJECT DATA



Source: Compiled from multiple online sources by Urbanism Next Center, 2020.

Note: data N/A means that data was not available.

COMMON GOALS AND PURPOSES

A common theme running through many of these pilots is the desire to test the technology. The main reasons that AV goods delivery pilot projects have been undertaken by government agencies, private companies, transit agencies, and others include:

- Private operators are looking for opportunities to pilot their vehicles/devices on public right-of-way.
- Cities want to be perceived as being open to innovation.
- Gauge public opinion
- Companies and cities want to identify potential use cases for the technology

GOVERNANCE STRUCTURES

Most of the autonomous goods delivery pilots are supported by private technology companies such as Starship Technologies, Udelv, and AutoX. These companies are eager to test and improve their devices and have been partnering with businesses to deliver goods, groceries, and meals. Three pilot projects are sponsored by car companies, such as Ford and GM. In some instances, cities have issued permits to technology providers to enable them to operate. In Redwood City, California, for instance, the City issued permits to Starship Technologies to allow them to operate on public streets and sidewalks. In other instances, private companies are able to test their vehicles without permits because they are covered by state regulations. In Scottsdale, Arizona, for example, Nuro was able to operate its vehicle without any additional permits from the city because the State of Arizona explicitly allows for the testing of AVs.

DATA SHARING

Because many of these pilots are operated solely by private technology companies, there have been limited instances of documented data sharing. If a city issues a permit to enable operation, there may be more of an opportunity to negotiate some data sharing. Given that this technology is still under development, however, data sharing is minimal. In general, there is limited publicly-available information about most of these pilots. Often, the information available is limited to a press release, a news article, and/or a city-issued document.

CONTRACTS AND PROCUREMENT

For the most part, public agencies have not yet begun issuing RFPs or procuring last-mile autonomous delivery services. In some instances, private providers may approach a city or jurisdiction and express their interest to test their services in the areas. In other instances, private providers may just begin to operate because, as noted above, they do not require any special permits if AV testing is allowed at the state level. Some jurisdictions have issued operating permits, but service contracts are not yet applicable.

STARSHIP DELIVERY ROBOT

Source: Starship
Note: images not to scale

NURO DELIVERY ROBOT

Source: NURO
Note: images not to scale

EQUITY, HEALTH AND SAFETY, THE ENVIRONMENT, AND ECONOMY

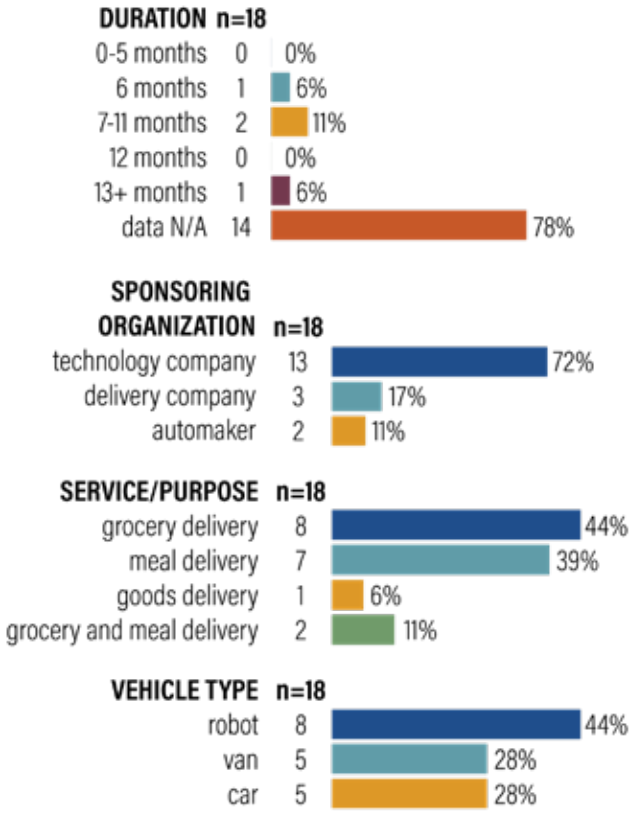
Because the primary goal of an AV delivery pilot is to test the technology, there are very limited instances of other goals or outcomes. Autonomous delivery vehicles could potentially have positive equity impacts if they increase access to goods, groceries, and meals for people with limited mobility. For now, though, these pilots are not specifically tailored to a particular population of users, and information about the people who are participating in these pilots is not publicly available.

Safety is a top priority for autonomous goods delivery pilots and provisions are in place to ensure that testing happens safely. Robots are accompanied by safety handlers and autonomous delivery vehicles have drivers on board in case of an emergency. For the robots that operate on sidewalks, pedestrian safety is a primary concern. Both private companies and cities are interested in ensuring that the robots react appropriately to other sidewalk users and do not create hazards. Vehicles operating on roads are learning how to navigate other vehicles and roadway users, where to pull over, and how to negotiate the curb.

Down the line, autonomous goods delivery robots could have positive or negative impacts on traffic congestion, which would have environmental implications. On the one hand, autonomous delivery robots that operate on sidewalks could help reduce congestion by replacing vehicle trips. On the other hand, if the ease of delivery induces demand, newly generated e-commerce trips could increase congestion, especially if vehicles must operate in the street.

Autonomous delivery vehicles could reduce last-mile delivery costs by eliminating the need for drivers. They may also help local businesses by expanding their customer base and allowing them to serve more people. The technology is still too new, however, to make any determinations about the economic impacts.

FIGURE 3-15: GOODS DELIVERY - SUMMARY OF PILOT PROJECT DATA



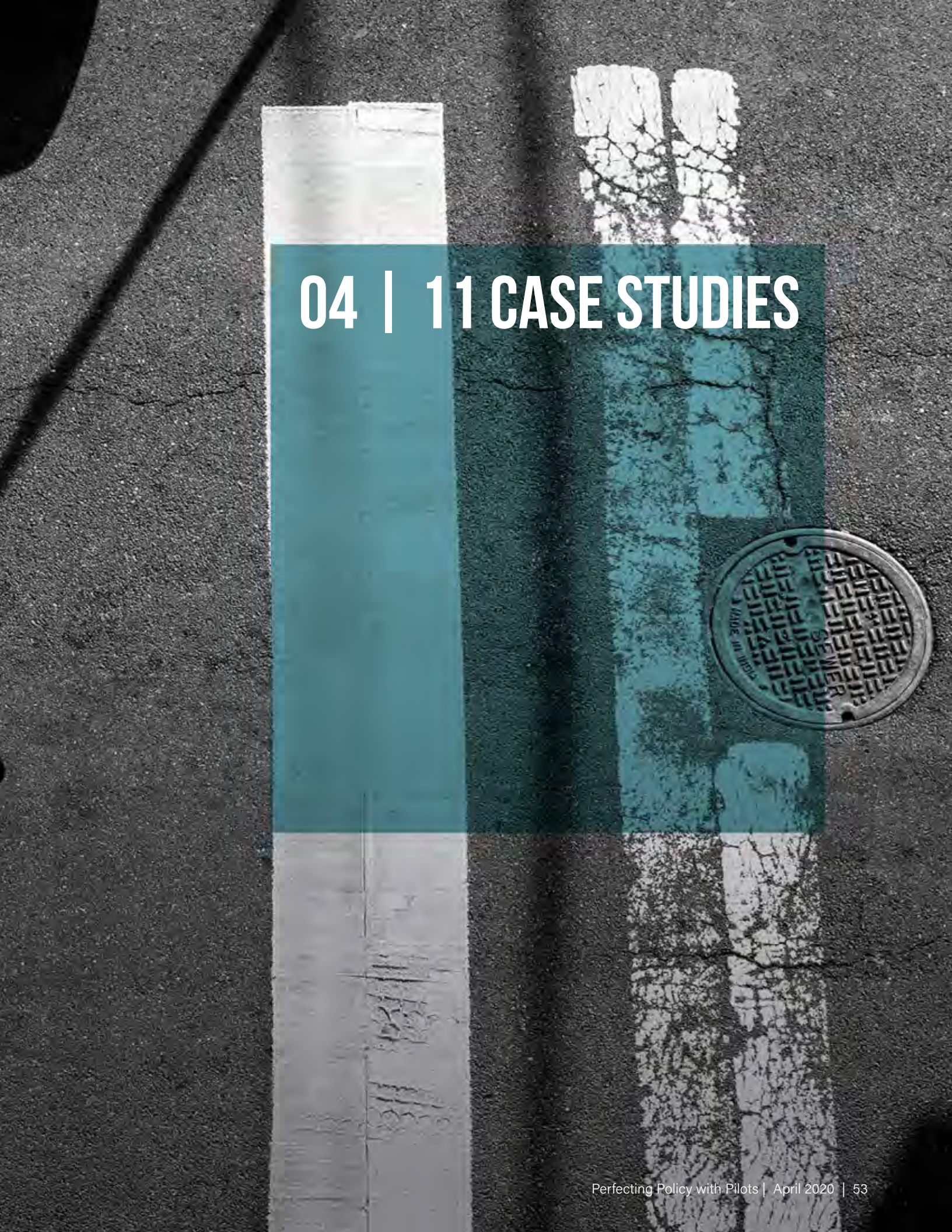
Source: Compiled from multiple online sources by Urbanism Next Center, 2020.

Note: data N/A means that data was not available.

COMMON PILOT CHALLENGES

A common pilot challenge is determining how customers will access the goods, groceries, or meals that are delivered. Unlike human drivers, autonomous delivery robots and vehicles cannot make it to a customer's doorstep—they are limited to the sidewalk or the curb. As a result, customers must be present when the delivery arrives and be ready to retrieve it themselves. There have also been some challenges in determining where a robot can and cannot operate in the instances when a permit has been issued. These vehicles also have limited service areas and relatively low travel ranges. More testing is needed to continue to develop the technology and to identify the most salient use cases for them.

Source: Skip



04 | 11 CASE STUDIES

INTRODUCTION

Chapter 3 provided an overview of 220 pilot projects from across the United States and Canada. Chapter 4 takes a deep dive into 11 case studies to better understand pilot goals, organization, management, and outcomes. Specifically, we analyzed existing materials, primarily evaluation reports, news articles, government documentation, and interviewed government and service provider representatives. The information from the analysis and interviews incorporated into this chapter describe what worked, or didn't work, with each pilot. Urbanism Next also focused on the outcomes of the pilots related to equity, health and safety, the environment, and the economy. Urbanism Next considered geographic diversity, available information, diversity of pilot projects, willingness of local government and service provider representatives to be interviewed when choosing case studies.

The case studies (organized by mode) are (see also Figure 4-1):

Micromobility

- 2018 E-Scooter Pilot: Portland Bureau of Transportation, Portland, OR, 2018
- Powered Scooter Share Pilot Program: San Francisco Municipal Transportation Agency, San Francisco, CA, 2018-2019
- Dockless Vehicle Pilot Program: City of San Antonio, TX, 2018-19

TNC Partnerships

- Innisfil Transit: Town of Innisfil, Innisfil, Ontario, 2017-2018
- Limited Access Connections: Pierce Transit, Tacoma, WA, 2019-2020

Microtransit

- Via to Transit: King County Metro Transit and Sound Transit, Seattle, WA, 2019
- Marin Transit Connect: Marin Transit, Marin County, CA, 2018 - Ongoing

AV Passengers

- ELA Autonomous Shuttle Pilot: Calgary, Alberta, 2018
- Babcock Ranch Autonomous Shuttle: Babcock Ranch, FL, 2018-Present

AV Goods Delivery

- Redwood City Personal Delivery Device Pilot: Redwood City, CA, 2016-2017 and 2017-2018
- Urban Delivery Research Partnership with Ford: Miami-Dade County, FL, 2018

FIGURE 4-1: MAP OF 11 CASE STUDIES

Source: Free Vector Maps edited by Urbanism Next. Data visualized with RAW Gra

MICROMOBILITY[1]

2018 E-SCOOTER PILOT: PORTLAND BUREAU OF TRANSPORTATION, PORTLAND, OR, 2018

In early 2018, e-scooter companies were putting e-scooters on city streets throughout the country without consent from local jurisdictions, regulations, or legal agreements holding companies accountable. With pressure mounting from e-scooter companies hoping to capture market share in Portland, Oregon, the Portland Bureau of Transportation (PBOT) proactively established the 2018 E-Scooter Pilot Program. The pilot aimed to give users access to e-scooters while assessing their ability to help meet Portland's transportation needs.

PBOT benefited from the early micromobility lessons learned in other cities. They also drew on their own experiences running a bikeshare system and the entrance of Uber and Lyft into Portland. PBOT landed on the pilot framework "as a way to incorporate new transportation modes and innovations in an urban context… and as an instrument of public involvement and outreach" (Public Information Officer, personal communication, November 22, 2019).

PBOT staff felt that the timeline of the 2018 pilot from idea to implementation moved "like warp speed" for the transportation planning world (Public Information Officer, personal communication, November 22, 2019). In May 2018, PBOT staff notified stakeholders that a pilot would be taking place starting in July. They informed companies that there would be consequences if they began operations before the pilot and to contact PBOT if they would like to participate. The application process began in June and the pilot began July 23, 2018.

TABLE 4-1: 2018 E-SCOOTER PILOT PROJECT SUMMARY, PORTLAND BUREAU OF TRANSPORTATION, 2018

Pilot	2018 E-Scooter Pilot Project
Location	Portland, Oregon
Service Area	Portland city boundaries (145 sq. mi)
Population	653,115 (census 2018 estimate)
Duration	120 days
Dates	July 23, 2018 to November 20, 2018
Sponsoring Organization	Portland Bureau of Transportation (PBOT)
Technology Companies	Bird Rides Inc., Lime, Skip Transport Inc.
Number of Permitted Vehicles	2,043
Number of Trips	700,369
Average Number of Trips per Day	5,885
Average Trip Length	1.15 miles

Source: 2018 E-Scooter Findings Report, 2019

FIGURE 4-2: 2018 E-SCOOTER PILOT PROJECT FINDINGS REPORT

Source: 2018 E-Scooter Findings Report, 2019

[1]While the case studies in this section are focused on e-scooter pilots, Urbanism Next acknowledges the importance of bicycles and e-bikes in micromobility pilots. Bikeshare systems prompted the current model of shared micromobility, but e-scooters quickly overtook bicycles in terms of numbers of rides taken (NACTO, 2019) and number of pilots per mode. As e-scooters have caused greater disruptions and required more accountability measures to ensure compliance and safety, pilots focused on these modes may provide greater insights into the challenges and opportunities shared micromobility may bring.

OPERATING REGULATIONS

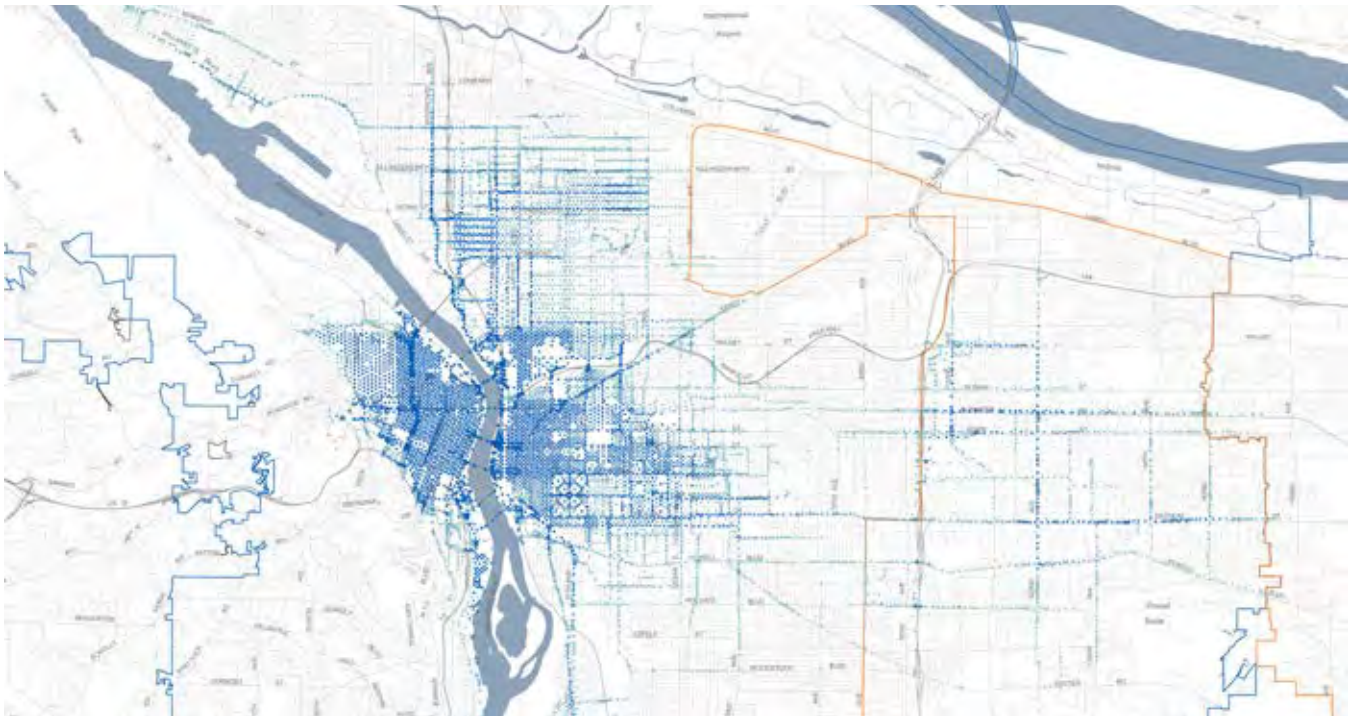
PBOT established the 2018 E-Scooter Pilot by administrative rule and an operating permit that set specific operational conditions. Each company had a 683-vehicle cap and was required to make 90% of their permitted fleet available daily. Companies were also required to deploy a minimum of 100 e-scooters per day in East Portland to reach equitable distribution goals. In addition, existing Oregon state laws enacted prior to the pilot prohibited users from riding e-scooters on sidewalks and required them to wear helmets. Portland city code prohibited the use of e-scooters on trails and in Portland parks. From Lime's perspective, "Portland is a model city–safety, equity, and utilization are all incentivized. Regulations set a floor for behavior, but partnerships and incentives inspire action" (J. Hopkins, personal communication, December 3, 2019).

DATA REQUIREMENTS

PBOT required e-scooter companies to share data through APIs (application programming interface), allowing them to share data in aggregated reporting to the public during the pilot. The PBOT Shared Electric Scooter Permit Application included a comprehensive datasharing agreement and companies were required to provide data on device availability, trips, collisions, and complaints. A full list of the data sharing specifications can be found in Appendix F – Data Sharing Agreement Specifications of the Permit Application (pages 13-16). PBOT modelled data specifications in this pilot after the Los Angeles Mobility Data Specification (MDS), General Bikeshare Feed Specifications (GBFS), and General Transit Feed Specifications (GTFS), which was born in Portland in a collaboration between TriMet and Google in 2005 (Roth, 2010).

PBOT staff felt that data sharing was one of the best things that happened during the pilot because they were able to collaborate with companies and quickly evaluate and share the impacts of e-scooters. They found that the ability to tell the public the number of rides per day early on helped show the positive potential for e-scooters and validated them as a legitimate transportation mode, which in turn helped the industry. Figure 4-3 shows how the data was used to illustrate e-scooter high usage corridors. They also felt that having quantitative data as well as the qualitative survey results gathered helped illuminate the opinions of the silent majority who generally doesn't pick up the phone to call PBOT.

FIGURE 4-3: 2018 E-SCOOTER PILOT PROJECT HEAT MAP, JULY 23 – NOVEMBER 20, 2018



Source: Portland Bureau of Transportation (PBOT), 2019

REVENUES AND EXPENSES

The pilot had a large workload impact on PBOT staff, requiring public outreach, coordination with companies, issue mitigation, and regulation enforcement in the right-of-way. PBOT was unsuccessful in making the fees commensurate with the staff load and administrative costs of the pilot and increased the permit fees for their 2019 pilot.

TABLE 4-2: 2018 E-SCOOTER PILOT PROJECT REVENUES AND EXPENSES

Permits & Fees		Expenses	
Pre-Pilot Phase		**Pre-Pilot Phase**	
n/a	$ -	Program design	$48,995
Subtotal	$ -	Subtotal	$48,995
Pilot Phase		**Pilot Phase**	
Application and permit fees	$15,500	Program administration and outreach	$155,415
Per trip surcharge	$187,577	Educational materials	$11,455
Fines and penalties	$9,000		
Subtotal	$212,077	Subtotal	$166,870
Post-Pilot Phase		**Post-Pilot Phase**	
n/a	$ -	Program evaluation	$71,417
Subtotal	$ -	Subtotal	$71,417
Total Permits & Fees	$212,077	Total Expenses	$287,282
		Balance	**$ (75,205)**

Source: 2018 E-Scooter Findings Report, 2019. Layout by Urbanism Next.

COMPLIANCE AND ENFORCEMENT

PBOT actively audited and enforced their permit requirements. PBOT said this required significant resources, but suggested that it was worthwhile. They acknowledged that it's much easier to make rules than ensure compliance and questioned which regulations are most important to ensuring consumer protection and safety. PBOT staff also felt that having their political leadership support and back the pilot's regulations was very important to the success of the pilot, acknowledging that Portland may be able to stand their ground more easily than smaller cities with less negotiating power.

DATA COMPLIANCE

PBOT largely received the kind of information they were expecting during the pilot including device availability and trip data. Staff felt that some companies were more open to compliance with city rules and more eager to collaborate while others wanted to do the bare minimum needed to comply. They also reflected on the complexity of data sharing and the amount of work needed to get the city system and private companies' systems to synchronize.

GEOFENCING AND DEPLOYMENT COMPLIANCE

Two out of the three companies in the pilot largely complied with the minimum fleet deployment requirements throughout the duration of the pilot. Bird and Lime performed well while Skip averaged below 90% of the citywide fleet requirement (Portland Bureau of Transportation, 2019). Companies also struggled to meet the East Portland deployment requirement with only Bird consistently meeting this requirement. Lime and Skip deployed below 90% of the minimum on average throughout the pilot.

Issues regarding deployment included blocking pedestrian and ADA access, access to transit, and vehicles being left on private property and in neighboring jurisdictions (Portland Bureau of Transportation, 2019). In addition, e-scooter use in parks was a significant challenge and 66% of users claimed they were unaware of the rule prohibiting e-scooters in parks and on trails.

GOAL OUTCOMES

According to the Findings Report, PBOT largely achieved their goals during the 2018 pilot. Their evaluation determined that e-scooters can help reduce automobile reliance and other goals. These goals included reducing private motor vehicle use and congestion, preventing serious traffic injuries and fatalities, expanding access for underserved Portlanders, and reducing air and climate pollution. Highlights from the report include that e-scooter trips replaced private vehicle use, no e-scooter related traffic deaths occurred during the pilot, e-scooters were determined to have the potential to expand access and opportunities to underserved Portlanders, and additional research is needed to determine whether e-scooters can reduce air and climate pollution.

EQUITY OUTCOMES

PBOT did not fully achieve their equity goals during the pilot. However, PBOT staff are applying what they learned to a second, 2019 pilot. The Findings Report indicated that only 47 users signed up for low-income plans during the 2018 pilot, indicating a lack of effective community outreach and advertising. During the 2019 pilot the private sector is also working to better achieve PBOT's equity-related goals. For example, Lime is partnering with a coalition of communities of color and equity groups in PBOT. They are working with people already in the community to get the word out and feel that partnering is one of the best things they've done in Portland.

In addition, in late 2019 PBOT partnered with Disability Rights Oregon, Rooted in Rights, and Lime to release an e-scooter safety video titled "Scoot Smart" to raise awareness about the importance of sidewalk access for people with disabilities. Lime also shared a shorter version of the video to their markets nationwide. The key takeaways from the video are to avoid sidewalk riding, park correctly, and wear helmets. The video features several advocates from the disability community sharing their experiences and why it is important to "scoot smart" and there is an ASL interpreter throughout the duration of the video.

Link to video:
https://www.youtube.com/watch?v=jX3rIcFIZZU

HEALTH AND SAFETY OUTCOMES

During the pilot, most e-scooter-related injuries did not require emergency transport. There were no e-scooter-related traffic deaths during the pilot and 83% of scooter-related emergency room visits resulted from individuals falling off e-scooters. Between July 25 and November 20, 2018 there were a total of 176 e-scooter related emergency room and urgent care visits in Multnomah County, as shown in Table 4-3.

TABLE 4-3: E-SCOOTER RELATED EMERGENCY ROOM AND URGENT CARE VISITS IN MULTNOMAH COUNTY, JULY 25 – NOVEMBER 20, 2018

Colliding Mode	Total Visits	Percent of Total
None/Fall	146	83%
Car	22	12.5%
Truck	2	1.1%
Pedestrian (Scooter user injured after colliding with pedestrian)	3	1.7%
Scooter (Pedestrian injured after being hit by a scooter)	2	1.1%
Scooter (Scooter user injured after colliding with another scooter)	1	0.6%
Total	**176**	**100%**

Source: 2018 E-Scooter Findings Report, 2019. Design by Urbanism Next.

ENVIRONMENTAL OUTCOMES

The PBOT Findings Report shows that e-scooter trips frequently replaced single occupancy vehicle (SOV) trips but further evaluation is needed to determine the emissions resulting from e-scooter charging and rebalancing. In addition, a lifecycle analysis of e-scooters is needed to definitively determine environmental impacts.

ECONOMIC OUTCOMES

While there were no hiring requirements built into the permit, local Portlanders were hired to deploy, service, charge, and collect e-scooters. According to the Findings Report, "companies reported working with 1,533 independent contractors (primarily chargers) and paying $643,000 in total wages to contractors" (Portland Bureau of Transportation, 2019).

IMPLICATIONS FOR POLICY, INFRASTRUCTURE, OR OTHER ISSUES

The clearest implications for infrastructure that came out of this pilot comes from data sharing and provides a "huge potential for cities to understand how streets are being used... and when" (Public Information Officer, personal communication, November 22, 2019). Data from the pilot allows PBOT to understand infrastructure demands in a more detailed, fine grained way than ever before. In their pilot evaluation they aggregated trip data up to street segments to protect privacy to create an e-scooter traffic volume map (See Figure 4-3. 2018 E-Scooter Pilot Project Heat Map, July 23 – November 20, 2018). This information can be used to supplement vehicle count and manual bike count data and will help determine what types of facilities are needed on which streets. The data gathered in this pilot showed that "on streets without bike facilities and/or speeds above 30 mph, most users ride on sidewalk. That has safety implications and with this data we're able to design for the kind of outcomes we want to see." (Public Information Officer, personal communication, November 22, 2019).

NEXT STEPS

Overall, Portlanders responded positively to this new mode of transportation and PBOT is currently conducting a second, yearlong pilot (originally April 26, 2019 – April 26, 2020, extended through December 31, 2020) that includes additional requirements focused on equity and environmental outcomes and additional fees to cover costs and build safer e-scooter infrastructure. PBOT chose to conduct a second pilot to continue gathering information about whether e-scooters could truly meet Portland's needs and PBOT/City of Portland goals, specifically regarding equity and environmental impacts. Although the initial pilot indicated that e-scooters could help advance Portland's transportation goals, PBOT felt that more data and time were needed to further address equitable access to e-scooters and ensuring safe and legal riding and parking. Key changes between the first and second pilot programs include the following:

- One major change from the first to second pilot was that PBOT incentivized providers in the application process to provide seated e-scooters. According to PBOT, the disabled community requested seated/adaptive e-scooters.
- The 2019 pilot requires companies to report GBFS publicly allowing 3rd party apps (e.g., E-Scooter Maps, Transit, Google) to show transportation options.
- The 2018 pilot did not result in as high of ridership in underserved areas (East Portland) as PBOT had hoped for, so the 2019 pilot incentivized companies to build partnerships with community organizations by offering increased fleet sizes to companies who did.
- The 2019 pilot had an increased fee structure from the 2018 pilot and included an additional fee for safe infrastructure that will go towards infrastructure improvements.
- PBOT built additional enforcement mechanisms into the 2019 pilot so that when PBOT staff document illegal behaviors, riders can be warned or fined through the companies. This was one key change disability advocates asked for that they were able to deliver on in the second pilot.
- During the 2019 pilot PBOT wants to report on the e-scooter lifecycle analysis and asked companies to submit life cycle analysis reports. They are also working with Portland State University (PSU) researchers through the Transportation Research and Education Center (TREC) to help analyze vehicle miles traveled (VMT) associated with e-scooter operations.

POWERED SCOOTER SHARE PILOT PROGRAM: SAN FRANCISCO MUNICIPAL TRANSPORTATION AGENCY, SAN FRANCISCO, CA, 2018-2019

In early 2018, San Francisco was among the first cities e-scooter companies launched in without city approval. According to staff at the San Francisco Municipal Transportation Agency (SFMTA), SFMTA received over 3,000 complaints in the first six weeks and every elected official wanted to shut e-scooter companies down. Regulations were clearly needed, which led to the San Francisco Board of Supervisors to amend Division I of the City's Transportation Code to allow SFMTA to regulate e-scooter providers. After SFMTA was given the authority to do so, their Board of Directors amended Division II of the Transportation Code to implement a 12-month Powered Scooter Share Pilot Program to address the initial issues and concerns.

SFMTA modeled the Powered Scooter Pilot Program on their earlier experience with dockless bikeshare as well as other cities experiences with e-scooters. They were also able to incorporate the lessons learned from the unregulated launch into the pilot, which ended up being centered around safety, equity, and accountability. Staff felt that as a highly desired market they were able to push companies to go above and beyond to meet their application criteria and acknowledged that this may not transfer to all other cities.

OPERATING REGULATIONS

For the first six months of the pilot, SFTMA permitted Scoot and Skip to operate 625 e-scooters each, and on average there were 617 devices total available at 8:00 a.m. each morning. The terms of the pilot allowed SFMTA to issue up to five permits with a maximum total of 1,250 e-scooters for the first six months and the potential to increase up to 2,500 for the remainder of the pilot. SFMTA built provisions around safety, equity, and accountability into their permit application and evaluated companies based on their ability to meet these criteria.

TABLE 4-4: POWERED SCOOTER SHARE PILOT PROGRAM SUMMARY, SAN FRANCISCO MUNICIPAL TRANSPORTATION AGENCY, 2018-2019

Pilot	Powered Scooter Pilot Program
Location	San Francisco, California
Service Area	Select neighborhoods in San Francisco
Population	883,305
Duration	12 months
Dates	October 15, 2018 – October 15, 2019
Sponsoring Organization	San Francisco Municipal Transportation Agency (SFMTA)
Technology Companies	Scoot, Skip
Number of Permitted Vehicles	1,250 with average of 617 deployed daily
Number of Trips	1,003,215
Average Number of Trips per Day	3,122 (weekday), 2,742 (weekend)
Average Trip Length	0.8 miles (median), 1 mile (mean)
Average Trip Duration	16 minutes (median), 10 minutes (mean)

Source: SFMTA Powered Scooter Share Mid-Pilot Evaluation and SFMTA staff

DATA REQUIREMENTS

The SFMTA Powered Scooter Pilot Program included comprehensive data sharing requirements and used a version of the Los Angeles Department of Transportation's MDS to ensure data accuracy and accountability. According to SFMTA staff, data sharing is the foundation of micromobility accountability and is essential to properly regulate companies, identify issues, and formulate policy responses.

Data from the pilot illustrated a low rate of low-income plan adoption, leading SFMTA to expand the low-income program and push operators to further promote it. In addition, they used distributional data to demonstrate that further geographic regulation was needed regarding what areas of the city would be served and how. Staff found that allowing e-scooters to move naturally around the city resulted in the majority migrating to the downtown core, which is where there are already the most transportation options. The full list

of the Powered Scooter Permit Program data sharing requirements can be found in the SFMTA Powered Scooter Share Program Permit Application.

REVENUES AND EXPENSES

SFTMA staff was unable to share exact revenues and expenses with Urbanism Next, but they estimated collecting several hundred thousand dollars and spending three times that much in staff time. SFMTA staff raised the question of whether it is appropriate for a public agency to charge high enough fees to cover the costs of a pilot given that that funding pilots is something they do often to meet their transportation goals.

SFTMA did incorporate an application fee (in addition to permit fees) into the pilot which they learned was important from their experience with dockless bikeshare as reviewing lengthy permit applications costs valuable staff time.

The fees charged by SFTMA during the Powered Scooter Pilot Program included:

- Non-refundable $5,000 permit application fee
- $35,000 permit fee (annual $25,000 permit fee plus $10,000 refundable endowment due at time of permit issuance for public property maintenance and repair costs)
- $100 citations for mis-parked e-scooters

COMPLIANCE AND ENFORCEMENT

According to the Mid-Pilot Evaluation Report, sidewalk riding and improper parking complaints significantly decreased during the pilot. In addition, SFMTA staff said they enforced improperly parked e-scooters more vigorously than most cities with a combination of on street parking enforcement (including $100 citations) and using data feeds to report on several compliance metrics. SFMTA staff said more robust equity engagement was needed to ensure that the e-scooter program was effectively serving historically disadvantaged communities.

DATA COMPLIANCE

SFMTA staff felt that companies complied with their data requirements throughout the pilot and that they received the data they asked for. Staff said that having multiple operators helped with their datasharing success because once one company committed to meeting the requirements it became difficult for others to say they could not.

GEOFENCING AND DEPLOYMENT COMPLIANCE

There were an average of 617 deployed vehicles on any given day. This low number led SFMTA staff to realize that it was necessary to further regulate deployment to ensure a reliable level of service. SFMTA added a minimum fleet deployment (or floor) of 50% of each company's permitted fleet in addition to the vehicle cap to alleviate this concern.

FIGURE 4-4: POWERED SCOOTER SHARE PILOT PROGRAM AVERAGE 8 AM E-SCOOTER DISTRIBUTION, FEBRUARY 2019

Source: SFMTA Powered Scooter Share Mid-Pilot Evaluation, 2019

GOAL OUTCOMES

According to SFMTA staff, an e-scooter system does have the potential to operate safely and accessibly, but that more work is needed in terms of equitable distribution, eliminating sidewalk riding, and creating a useful transportation system. Now that the pilot is complete and SFMTA has moved on to a more permanent program, staff hope to determine how e-scooters can meet a broader range of transportation goals including reducing single occupancy vehicle trips.

EQUITY OUTCOMES

According to company reporting, 68 people participated in Scoot's low-income plan and 75 participated in Skip's. SFMTA determined that more "robust equity engagement and multilingual outreach is needed to ensure underrepresented communities can actively participate in the program" (San Francisco Municipal Transportation Agency, 2019). Staff echoed the evaluation report and mentioned that equity became a higher priority in the second half of the pilot.

During the pilot, staff focused on three areas of equity including physical access to vehicles (deployment locations), affordability, and outreach and education to inform users about the system and how to use it. This led to SFMTA's efforts towards ensuring equitable distribution, requiring companies to offer discounted, low-income plans that were affordable, and requiring companies to have community outreach plans and partner organizations for education and outreach. However, both companies proposed unique, equity-related deployment goals and their overall approaches to equity were very different. Staff reported that having two different equity frameworks was confusing and did not recommend letting the equitable deployment standards be set by each company individually. Overall, staff felt that equitable distribution was a goal they may not have fully been met during the pilot and moving forward they hope to promote e-scooters as a first- and last-mile solution in areas with less frequent and widespread transit options to help meet their mode shift goals.

HEALTH AND SAFETY OUTCOMES

SFTMA has had success asking e-scooter companies to deploy vehicles with lock-to mechanisms that encourage users to park them at bicycle racks. In addition, the pilot illustrated that it would be valuable to have a shared complaint database for the public to report issues where companies must log each complaint and share it with SFMTA. One thing staff noted is that they would like to further integrate the database to sync up to their 311 system so public complaints sent directly to the city could be handled similarly.

SFMTA included a question in their user survey asking why people chose e-scooters over other modes and the third most popular response was that it was fun. This could be an indicator that e-scooters have mental health and wellbeing benefits.

ENVIRONMENTAL OUTCOMES

Through their user survey SFTMA found that 42% of all e-scooter users indicated that they "would have taken an automobile mode on their last trip had a e-scooter not been available" (San Francisco Municipal Transportation Agency, 2019). On the other hand, data sharing showed that one of the companies' ratio of non-revenue VMT associated with operations and distribution to e-scooter VMT was high.

ECONOMIC OUTCOMES

According to SFMTA staff, economic outcomes were not specifically brought up as a result of the pilot, but this is something they are interested in working on with researchers in the future.

IMPLICATIONS FOR POLICY, INFRASTRUCTURE, OR OTHER ISSUES

One broad policy implication SFMTA staff identified was the public sectors willingness to ask companies to do more and do better. Staff felt that this is something that could extend to many different areas and industries. Implications for infrastructure include the ability to design streets based on micromobility data and a significantly increased demand for bike racks due to the number of dockless vehicles with lock-to mechanisms.

NEXT STEPS

SFMTA staff began working on a permanent permit program after they completed the mid-pilot evaluation and shared it with San Francisco decision makers. They had already considered the next steps but did not start any work on the permit program before releasing the mid-pilot evaluation. Staff said they knew it would take around six months to create a new application, solicit companies, and complete the permitting process and they barely made it without a gap in service between the pilot and permit program. Key changes between the pilot and permanent permit program include the following:

- The permit program increased the number of operators and vehicles available in San Francisco, which has a more meaningful impact in terms of mode shift and is allowing e-scooters to serve areas outside of the downtown core.
- SFMTA staff said that having four operators worked better in San Francisco than two because the competition from additional companies helped hold each of the companies accountable. They felt that slightly more competition was valuable while still not having so many companies involved that regulating became unwieldy.
- In the permit program SFMTA made lock-to systems mandatory for all dockless vehicles including bikes and e-scooters.
- For the permit program SFMTA requires companies to report how they are responding to and resolving all public complaints.
- For the permit program SFMTA included an infrastructure fee in the permit process to build bike racks throughout the city which will all be publicly accessible.
- During the permit program SFMTA is piloting putting bike racks in daylighting zones.

SAN FRANCISCO SCOOTER RIDERS

Source: Skip

DOCKLESS VEHICLE PILOT PROGRAM, CITY OF SAN ANTONIO: SAN ANTONIO, TX, 2018-2019

By late 2017, City of San Antonio staff were aware of dockless bicycles and the possibility that they may appear locally anytime. By January 2018 they had been contacted by a few companies in the field and began researching what was happening in other cities and potential frameworks for creating a pilot program focused on dockless bikes. As far as San Antonio staff were aware, e-scooters were not deployed in Texas, but Dallas had witnessed a huge influx of dockless bicycles leading them to think through potential responses San Antonio could take.

By April 2018, city staff had been contacted by approximately six micromobility companies and began talking with their Transportation Committee about general policies and guidelines for a pilot. Many of the companies were anxious to enter the market but were waiting for a permit structure to do so and then in June 2018 Bird launched several thousand e-scooters without making any prior contact with the city, which sped up San Antonio's efforts to develop a pilot. The pilot began on October 19, 2018 as a six-month pilot and an ordinance amendment on May 30, 2019 provided permit extensions to all the operating companies through September 30, 2019.

OPERATING REGULATIONS

The San Antonio Transportation Committee supported a "light-handed approach with a very low permit fee structure, limited internal and enforcement staffing, and a very lax regulatory framework with no caps on numbers of vehicles or vendors" (J. Stevens, personal communication, January 24, 2020). San Antonio considered doing an RFP instead of a permit, but the light-handed pilot approach lent itself to a permit, which allowed for more flexibility to make changes during the program. The permit they ended up using for the pilot required minimal fees, business contact info, a number for the public to report violations (posted on each vehicles), proof of liability insurance, as well as numbers and types of vehicles.

TABLE 4-5: DOCKLESS VEHICLE PILOT PROGRAM SUMMARY, CITY OF SAN ANTONIO, 2018-2019

Pilot	Dockless Vehicle Pilot Program
Location	San Antonio, Texas
Service Area	City limits
Population	1,532,233
Duration	Eleven months
Dates	October 19, 2018 – September 30, 2019
Sponsoring Organization	The City of San Antonio
Technology Companies	Bird, Blue Duck, Lime, Razor, Lyft, and Spin
Number of Permitted Vehicles	16,100 (14,100 e-scooters and 2,000 dockless e-bikes)
Number of Trips	Incomplete data collected
Average Number of Trips per Day	Incomplete data collected
Average Trip Length	Incomplete data collected

Source: City of San Antonio website and staff

The private sector representatives we spoke with about San Antonio mentioned preferring markets with slightly more regulation and enforcement. A representative from Spin stated that they have a "strong preference for markets where the city has control of the system and a limited vendor program in place" (K. Rowe, personal communication, December 12, 2020). This provides a better opportunity for the vendors who are chosen and usually works better for cities as well. Spin entered San Antonio later in the pilot as it was not the top priority at the time, but they hoped to be in the market long term.

DATA REQUIREMENTS

Staff felt they did not have the tools necessary to compile data they did receive or evaluate it as much as they would have liked. Staff also felt that it was difficult to work with various companies that all have different data standards and feeds. According to staff, companies were required to provide monthly status reports with the total number of rides. This allowed San Antonio to compile some anonymized data for reporting, but it was a static level of data such as the aggregate number of rides per month. While San Antonio did not

receive all the data they hoped for in the pilot, staff acknowledged the broad uses and implications of micromobility data including planning bike lanes and parking infrastructure.

REVENUES AND EXPENSES

This pilot included a semi-annual permit business fee of $500 and a $10 semi-annual per vehicle permit fee. A representative from Lime shared that they liked that San Antonio initially set a low bar for entry in terms of fees and regulations and then added more as needed. They started with minimal rules and saw where they needed to add them as the pilot progressed.

COMPLIANCE AND ENFORCEMENT

According to city staff, San Antonio did not have any staff assigned specifically to the Dockless Vehicle Pilot Program. Staff had to use the limited funds from the permits to pay overtime for the police department and temps to do vehicle correction. The limited staffing was all the permit fees could support but it did not create the consistent, orderly environment that city leadership wanted. Limited staff capacity also led those involved in the pilot to feel that they were not getting the best out of companies.

GEOFENCING AND DEPLOYMENT COMPLIANCE

The city banned dockless vehicles from the Alamo and River Walk, which was challenging for the companies. The representative at Lime said that the city had little tolerance for geofencing violations which pushed Lime to build solutions. While this was challenging at the time, they were able to apply the tools they built for San Antonio to other cities and felt that the challenges prepared them for competition in other cities.

GOAL OUTCOMES

According to San Antonio staff, their number one goal was maintaining an orderly environment in their downtown and protecting resources such as the Alamo and River Walk. Staff felt the pilot allowed them to improve dockless vehicle deployment in the City of San Antonio and gave them some tools to try to address issues. However, staff said that they would not have transitioned to the RFP approach if the initial pilot solved all issues that arose during the pilot. In particular, the initial open permit structure led to an unworkable number of companies in San Antonio. Overall, staff felt that they are working towards aspirational goals but were uncertain about their ability to regulate to the point where there would be an entirely safe and controlled micromobility ecosystem.

EQUITY OUTCOMES

From the city staff perspective there continues to be opportunities to improve equity outcomes. In the beginning, the city was just trying to grasp what to do to manage unannounced e-scooter deployment and equity was not one of the biggest drivers behind the pilot. Staff did hope from the beginning that dockless vehicles could be a first- and last-mile option and solve holes in the transit network in a city with limited transportation.

HEALTH AND SAFETY OUTCOMES

In a mid-pilot ordinance amendment, the San Antonio City Council voted to prohibit sidewalk riding effective July 1, 2019 as well as reduce the number of e-scooter permits and ban nighttime riding. The mid-pilot ordinance amendment also extended the pilot until a more permanent program could be established. Prohibiting sidewalk and nighttime riding were both attempts to increase the safety of the pilot. The City also reduced the number of e-scooter vehicles in an attempt to reduce clutter.

ENVIRONMENTAL OUTCOMES

San Antonio required companies to respond within a certain timeframe to remove e-scooters in waterways, which was an early issue with the program. Lime also claims to have made their latest generation of e-scooters 100% waterproof to protect against leeching as well as making their pieces more compatible to pull apart and replace as necessary. This has allowed them to replace broken parts and extend the lives of their vehicles (J. Deshotel, personal communication, December 20, 2020).

ECONOMIC OUTCOMES

From the private sector's perspective, the profitability of San Antonio was hard because of how many companies and e-scooters were in the market. In addition, because the vendors who deployed vehicles initially without permits were invited to stay, those who prioritized compliance and partnership were left with lower market shares once they did launch. "This is something city policymakers aren't really thinking about because they're not a private mobility service operating against competitors. If someone shows up unannounced and you let them waltz in and stay in, they will already have a leg up on competitors who followed the rules from day one" (K. Rowe, personal communication, December 12, 2020).

IMPLICATIONS FOR POLICY, INFRASTRUCTURE, OR OTHER ISSUES

During the pilot, the lack of parking infrastructure, enforcement dollars, and limited capacity for administrative staff informed policy changes during the RFP process. San Antonio staff also felt that collecting better data would help plan where bike lanes and parking would be most effective.

NEXT STEPS

The pilot was initially extended through September 2019 and then the City of San Antonio established that they would transition into an RFP process to continue dockless vehicle services. City staff said that the RFP process was very lengthy and required significant staff time, but that overall, it seemed like a better approach. The process also included putting together an evaluation committee and doing multiple rounds of discussion, evaluation, and interviews. They received nine responses to review.

During the RFP process, the city initially proposed a flat permit fee structure of $100 per vehicle annually plus a $25,000 one-time infrastructure fee. They received pushback from at least one of the companies and eventually lowered the upfront permit fee and used a percent per ride approach. The finalized structure includes a 1,000-vehicle minimum fleet with a $10 per vehicle annual permit fee, a $25,000 per year one-time infrastructure fee, and a $0.25 fee per ride to the city.

From Lime's perspective, the RFP process is a natural maturation of the industry. Lime representatives said that the company is starting to see movement towards RFPs in cities oversaturated with e-scooters. Lyft scored highest on the cities criteria and it was announced that they were one of three selected companies. However, the next day Lyft made a national announcement that they were pulling out of several cities including San Antonio. Lime was the second highest rated applicant and shortly after Urbanism Next spoke with them, they also withdrew from San Antonio and several other cities. As a result, Razor and Bird are the sole providers contracted for service in San Antonio. Key changes between the pilot and RFP process include the following:

- There are more data requirements in the RFP than the pilot permit. When Urbanism Next spoke with city staff, they were still negotiating final details but said that companies will provide them with APIs for MDS data and that they would like to receive San Antonio specific data dashboards with greater reporting than their standard dashboards.
- Both the pilot permit and RFP process required substantial staff time, but it was relatively easy to administratively approve the permits. The actual staff time related to the permit was largely spent on outreach and coordination rather than administration.
- The RFP provides more reliability or continuity of service.
- The RFP allowed the city an opportunity to further regulate companies and influence user behavior, creating an escalating penalty structure unique to San Antonio. Companies will have a minimum threshold for education, warning, and suspensions.
- There are higher fees for the companies awarded contracts through the RFP process compared with the pilot permit fees and the upfront infrastructure fee included in the RFP process will be used to install scooter racks and corrals.

TRANSPORTATION NETWORK COMPANY PARTNERSHIPS

INNISFIL TRANSIT: TOWN OF INNISFIL, INNISFIL, ONTARIO, 2017-2018

In 2015, the small but growing Town of Innisfil, Ontario (population 36,566), sixty miles north of Toronto, determined that residents needed more transportation options. Town planners evaluated the expected costs and ridership levels for a fixed-route bus service and arrived at the conclusion that for the time being, the fixed-route bus was too expensive. Instead of a fixed-route bus, town planners decided to go forward with a relatively new transportation service provided by TNCs. Working with Uber, the town of Innisfil created the "Innisfil Transit" pilot program, where the town subsidized Uber rides beginning or ending inside Innisfil. The program launched March 15, 2017 and continues to operate in 2020. The Innisfil Transit program had two main pilot stages each roughly one year long. During the first stage, the first seven-and-a-half months of operation, residents took a total of 26,688 trips and the town spent $147,234 (Canadian dollars (CAD))[4] on trip subsidies. In 2018, the second stage of the service, residents took 85,943 trips and the total trip subsidies totaled roughly $640,000 CAD (Pentikainen & Cane, 2019).

Throughout the pilot, the Town of Innisfil published numerous staff reports on the Innisfil Transit website. The staff reports detail the motivations, procurement process, status updates, and council recommendations relating to the pilot. This case study draws on relevant information found in the staff reports along with an interview with a town planner.

Initially, town planners justified the price tag associated with the Uber service because everyone in the town was served, not only those walking distance from a bus line. However, as the service began to grow in popularity the total amount of subsidy also grew, and town planners found that the service, as it was initially designed, was not a sustainable solution to the town's transportation challenges.

TABLE 4-6: INNISFIL TRANSIT PILOT PROJECT SUMMARY, TOWN OF INNISFIL, ONTARIO, 2017-2018

Pilot	Innisfil Transit
Location	Innisfil, Ontario, Canada
Sponsoring Organization	Town of Innisfil
Technology Company	Uber
Trips (May 2017 to Dec 2018)	26,688 (2017), 85,943 (2018)
Riders	3493 (2017), 5749 (2018)[2]
Drivers	1393 (2017), 2203 (2018)[3]
Match rate	17% (2017), 31% (2018)
Wait time	9:10 mins (2017), 6:10 mins (2018)
Completion rate	71% (2017), 87% (2018)
Subsidy	$150,000 (2017), $640,000 (2018)

Source: Innisfil Transit - 2018 Results and Fare Changes Staff Report DSR-038-19, 2019.

OPERATING REGULATIONS

The Town of Innisfil did not embark on this project knowing what type of service or what company they wanted to work with. To explore their options, town planners issued a Request for Expression of Interest (RFEOI) for a transportation option, which, unlike a more traditional Request for Proposals (RFP) that must result in a contract, an RFEOI does not (Cane, 2016). Initial responses to the RFEOI underwhelmed the town planners and the two submissions the town received did not fit the town's vision for their transportation service (P. Pentikainen, personal communication, December 2, 2019). Because the city did not use an RFP, and used an RFEOI instead, the town was not contractually obligated to enter a partnership with either of the two companies that responded, allowing the town to propose a partnership directly to Uber. Working closely together, the town and Uber ultimately decided on the Innisfil Transit model, where the town subsidized shared rides, known as UberPool, beginning or ending within the town. The initial contract between the Town of Innisfil and Uber was a fixed-term, one-year contract. Innisfil council members voted to renew the contract multiple times in 2017, 2018, and 2019. Since the approval of the first contract, town planners did not change the contract in any significant way (P. Pentikainen, personal communication, December 2, 2019).

[2] There is an unknown number of riders that participated in both the 2017 and 2018 pilot stages.
[3] There is an unknown number of drivers that participated in both the 2017 and 2018 pilot stages.
[4] Yearly average exchange rate for 2017: 1 USD = 1.35 CAD. Viewed on January 15, 2020. (Yearly Average Currency Exchange Rates | Internal Revenue Service, n.d.).

DATA REQUIREMENTS

The 2017 contract between Uber and Innisfil may be unique as it sought to subsidize rides for all residents. The town worked quickly to set up the contract and accepted a contract without robust data requirements. While the town receives more information than simply the cost of the subsidy as seen in some earlier pilots, town planners acknowledge that the data they receive is not as detailed as they would like (P. Pentikainen, personal communication, December 2, 2019). Uber shares a standard data letter including:

- Heat maps of origins and destinations (no specific addresses)
- Number of trips
- Average trip distance
- Average wait times
- Total town subsidy

If town planners could do the pilot over again, they admit they would be more specific and ask for significantly more data, including the raw trip data so the town could conduct more analysis themselves. Town planners in Innisfil wish they co-owned the data with Uber. Even though data reported is not as detailed as desired, Uber responds to the town's custom data requests, which the town is using to further their goals of increasing mobility for its citizens. For example, the city requested information on the percent of trips within close proximity (i.e., 200, 400 meters) to the proposed fixed-route bus that prompted this partnership (P. Pentikainen, personal communication, December 2, 2019). They are using that data to understand the potential demand for transit service and routing in the future.

REVENUES AND EXPENSES

The city pursued this new transportation model largely because the city believed that fixed-route buses required too much capital and operating costs to justify the number of people that would use the service. The initial assessment on the fixed-route transit suggested that in the first year, one bus would cost $272,000 CAD and two buses would cost $605,000 CAD and estimated the ridership at 17,000 riders and 28,000 riders per year for the one bus and two-bus options, respectively (MMM Group Limited, 2015). The estimated costs in the second year were expected to be $155,000 CAD for one bus and $267,000 CAD for two buses. The estimated annual ridership in the second year was 21,000 for one bus and 35,000 on two buses (MMM Group Limited, 2015).

Even though the program cost less than the proposed fixed-route buses, the program grew at an unexpectedly fast rate and cost more than the town initially budgeted. The Town of Innisfil initially budgeted $500,000 CAD for the second stage of the pilot, of which $125,000 was for trip subsidies (Cane, 2018). Ultimately, town residents took 85,943 trips that cost the town $640,000 CAD. Even though the average TNC trip subsidy in the first year of Innisfil Transit was $5.62 CAD per ride and increased in the second year to $7.44 CAD per ride, it was less than the estimates for one bus system with a $17 CAD cost-per-rider estimate in the first year and $14 CAD in the second year. The two-bus cost-per-ride was $17 CAD in the first year and $15 CAD in the second year (MMM Group Limited, 2015).

Town planners realized that funding for the program would be difficult to sustain given the demand by residents. Over the course of the pilot, city planners changed the pilot program to reduce costs. For example, in April 2019 the town reduced the subsidy amount from $5 to $4, added a 30 ride per month cap, and amended the rules of the subsidy so that only trips beginning and ending in Innisfil were eligible (with a few exceptions) (Pentikainen & Cane, 2019).

COMPLIANCE

One of the reasons why the Town of Innisfil chose Uber as a partner for this pilot project was because of Uber's UberPool technology, which allows multiple riders to share a ride (P. Pentikainen, personal communication, December 2, 2019). The rate of trips being combined together, or matched together, increased over the course of the pilot. In the first stage of the pilot, 17% of all trips were matched trips and in the second stage of the pilot, 31% of trips were matched trips (Pentikainen & Cane, 2019). The trip completion rate also increased over the course of the pilot. Uber completed 71% of all requested trips in the first stage of the pilot and completed 87% of all trips in the second stage (Pentikainen & Cane, 2019).

GOAL OUTCOMES

The goal of the pilot was to provide transportation for the people of Innisfil while simultaneously testing and innovating a new transportation model (P. Pentikainen, personal communication, December 2, 2019). The door-to-door level of service and the 24/7 availability of the service are two features town planners point to when justifying the cost of the program.

Uber had their own goals for the pilot. With this pilot project, Uber wanted to demonstrate that ridesharing technology could be expanded to new applications and that it could collaborate with public agencies to achieve public goals through partnership (Uber Canada, 2019). Further, Uber wanted to use Innisfil as an example for other cities who are considering TNC partnerships (P. Pentikainen, personal communication, December 2, 2019).

HAPPINESS/SATISFACTION OUTCOMES

Town planners conducted two surveys during the pilot periods, one in each stage. The first survey collected nearly 200 responses between July and September 2017. The second pilot opened in March 2018 and received 175 responses. Results from both surveys indicated that the public view of the service was overwhelmingly positive. Sixty-two percent of survey respondents reported they were "satisfied" or "strongly satisfied" with Innisfil Transit service (Pentikainen & Cane, 2019). In the second survey, 65% of survey respondents reported being "satisfied" or "strongly satisfied" (Cane, 2018). Fifty-three percent of second survey respondents felt that the service improved, 40% of survey respondents felt that the service stayed the same, and 7% felt that the service worsened. Anecdotally, Innisfil Transit found that groups, especially seniors and youth, experienced the greatest increase in mobility and were very positive about the program (P. Pentikainen, personal communication, December 2, 2019).

EQUITABLE OUTCOMES

The Town of Innisfil took multiple steps to ensure equitable service. For example, the town partnered with Barrie-Innisfil Taxi to provide rides to those who need wheelchair accessible vehicles. To date, no one took any wheelchair-accessible trips through Barrie-Innisfil Taxi (P. Pentikainen, personal communication, December 2, 2019). Some people did attempt to book a ride through the taxi company and did not receive service through them. Providing service for those in mobility device is a goal of the pilot that has town planners are still trying to meet (P. Pentikainen, personal communication, December 2, 2019). Town planners proposed a couple possible explanations for the lack of rides. One reason that may contribute to the absent usage of wheelchair-accessible service is that Canadian Red Cross provides a cheaper for those who need WAVs, so it is likely that residents are using that instead. Additionally, town planners propose that some individuals who can get themselves in and out of mobility devices themselves may be using the Uber service, rather than contacting the taxi company for wheelchair-accessible service.

In addition to providing wheelchair-accessible service through Barrie-Innisfil Taxi, an additional step to provide equitable service was to allow call-in reservations of Uber and taxi rides, so people without smartphones could access the service. It is assumed that some riders booked rides in publicly available computers in the Town Hall and libraries. In 2019, Uber gift cards became available so people without smartphones can book rides too.

Town planners leveraged the flexibility of having a one-year contract to further prioritize equitable service by creating the Fair Transit Program in late 2019, a more focused effort to address socioeconomic inequity as it relates to this program by working with Uber to screen residents for low-income eligibility and offer those residents a discount of half the price of fare on Innisfil Transit trips generally, and free trips to food banks and other select locations (Innisfil Transit, 2020).

HEALTH AND SAFETY OUTCOMES

In the second survey of Innisfil Transit users, 12 out of 175 survey respondents, roughly 7%, reported they were 65 or older. In the same survey 33 respondents out of 168, roughly 20%, reported they used the service to get to medical appointments, suggesting the pilot could contribute to health improvements due to improved access to medical appointments and facilities.

Town planners assessed sentiments of safety in the pilot using the Innisfil Transit Survey as well by asking the question, "Select any of the following concerns you have with using Innisfil Transit." Out of the seven available responses, "safety" was the sixth most chosen (13% of all responses), suggesting that riders generally feel safe using Innisfil Transit.

ENVIRONMENTAL OUTCOMES

There is some uncertainty regarding the environmental impacts of the pilot. It is likely that the program ultimately leads to an overall increase in VMT and emissions from vehicles, but it is unclear if it is more than a bus service with relatively low ridership. Neither the Town of Innisfil nor Uber measured the environmental impact of this pilot (P. Pentikainen, personal communication, December 2, 2019).

ECONOMIC OUTCOMES

The economic outcomes of this pilot are largely speculative. Forty-three percent of respondents of the Innisfil Transit Community Satisfaction Survey said they used Innisfil Transit to go to work (Pentikainen & Cane, 2019). Additionally, the Innisfil Heights Employee Areas was the most popular destination in the first stage of the pilot but dropped to the fourth most popular destination in the second stage of the pilot.

It is also possible that the number of people who signed up to drive for Uber increased as a result of the pilot. Between May 15 and December 31, 2017 Uber reported to the Town of Innisfil that there were 1,393 drivers in the town. In 2018, the number of Uber drivers increased to 2,203 (Pentikainen & Cane, 2019). It is not possible to discern how much of the increase in drivers can be attributed to the pilot directly.

POLICY OUTCOMES

As a result of the pilot, and the entrance of Uber into Innisfil, the town made changes to taxi by-laws to ensure that taxi companies could remain competitive with Uber service and to make their requirements more similar to those that Uber must comply with (P. Pentikainen, personal communication, December 2, 2019). For example, the town council members eliminated a minimum rate requirement that taxis had to charge. Additionally, the town lowered the requirements for taxi drivers by removing an annual medical check that taxi drivers had to complete that Uber drivers did not.

RIDESHARE SERVICE

Source: Uber

LIMITED ACCESS CONNECTIONS: PIERCE TRANSIT, TACOMA, WA, 2018-2019

Pierce Transit in Tacoma, WA faced three transportation-related issues in 2017. First, there was high demand for park-and-ride. Second, fixed-route buses stopped operating before night classes at the local community college ended, and third, the transit agency identified that a large population lived in areas not easily walkable to fixed-route bus stops. To address these issues, Pierce Transit pursued a TNC partnership pilot with Lyft to provide first- and last-mile connections. The Federal Transit Administration (FTA) funded this pilot as part of the Mobility on Demand (MOD) Sandbox Demonstration Program (Cordahi et al., 2018). The pilot launched May 15, 2018 and was originally scheduled to last one year. In March 2019, the FTA granted Pierce transit an extension for the pilot because grant funds remained. The pilot ended December 2019.

OPERATING REGULATIONS

The FTA did not require Pierce Transit to choose a technology partner for this pilot using a formal procurement process. Instead of issuing an RFP or similar, Pierce Transit directly approached the only TNC operating in the area, Uber, with a proposal for a partnership. Pierce Transit and Uber shortly began working together on a contract. After several months of deliberations with Uber, it became apparent to Pierce Transit that they would not be able to reach an agreement. At the time Pierce Transit and Uber explored a partnership, Uber could not immediately provide a call-in option to book rides to ensure equitable service. Additionally, Uber did not agree with some legal language standard in Pierce Transit contracts. Pierce Transit ultimately switched partners to Lyft, who recently started to recruit contract drivers in the area (P. Grellier, personal communication, February 28, 2020). Lyft signed a one-year contract with Pierce Transit for the Limited Access Connections pilot (Pierce Transit & Lyft, 2018).

TABLE 4-7: LIMITED ACCESS CONNECTIONS PILOT PROJECT SUMMARY, PIERCE TRANSIT, 2018-2019

Pilot	Limited Access Connections
Location	Tacoma, WA
Sponsoring Organization	Pierce Transit
Technology Company	Lyft
Trips	8,827
Riders	330
Subsidy	$103,160

Source: Pierce Transit and Lyft: Project Summary, 2020.

DATA REQUIREMENTS

Pierce Transit began the contracting process with Lyft with a detailed list of desired data. However, Pierce Transit forwent much of the data in order to get the pilot up and running (P. Grellier, personal communication, February 28, 2020). The final data reporting specified in the contract required Lyft to provide a monthly data report to Pierce Transit including:

- Trip duration in five-minute increments
- Trip distance in two-mile increments
- Trip time of day (e.g., AM peak, midday, PM peak, late night)
- Day of trip
- Zone of trip
- Trip subsidy
- Census-block level heat map for the pick-ups and drop offs.

The limited, generalized data Pierce Transit received from Lyft made it hard for the transit agency to understand the outcomes of the pilot. Pierce Transit staff indicated that they wished they had more granular data about pilot project riders (P. Grellier, personal communication, February 28, 2020).

REVENUES AND EXPENSES

The Federal Transit Administration provided 80% of the total budget for the pilot, and Pierce County provided the remaining 20%, a requirement for participation in the FTA MOD Sandbox Program.

THE FTA'S MOD SANDBOX PROGRAM

The Federal Transit Administration created the Mobility on Demand (MOD) Sandbox Program in 2016 facilitate research into on-demand transportation services, technologies, models, and applications to increase individual mobility. In total, the FTA awarded $8 million to 11 different projects. The projects are all public-private partnerships and examples include developing Mobility as a Service applications and transportation provision by TNCs. All MOD Sandbox projects include an independent evaluation component (Federal Transit Administration, 2019).

For more information on the FTA MOD program see the box above. In total, Pierce Transit received $205,000 in FTA grant funds. At the conclusion of the pilot Pierce Transit spent $142,598, including $103,160 for trip subsidies, $27,017 for marketing, and $12,421 on administrative expenses (Grellier, 2020).

Participants in the pilot did not pay for their rides. Pierce Transit used the FTA grant to fully subsidize the cost of the ride. The resulting average cost per trip was $11.47. The average cost per passenger of Pierce Transit's directly operated fixed-route bus service was $8.00 per passenger in 2018 (Federal Transit Administration, 2018). While the average cost per passenger was more than the cost of per passenger of the bus service, the cost per passenger was much lower than the directly operated and purchased demand-response transportation options Pierce Transit provides.

COMPLIANCE

Pierce Transit received very limited information on trip completions. Pierce Transit did not receive the number of trips requested by users but declined by Lyft. The transit agency received information on trip "no shows," where a Lyft driver arrived at a trip request location but could not find the user who requested the trip. In the event where a Lyft driver could not find the passenger who sent the request, Lyft charged Pierce Transit $5. According to Pierce Transit staff, Lyft charged the $5 no-show fee about once or twice per month (P. Grellier, personal communication, February 28, 2020).

GOAL OUTCOMES

Pierce Transit's goals for the pilot included reducing reliance upon single-occupancy vehicles, promoting mobility as a service, improving networked travel, and easing congestion in park-and-ride lots and on roads (Grellier, 2020). Pierce Transit also had the goal of exploring new, on-demand transportation options in the community, and to see the reasonableness of a partnership for to overcome this transportation gap (P. Grellier, personal communication, February 28, 2020).

Along with these qualitative goals, Pierce Transit also set quantitative ridership goals of 55 boardings per day (P. Grellier, personal communication, February 28, 2020). While the average daily boardings (rides) increased over the course of the pilot, the average boardings peaked at 38 per day.

Additionally, Pierce Transit asked that wait times during the pilot be around a maximum of 15 minutes. However, Lyft did not provide the transit agency with data wait times so the only way that the transit agency could know if people experienced much longer wait times was through a complaint, either formal or informal. Pierce Transit did not receive any complaints for long wait times; however, it is impossible to know if people did experience much longer wait times and did not report them (P. Grellier, personal communication, February 28, 2020).

Because Pierce Transit did not receive the granular data they wished for, evaluating the pilot took longer and was more challenging than expected.

EQUITABLE OUTCOMES

Pierce Transit took multiple steps to ensure equitable service during the pilot. First, Pierce Transit required that Lyft provide users with a "call-in" option, so users did not need a smartphone to participate in the pilot. Additionally, Pierce Transit supplemented the Lyft service with their in-house paratransit service because Lyft could not provide wheelchair-accessible rides. However, at the conclusion of the pilot no one requested a ride wheelchair-accessible ride and the call-in service was used for less than 5% of trips (P. Grellier, personal communication, February 28, 2020).

The eligibility requirement for a trip subsidy, that trip must begin or end at a transit stop, likely contributed to the absence of wheelchair-accessible requests during the pilot. Individuals who, through an assessment process, are determined unable to use the fixed-route service, are eligible for Pierce Transit's ADA paratransit services and would likely choose to use it instead (P. Grellier, personal communication, February 28, 2020).

HEALTH AND SAFETY OUTCOMES

The health and safety outcomes of this pilot are anecdotal. Some of the pilot zones were areas that people are not inclined to walk or bike because of the unsafe road conditions including narrow shoulders or streets without sidewalks. Transit staff hoped that providing a subsidized TNC ride to transit would increase the number of people using transportation by giving people a safer option to get to transit stops (P. Grellier, personal communication, February 28, 2020).

Pierce Transit designed one of the zones to connect students at Pierce College Puyallup to trunk routes after their late-night classes ended. However, this zone was one of the underutilized pilot zones. Over the course of the pilot, Pierce Transit staff observed 10 or fewer rides reported by Lyft as falling into the "late night" category of rides.

HAPPINESS/SATISFACTION OUTCOMES

Pierce Transit has plans to measure satisfaction with the service and with the transit agency itself through a survey that Lyft will send out to users on the app in early 2020. At this time, there are not yet results from this survey. Transit agency staff feel that the survey component of the pilot is very important because it allows them to supplement the limited data that Lyft provides, "the user feedback and opinions are very important to measure the level of success of the program to get a well-rounded analysis of the program" (P. Grellier, personal communication, February 28, 2020).

Included in the customer survey are questions regarding user's preferences before and after the pilot, impact on car usage, and questions about reasons for using the service, and public transit usage changes due to the service.

ENVIRONMENTAL OUTCOMES

This pilot did not measure environmental outcomes. It is possible that this pilot contributed to an increase in VMT in the areas where people choose a TNC instead of walking or biking to get to a transit stop.

POLICY AND INFRASTRUCTURE OUTCOMES

Pierce Transit wants to continue to integrate innovative solutions into their transportation network. In late 2019 Pierce Transit issued an RFP to extend the Limited Access Connection pilot in two zones of the pilot. Pierce Transit wanted multiple providers to emerge from the RFP process so they could use FTA funding to subsidize the rides. If the transit agency contracts with more than one provider, they can use FTA funds for the program without having to comply with drug and alcohol testing requirements. However, Lyft was the only respondent to the RFP, so the transit agency decided not to continue with the service.

Pierce Transit designed one of the pilot zones to reduce congestion at a park and ride lot located at a popular rail station with service from Tacoma to Seattle. Transit agency staff did monthly counts of the parked cars in the lot and will use the monthly counts to determine if the pilot project had in impact on the park and ride lot.

MICROTRANSIT/SHUTTLES

VIA TO TRANSIT: KING COUNTY METRO TRANSIT AND SOUND TRANSIT, PUGET SOUND, WA, 2019-2020

Via to Transit is a microtransit pilot created in collaboration between three public agencies in the Seattle, WA and Los Angeles, CA areas. The FTA awarded a grant to Los Angeles (LA) Metro and King County Metro Transit to conduct a two-market test of the viability of TNC to supplement transit service. The pilot project in Los Angeles, Ride with Via, operated under a classical TNC partnership model where drivers supply their own vehicles. In the Via to Transit pilot in Puget Sound, Via manages drivers, and worked with King County Metro Transit and a third party to provide vehicles dedicated specifically for the program.

Along with $350,000 in funding for operations, the FTA provided guidance to the public agencies for how to design, implement, and evaluate the pilot program.

The pilot began in April 2019 and will last one year, ending in April 2020. Between April and November 2019, 142,689 trips were completed using Via to Transit (King County Metro Transit, 2019b).

OPERATING REGULATIONS

LA Metro named Lyft as their technology partner. However, planners at LA Metro and in Puget Sound learned that Lyft was not willing to provide granular data that the three transit agencies needed in order to conduct a thorough evaluation of the pilot and to uphold the intent of the grant. After LA Metro changed their partner to Via, who emerged as a partner who was willing to provide detailed data and wheelchair accessible vehicles on-platform, King County Metro Transit and Sound Transit decided to work with Via. The contract between King County Metro Transit and Via is a fixed-term contract of one-year with an option to renew.

DATA REQUIREMENTS

The contract between Via and King County Metro Transit includes one of the most extensive data provisions in a microtransit pilot project contract. The contract specifies that anonymized trip data be reported to the public agencies and research organizations. The Eno Center for Transportation provided an independent evaluation of the data policies and implications of this pilot and the LA Metro pilot in their report, *Data on Demand* (Grossman & Lewis, 2020). The Eno researchers found that adequately anonymized granular trip data, in addition to data collected from surveys and fare-revenue cards, are crucial to conduct a thorough analysis of the pilot. Data retrieved from the ORCA card allowed the public agencies and researchers to learn valuable information about the riders, including demographic information (Grossman & Lewis, 2020).

One of the greatest project successes of the Via to Transit pilot in Puget Sound was the ability of the public agency to link together trips taken on Via with ORCA cards. Roughly 96% of people pay for Via to Transit using the ORCA card, a public transportation payment card used in the Puget Sound region. Linking the Via trips to the ORCA card allows King County Metro Transit and Sound Transit to see how commuters use microtransit. Linking the ORCA card data allowed public agencies to answer important questions such as: are people using public transportation after they use the service? Where are users going after Via? How often are users using the service?

TABLE 4-8: VIA TO TRANSIT PILOT PROJECT SUMMARY, KING COUNTY METRO TRANSIT AND SOUND TRANSIT, 2019-2020

Pilot	Via to Transit
Location	Puget Sound, WA
Sponsoring Organizations	King County Metro, Sound Transit, City of Seattle
Technology Company	Via
Total rides	195,141 (through 12/31/19)
Total unique riders	7,384
Average wait time	8 minutes
Average trip time	7.5 minutes

Source: Performance Updates, King County Metro, 2019; Via staff, personal communication, 2020

COMPLIANCE

Allowing users to pay with their ORCA card and subsequently allowing the public agencies to collect data from the ORCA cards required that Via carry ORCA card readers in each of the vehicles. King County Metro Transit ensured that the readers charged users appropriately. Staff at Via found that adding the readers into the vehicles was one of the more challenging operational requests during the pilot, due in large part to the age of the ORCA card readers (Via staff, personal communication, January 8 and April 20, 2020).

REVENUE AND EXPENSES

In addition to the $350,000 from the Federal Transportation Administration, the pilot was funded with $2.7 million from the City of Seattle, $100,000 from Sound Transit, and $100,000 from King County Metro Transit, resulting in a total budget of $3.25 million for the pilot. Via to Transit users paid the same rate to use the service as they would for a Metro bus ride, $2.75 for adults, $1.50 for youth and income-qualified ORCA LIFT cardholders, and $1.00 for registered seniors and individuals who receive Medicare or are disabled (King County Metro Transit, n.d.).

Planners at King County Metro Transit felt that the fare charged in the pilot is the right amount, "other agencies take the perspective that they should charge more for a higher quality service. Arguably on-demand is a higher quality service, however there is lots of fault with that with regards to equity and accessibility" (C. Gifford, personal communication, December 13, 2019).

GOAL OUTCOMES

King County Metro Transit and Sound Transit included a detailed scope of work, which included the transit agencies' goals for the pilot program. The project goals outlined in the contract are to:

- Improve mobility by increasing ridership for [King County Metro Transit] and [Sound Transit] through the pilot service
- Provide a reliable, high quality customer experience
- Ensure optimal utilization of pilot vehicles through efficient aggregation of riders
- Ensure access for disadvantaged and underserved populations
- Ensure comparable level of service for customers requiring an ADA-compliant accessible vehicle
- Create cost efficiency for [King County Metro Transit] and [Sound Transit] and the contractor
- [King County Metro Transit] and [Sound Transit] develop efficient tools for measuring and implementing trip linking between the Pilot service and fixed-route transit (King County Metro Transit & NoMad Transit LLC, 2018).

Associated with the project goals are "Key Performance Targets for Via" which include measurable performance targets such as: 1,000 trips per week, an average wait time of 10 minutes or less, and average ride rating of 4.5 out of 5, and an 80% of demand met, among others (King County Metro Transit & NoMad Transit LLC, 2018). To determine if the pilot achieved its goals set in the contract, independent evaluations will be carried out by researchers at local universities and the Eno Center for Transportation (A. Chazanow, personal communication, December 13, 2019; C. Gifford, personal communication, December 13, 2019). Early results from this pilot indicate a 96% transfer rate between Via and fixed-route transit service, suggesting that using Via to complete first and last-mile connections to fixed-route stops is working.

Via's goals centered around meeting the goals of the public agencies. Additionally, high ridership, high utilization, and overall quality of the service (measured by wait times) were goals set by Via. Via was focused on increasing the number of people in each vehicle in operation during the pilot (Via staff, personal communication, January 8, 2020).

HAPPINESS/SATISFACTION OUTCOMES

Happiness and joyfulness are important for public agencies to consider when providing transportation services. Surveys and in-app ratings allowed public agencies to measure the satisfaction of users. As of December 2019, users overall rated the service 4.7 out of five and users who requested a wheelchair accessible vehicle rated the service 4.6 out of five (King County Metro Transit, 2019b).

EQUITABLE OUTCOMES

Ensuring equitable service was one of the main goals of the pilot. Planners at King County Metro Transit and Sound Transit focused on making the service equitable and accessible for disadvantaged populations. For those with limited digital literacy, riders could call a call center to request and pay for trips. For those with limited English language proficiency, King County Metro Transit and Sound Transit created materials in multiple languages and used infographics to ensure use. The agencies also created a fee structure parallel to the existing public transportation system, which offers roughly a 45% fare reduction for youth and income-qualified ORCA card holders and roughly a 64% reduced fare for registered seniors, Medicare recipients, and disabled persons (King County Metro Transit, 2019a).

To measure equitable impacts, the public agencies and research teams used data from ORCA cards, an in-app Via survey, and a survey of transit riders at four Sound Transit stations. The ORCA data revealed that a considerable number of users met requirements for discounted fare, 29% of total trips were reduced fare trips. Additionally, a survey of transit riders at four transit stations indicated that 43% of transit customers did not have access to a car for their trip to the station (King County Metro Transit, 2019b). Responses from the survey of Via riders revealed that 59% of respondents were women.

> "SEATTLE IS ONE OF THE CITIES IN AMERICA WHERE TRANSIT USE IS ACTUALLY INCREASING, AND WE'VE SEEN IF WE MAKE IT AVAILABLE, PEOPLE USE IT. NOW, WE COULD CALL THIS TAP-AND-RIDE. I JUST THINK IT'S PRETTY COOL AND CONVENIENT."
>
> -Mayor Jenny Durkan, City of Seattle

The Seattle Times, April 16, 2019

Preliminary estimates of the wait times for WAVs are higher than non-WAV vehicles, an average wait of 14 minutes compared to eight minutes. Part of the issue is trying to navigate what the FTA means by "an equivalent level of service," and staff at Sound Transit mentioned that "part of the pilot is to test how close to an equivalent level of service can be achieved" (A. Chazanow, personal communication, December 13, 2019).

HEALTH AND SAFETY OUTCOMES

Sound Transit and King County Metro Transit measured safety-related outcomes using surveys of riders. Survey results regarding safety are as follows (King County Metro Transit, 2019b):

- 92% of riders are satisfied or very satisfied with their personal safety with other passengers
- 86% of riders are satisfied or very satisfied with feeling safe in terms of how the driver operates the vehicle
- 80% of riders feel safe when waiting for pick-up.

ENVIRONMENTAL OUTCOMES

Project leads at King County Metro Transit and Sound Transit admit that there is "room for improvement with regards to environmental sustainability" (C. Gifford, personal communication, December 13, 2019). The public agencies identified two ways to reduce the environmental impact of the service in the future. The first is to work with Via on routing improvements to reduce the ratio of VMT to PMT (personal miles traveled), in part by reducing the number of people who ride alone. Project leads at King County Metro Transit and Sound Transit plan on using survey data collected throughout the pilot to see if the service replaced trips that people would otherwise have taken alone. The second way to reduce GHG emissions is to use more fuel-efficient vehicles. More detailed environmental impact and analysis of VMT stemming from this pilot project will be assessed by researchers upon completion of the pilot (A. Chazanow, personal communication, December 13, 2019; C. Gifford, personal communication, December 13, 2019).

ECONOMIC OUTCOMES

Via complied with King County's living wage ordinance which requires that certain contractors and subcontractors of King County Metro Transit pay living wages to their employees (Living Wage Ordinance, 2014). Additionally, Via paid a higher rate to drivers at rush hour and for driving wheelchair users.

POLICY/INFRASTRUCTURE OUTCOMES

As a result of the pilot city planners discovered that some pick-up and drop-off locations lacked curb cuts for mobility devices. Pursuant to local code there are curb cuts near transit stops, but local code did not require curb cuts at all of the pick-up and drop-off locations used in the pilot. In some cases, individuals in wheelchairs had to be dropped off next to the curb on the street and then navigate to the end of the block where there was a curb cut in order to get back on the sidewalk. This raises the question for public agencies of how to budget for accommodations for the safety of wheelchair users.

MARIN TRANSIT CONNECT: MARIN TRANSIT, MARIN COUNTY, CA, 2018 - ONGOING

TABLE 4-9: MARIN TRANSIT CONNECT PILOT SUMMARY, 2018-ONGOING

Pilot	Marin Transit Connect
Location	Marin County, CA
Sponsoring Organizations	Marin Transit
Technology Company	Via
Total rides	11,199 (May 2018 – May 2019)
Total unique riders	828 accounts created, 248 utilized service
Average wait time	7.73 min
Average tip time	7.51 min, 1.1 mi.

Source: Marin Transit Connect Evaluation Report

This pilot project was initiated by Marin Transit to provide an accessible, on-demand service transportation option. In 2017, California had not yet passed legislation requiring TNCs to provide WAV services and TNC companies were unable to adequately meet these needs. Marin Transit saw this as an opportunity to fill a service gap for older adults and people with mobility limitations. Marin Transit was awarded federal MOD funding for the project and was able to implement it in May 2018 it in collaboration with Via. At the time, few companies were offering the technology services needed for microtransit and Via was a natural choice. The partnership began as a no fee agreement with Via for the initial yearlong pilot phase with Via seeing it as an opportunity to promote their business and the transit agency partnership model.

Service began in May 2018 with free passenger fares for the first two months of operations. The pilot was planned as a yearlong project, but staff quickly realized that one year was not long enough to adequately test their new public transit offering. This led to two additional six-month partnership extensions with Via. The second extension goes through June 2020 and Marin Transit is undergoing an RFP process (as of March 2020) in hopes of seamlessly extending the service beyond the pilot timeframe.

OPERATING REGULATIONS

This pilot began with a Marin Transit Board Request for an Agreement with Via for On-Demand Scheduling Software (11/20/17). Via provided their cloud-based technology platform for the scheduling and dispatch of the on-demand service, which was operated by Whistlstop, Marin Transit's paratransit operator. The operational standards that were met throughout the first year of the pilot are shown in Table 4-10.

TABLE 4-10: MARIN TRANSIT CONNECT PILOT SERVICE PROFILE SUMMARY

Service Hours	6:05 am – 7:00 pm (weekdays only)
Ride Requests	Requested through the app or by calling scheduling line
Regular Fares	Originally $4.00 per trip, $40.00 monthly pass; currently $4/mile distance-based fare or $80 monthly pass
Discounted Fares	Originally $2.00 (Senior/ADA), $2.00 (to/from bus or rail stop); currently $3 (Senior/ADA) and the transit stop discount discontinued
Service Area	San Rafael
Vehicles	Ford Transit (9 passenger or 5 passenger + WC)

Source: Marin Transit Connect Evaluation Report

DATA REQUIREMENTS

Via provided the software for the pilot but did not operate the service themselves. Via ensured that Marin Transit had access to the service data collected throughout the pilot. Via also created a customized dashboard specific to Marin showing ridership based on account type. This allowed Marin Transit to conduct data driven evaluations throughout the pilot and quickly see how the service was being used and what improvements were needed. Receiving comprehensive data and customized reports from Via allowed Marin Transit to publish monthly reports on their website as well as evaluating standard performance metrics on a monthly, quarterly, and annual basis. In addition, the data allowed Marin Transit staff to quickly see how well the service was working and who it was serving.

COMPLIANCE

This pilot did not encounter any notable issues related to compliance. Via shared all the data as promised, and Marin Transit staff felt that they were a great partner in terms of data sharing. In addition, Via worked hard early in the pilot to do outreach and marketing and customize the software to meet the unique needs of Marin Transit.

REVENUE AND EXPENSES

According to the Marin Transit Connect Evaluation Report, "the initial budget for the program assumed approximately 11,000 hours of service and a total budget of just over $800,000 annually. Estimated actuals for service are expected to be approximately 8,460 hours at a cost of $646,000. The primary difference in the original budget and the estimated actuals is the weekend service that was never implemented. In FY 2019/20, the project was primarily funded with federal grants, fare revenue, and Marin County Vehicle Registration Fees (Measure B). In 2017, Marin Transit received $700,000 Federal Transit Administration (FTA) Section 5310 grant for the operation of same day accessible service. A portion of these funds were allocated for operations during the first year" (Marin Transit, 2019).

GOAL OUTCOMES

The main goal of this pilot was "to provide on-demand, same day ADA service to older adults and people with disabilities" (C. Lowe, personal communication, March 9, 2020). Additionally, Marin Transit staff hoped to help commuters reach employment sites in Marin County. Rider surveys showed that 67% of riders used the service to travel for work and that riders tended to be higher income. Nearly half of riders indicated that their household income was over $100,000 (Marin Transit, 2019). Marin Transit partnered with two local employers, the County of Marin and Kaiser Permanente to provide their employees sponsored rides. This sponsorship led to 33% of riders surveyed responding that they were employees associated with the County of Marin and 14% responding that they were associated with Kaiser.

While Marin Transit staff considered the pilot to be an overall success, additional changes may be needed to fully meet their desired outcomes, especially in terms of equity and accessibility. Marin Transit Connect served the first- and last-mile commuter much more than Marin Access riders, with Marin Access WAV riders making up only 8% of total ridership in the first year of the pilot. The extensions after the initial pilot allowed Marin Transit to change their fare structure and expand the service area in hopes of better serving seniors and ADA riders. In addition, Marin Transit has tried to reach out to the medical community to try to allow patients to use the service for medical appointments.

HAPPINESS/SATISFACTION OUTCOMES

Marin Transit received positive feedback from riders about the quality of the service. Rider surveys indicated that 90% of riders were somewhat satisfied, satisfied, or very satisfied. In addition, nearly 90% of rated rides are rated as 5/5 (Marin Transit, 2019).

EQUITABLE OUTCOMES

While this service was intended to primarily serve as an accessible on-demand option to better meet the needs of seniors and people with disabilities, the service was primarily used by everyday commuters. Marin Transit also provided a call-in option for users without access to smartphones, but 97% of riders surveyed indicated that they booked their rides using the app. This illustrates low utilization of the call-in option and while the call-in option is helpful for users without access to smartphones, the technology was designed to be used by them.

Marin Transit implemented a cash option moving into FY19-20 shortly after publishing their evaluation report to increase accessibility for unbanked riders. According to staff, nearly 50% of transit riders in Marin County use cash payments, so this is an important option for achieving equity outcomes. However, even with the cash payment option, riders still need to create an account to use the service.

New transportation technology such as microtransit services are "great if you have a smartphone" (C. Lowe, personal communication, March 9, 2020), but adjusting the service to make it more accessible by offering call-in and cash payment options makes it more challenging to operate and creates additional barriers for users.

HEALTH AND SAFETY OUTCOMES

In terms of health and safety, many older adults and some Marin Access riders used the service to reach Kaiser facilities or other county health locations during the pilot and there are further opportunities to meet this need. In addition, the drivers operating the service through Whistlestop were all trained and vetted, creating a perception of safety for riders. Otherwise, this pilot did not specifically focus on health and safety outcomes.

ENVIRONMENTAL OUTCOMES

The main environmental outcome that came out of this pilot was the number of shared rides that occurred during the pilot. During peak hours corresponding with commute times there were an average of 4-5 passengers per hour. In addition, the State of California has an electric vehicle mandate for transit fleets in the state and Marin Transit is looking into the feasibility of procuring electric vans or shuttles to continue providing this type of service.

ECONOMIC OUTCOMES

Marin Transit received 5310 funds (Federal Transit Administration's (FTA's) Enhanced Mobility of Seniors & People with Disabilities program) to implement the project for three years. These funds were supplemented with local funds from Marin County vehicle registration fees to pay for some operational expenses. Although the pilot began with a no-fee agreement with Via, Marin Transit spent approximately $25,000 per pilot extension for the software.

The Marin Transit Connect Evaluation Report showed that the subsidy per rider was very high as seen in Tables 4-11 and 4-12. Marin Transit staff would like to see the subsidy number come down to $15 per passenger trip, but more changes may

be needed to achieve this. In addition, Marin Transit staff acknowledged that many trips are being taken by high-income riders and questioned whether it is equitable to be subsidizing trips of high-income riders.

In addition, Marin Transit Connect is operated by Marin Transit's paratransit operator Whistlestop, a local nonprofit that has a positive community reputation. All their drivers are trained and vetted and paid hourly regardless of ridership, a significantly different model than what is commonly used for TNCs. Having a reputable operator has also helped older riders feel more comfortable trying the new service due to a higher sense of comfort and safety.

POLICY/INFRASTRUCTURE OUTCOMES

Microtransit has the potential to serve communities who need a higher level of service than what can be offered by fixed-route transit. It can also provide an additional affordable public transportation option if agencies are willing to subsidize it. To make this type of service sustainable long-term, it is likely that those who can pay more will need to so rides for seniors, ADA riders, and other vulnerable populations can continue to be heavily subsidized.

This pilot specifically impacted Marin Transit's fare policies by allowing staff to rethink their standard fares when planning the new service. It is also providing an opportunity to reconsider the current Marin Access program (serving older adults and ADA riders) and how to better serve Access riders.

NEXT STEPS

The original yearlong pilot was extended two additional times with six-month pilot extensions, extending the pilot period through June 2020. As of March 2020, Marin Transit was in an open procurement process for mobility-on-demand software services. Staff shared that they had a very high level of response and that it may have been an agency record in terms of bidders. They are hoping to implement the next phase of service in July 2020 with a seamless transition from the end of the pilot to the beginning of the next phase. Whistlestop will remain the operator for the next phase of service.

TABLE 4-11: MARIN TRANSIT CONNECT ANNUAL PERFORMANCE ESTIMATE

Connect Market	District Typology Market	Passenger Allocations	Driver Hours Allocations	Subsidy per Passenger	Productivity
Senior/ADA Trips	Demand Response	8%	11%	$70.18	1.10 pax/hr
Employer Sponsored: Kaiser	Partnership	14%	14%	$35.49	2.02 pax/hr
Employer Sponsored: County	Partnership	33%	27%	$39.87	1.81 pax/hr
Regular/Other	Local Connector	45%	52%	$61.28	1.26 pax/hr
Total				**$52.70**	**1.47 pax/hr**

Source: Marin Transit Connect Evaluation Report. Design by Urbanism Next.

TABLE 4-12: JANUARY 2019 – MAY 2019 PERFORMANCE (SOFTWARE STABILIZATION PERIOD)

Connect Market	District Typology Market	Passenger Allocations	Driver Hours Allocations	Subsidy per Passenger	Productivity
Senior/ADA Trips	Demand Response	8%	11%	$54.13	1.62 pax/hr
Employer Sponsored: Kaiser	Partnership	13%	10%	$27.59	2.88 pax/hr
Employer Sponsored: County	Partnership	35%	32%	$33.03	2.44pax/hr
Regular/Other	Local Connector	44%	47%	$42.46	2.06 pax/hr
Total				**$39.48**	**2.22 pax/hr**

Source: Marin Transit Connect Evaluation Report. Design by Urbanism Next.

PASSENGER AVS

ELA AUTONOMOUS SHUTTLE PILOT: CALGARY, ALBERTA, 2018

In 2017, the City of Calgary completed work on the "Future of Transportation in Calgary," examining societal trends and transformative transportation technologies at the direction of Calgary City Council (City of Calgary Transportation Department, 2017). The report covered topics including autonomy, electrification, and shared mobility. During the work that was done on this report, some city staff and City Council members had an opportunity to ride in a semi-autonomous Tesla. They wanted to do some demonstrations to help senior officials and the public better understand autonomous vehicle technology. They also communicated with government staff in Singapore and Las Vegas, Nevada who had experience running a low-speed autonomous shuttle pilot. They were able to ask questions about their experiences with running a pilot, to understand the challenges associated with it, and get a sense about whether it was worth doing. The feedback they received was largely positive, so they added a recommendation in the final report to pilot low-speed autonomous shuttles. The recommendations were unanimously passed by City Council in 2017, and the City of Calgary received funding from Transport Canada to pursue an autonomous shuttle pilot. Up until this point, there had been no public deployment of an autonomous shuttle in Canada.

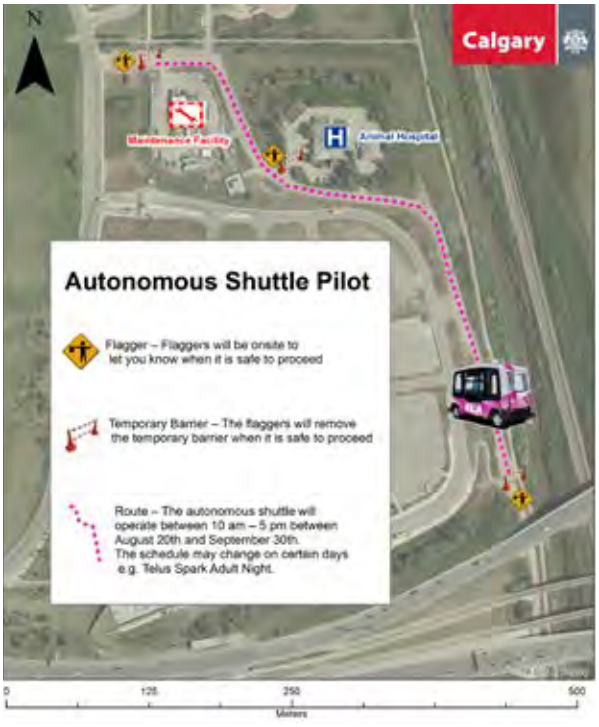
Canadian service operator Pacific Western Transportation (PWT) approached the City of Calgary and expressed their interest in being involved and offered to help sponsor the project. PWT is a "people transportation company" and they "believe that they are at the forefront of transportation solutions" (G. Moreno, personal communication, December 3, 2019). They wanted to find a route that would solve a last-mile problem. Regulations in the Province of Alberta did not, at the time, allow for autonomous testing on public roads, so the City of Calgary selected a city-owned service road that was not open to the general public. The route connected the Calgary Zoo with the TELUS Spark Science Center, as shown in Figure 4-5.

TABLE 4-13: ELA AUTONOMOUS SHUTTLE PILOT PROJECT SUMMARY, CITY OF CALGARY AND PACIFIC WESTERN TRANSPORTATION, 2018

Pilot	ELA Autonomous Shuttle Pilot
Location	Calgary, Alberta
Service Area	About 1 km fixed route between Calgary Zoo and TELUS Spark Science Center
Population	1.5 million[5]
Duration	22 days
Dates	September 8-30, 2018
Sponsoring Organization	Pacific Western Transportation
Technology Companies	EasyMile
Number of Permitted Vehicles	1
Number of Passengers	About 4,500 over the duration of the pilot
Hours of Operation	Shuttle ran between 10AM-4PM
Trip Length	Approximately 1 km

Source: Calgary Autonomous Shuttle ACATS Final Report (2019)

FIGURE 4-5: ELA AUTONOMOUS SHUTTLE PILOT ROUTE MAP



Source: Calgary Autonomous Shuttle ACATS Final Report (2019)

[5] *Source: Statistics Canada 2019 from City of Calgary Economic Development*

OPERATING REGULATIONS

PWT took on the responsibility of procuring the shuttle. They approached both Navya and EasyMile but ultimately chose EasyMile "PWT choose Easy Mile because of the number of completed deployments, their safety record, and ultimately because of AV availability at the time of the project" (G. Moreno). Transport Canada helped to import the shuttle. They named it ELA (Electric, Low-Speed, Autonomous) so that it would sound "friendly."

Acquiring the shuttle and bringing it to Canada required clearing several hurdles. There was a significant learning curve involved with the negotiations, particularly around determining liability. Defining liabilities was a "big experiment" and required lots of exemptions from the Province. There was also the expectation at the beginning of the project that the vehicle would leave Canada once the pilot was complete, but Gerardo Moreno, Project Manager with PWT reported that the Province and Transport Canada grew more confident over time, the PWT was able to extend the permit, and deploy the AV in other pilot projects. One of the operating requirements was that an operator always be on board. Andrew Sedor with the City of Calgary said they had to jump through some hoops and present quite a lot of documentation in order to help explain the technology. In his words, "the first time you do anything it is going to be difficult" (A. Sedor, personal communication, December 2, 2019).

Andrew cited this as a good example of a private-public partnership. PWT approached the City after the recommendations were adopted by Council and the City put together a sponsorship agreement with PWT. He said that the agreement with PWT and their willingness to take on the procurement and operations of the vehicle is what made the project possible, particularly because they had very limited funding available.

DATA REQUIREMENTS

PWT operated the shuttle and was responsible for tracking ridership. There was a data sharing agreement between the City of Calgary and PWT. There were organic partnerships that came together with the University of Calgary. There were three research activities associated with the pilot, including a civil engineering study on user behavior and rider demographics (City of Calgary Transportation Department, 2019). As the project continued there were several requests for data from academic institutions, but the data requests moved slowly and by the time they signed a nondisclosure agreement with EasyMile, the pilot in Calgary had already concluded. It was noted that the University of Calgary survey of riders was likely too long since it took approximately 10 minutes to complete.

There was some speculation that if the universities had been able to get involved sooner, they may have been able to negotiate their own data sharing agreements with EasyMile or develop an MOU. As it happened, the University communicated with the City of Calgary, who were in communication with PWT, who were communicating with EasyMile. Andrew speculated that there may have some information lost in translation as a result.

REVENUES AND EXPENSES

Transport Canada's Program to Advance Connectivity and Automation in the Transportation System (ACATS) provided $50,000 CAD to the City of Calgary for the pilot, but PWT was responsible for the majority of the costs. Andrew said that some of the $50,000 CAD went to PWT to help cover costs, but the rest was used for site improvements, which they estimated as costing approximately $20,000 CAD. Site improvements included pouring asphalt pads at both ends of the route to provide a waiting area and installing signage for the vehicle to use for localization (City of Calgary Transportation Department, 2019). The City of Calgary also hired flaggers as part of the project, which was estimated to be the biggest cost they had. This was a requirement by the Province.

Other organizations were involved but their contributions were in-kind. Andrew likened it to a NASCAR vehicle with all the organizational sponsors on the wrap of the vehicle. The City of Calgary estimated that they received approximately $52,000 CAD of earned media over the course of the pilot. No fees were collected. The shuttle was free to ride.

COMPLIANCE AND ENFORCEMENT

In this pilot, compliance had more to do with the City of Calgary and PWT complying with the regulations of the Province than of a company needing to comply with regulations set out by the city, as was the case in other pilots Urbanism Next looked at for this study. Among the requirements were that the shuttle operate on a private road, that a safety operator remain on board at all times, and that they hire flaggers to help manage traffic. (While the service road is not publicly accessible, it is used by zoo staff.) The City of Calgary and PWT complied with these regulations. Andrew said that traffic flaggers were out on the route every day the pilot was running, as shown in Figure 4-5, and he also had volunteers out on the route talking to people about their experiences.

GOAL OUTCOMES

The City of Calgary outlined three goals for the autonomous shuttle pilot project:

- Deploy an automated vehicle to understand how it operates in Calgary;
- Increase the public awareness of the technology and gather public feedback that can be used for future planning efforts; and
- Help inform and develop highly qualified public sector officials, industry, and academia in the area of connected-autonomous vehicles (CAVs).

They feel that they achieved these goals and overall, they consider the project to have gone quite smoothly (City of Calgary Transportation Department, 2019). Public perception was largely positive, in part because very little public funding was required.

PWT's goal with the project was to introduce autonomous technology as well as test the AVs operational feasibility in a Canadian environment. They wanted to better understand how open the government and the public is to autonomous technology. They also wanted to better understand flexibility and elasticity in government regulations to respond to a changing transportation landscape.

Given the state of the technology and the limited nature of these deployments, some of the other goals discussed in other case studies as part of this research do not apply here.

FIGURE 4-6: ELA SHUTTLE, 2019

Source: Calgary Autonomous Shuttle ACATS Final Report (2019)

EQUITABLE OUTCOMES

The city did not have equity-specific goals, but they did ensure general accessibility of the vehicle. There were no costs to ride, so affordability was not a barrier. They poured asphalt pads on the gravel roadway at the both ends of the route to improve wheelchair access. When there was a malfunction with the wheelchair ramp in the shuttle PWT brought their own temporary ramp in order to continue to ensure accessibility for all users. ACATS also provided some funding to the Canadian Institute for the Blind so that they could participate in the demonstration and provide feedback.

ENVIRONMENTAL OUTCOMES

The shuttle is fully electric but there were no specific environmental outcomes studied. The route provided a last-mile connection between two major attractions, so it is possible that the presence of the shuttle may have resulted in a reduction in the number of vehicle trips, but that was not explicitly measured. It may also have been offset by the fact that the shuttle itself was a draw. The representative from PWT said they had some people who came to ride it multiple times. Also, 72% of survey respondents reported that they came specifically to ride in the shuttle (City of Calgary Transportation Department, 2019).

ECONOMIC OUTCOMES

In terms of job opportunities, they hired temporary flaggers to help during the pilot project, but no permanent hires were made.

There may be some positive economic impacts, although they are difficult to quantify, by the positive press coverage that the City received and that it is now seen as an innovator. There was also the positive externality that there were additional visitors to the local attractions during the pilot.

IMPLICATIONS FOR POLICY, INFRASTRUCTURE, OR OTHER ISSUES

Both Andrew and Gerardo said that they considered the pilot a success, in part because they learned a lot about the current limitations of the technology. They also had a positive experience with a partnering, and they were able to work with the Province to ensure a successful pilot.

Implications for policy are that the Province increasingly loosened restrictions and the project helped pave the way for future autonomous pilots to take place. They also learned about the accuracy of Novatel, a high-precision GPS system made by a local company, Hexagon. The technology enabled the vehicle to travel within 5mm precision of its defined route. In the future, this technology could enable vehicles to travel in smaller lanes, which could have implications for infrastructure. Andrew mentioned that a potential use case for the technology could be autonomous transit: "Autonomous Uber is still some ways away, but what could exist is that you could apply autonomous technology to a dedicated ROW, (e.g., a train without tracks") because of the high-precision GPS (A. Sedor, personal communication, December 2, 2019). It was beneficial to be able to offer people an opportunity to see the technology, including its limitations, up close. "Some politicians think AVs are silver bullets but getting them use the technology and see the limitations up close" said Andrew.

They also learned about the limitations of the technology. They discovered that dust is an issue for the vehicle. (They were operating on a gravel roadway and dust would impact the functioning of the vehicle, making it halt.) Gerardo thinks that on a clear day in moderate conditions the shuttle can operate fully autonomously (without an operator) but weather is a significant factor in Canada and the technology is not advanced enough yet to handle variable weather.

KEY TAKEAWAYS

There were a lot of benefits to the project from the City of Calgary's point of view. They were able to showcase the work that Hexagon is doing; they had an opportunity to collaborate with several business; and they found the lessons they learned from the University of Calgary user study to be very valuable. Namely, they learned that the majority of those surveyed wanted AVs to operate in a dedicated right-of-way. While it was a "great experience," Andrew said doing something permanent would require a different location than the one they used for the pilot.

Additionally, Andrew noted that the "only way that the technology can begin to make sense financially is if you can eliminate the driver, but the driver serves a lot of purposes." He noted that a possible use case for it in the near-term could be on a closed campus. He also noted that it is difficult to start to understand how AVs might affect cities at this stage. There are only limited learnings you can get about people's behavior and how they might use an AV from taking a ride in a low-speed shuttle, he told interviewers. He said it felt novel at first but then after the initial excitement, he likened the experience to riding an elevator. He also wondered about the future of AVs and how widespread they may become. He referenced the moving sidewalks that were introduced at the World's Fair in Paris in 1900. Moving sidewalks did not disappear after that, but to this day their use cases are limited and very specific.

The representative from PWT has also considered the pilot in Calgary to be successful, in part because it sparked a series of subsequent pilot projects. He did identify a few key challenges in the process as well. For instance, importing the vehicle at the outset proved to be a hurdle since there were no existing regulations in place. They had to jump through a number of hurdles to make it happen. He also said that he thinks cities need to do more in the way of preparation though education and outreach about AVs and what it means to have them on the road. He said, it's "good to take a cautious approach."

WHAT'S NEXT

The City of Calgary does not currently have plans to run additional autonomous shuttle pilots. According to Andrew: "The technology is too premature. We would need a very specific use case for it." They're not sure what they'd be trying to prove with another pilot. Unless they had a problem that needed solving and an autonomous shuttle seemed like it would be an applicable tool, which he deemed unlikely, or if a private company said they thought it would be beneficial to use one on a private lot, they don't see another pilot happening. As for now, they are just watching other jurisdictions for additional learnings.

The City of Calgary instigated the ELA pilot, but there was interest from other Canadian cities. There were visitors from other municipalities while the pilot was running who had an opportunity to learn about it, ride in the vehicle, and gain exposure to the technology. It was a good way to promote the project and establish PWT as a leader in the field in Canada. PWT subsequently worked with Edmonton, Surrey, Vancouver, and Beaumont throughout 2019 for limited deployments. PWT continued to oversee the pilots and operated the shuttle. The longest deployment occurred in Beaumont, a small city outside of Edmonton, where it ran for five months.

ELA may survive as a brand, but the actual vehicle has been returned to EasyMile. PWT is looking at bringing the newest generation vehicle to Canada for any future deployments. They are now also interested in long-term deployments so that they learn about "a real operational experience and get a good grasp of the challenges by running it for longer and thinking about how it might integrate into the transportation system." Gerardo indicated that he does see a future for autonomous shuttles and thinks they could be an ideal way to enhance a transit grid. He also thinks potential use cases may include places that have 24/7 operations, such as airports, hospitals, and other facilities.

BABCOCK RANCH AUTONOMOUS SHUTTLE, BABCOCK RANCH, FL 2018-PRESENT

TABLE 4-14: BABCOCK RANCH AUTONOMOUS SHUTTLE PILOT PROJECT SUMMARY, KITSON & PARTNERS, 2018-PRESENT

Pilot	Babcock Ranch Autonomous Shuttle
Location	Babcock Ranch, FL
Service Area	2-3 fixed routes
Population	Appx. 50,000 (Planned)
Duration	Ongoing
Dates	March 2018 – Present
Sponsoring Organization	Babcock Ranch Transportation Services
Technology Companies	Transdev, EasyMile
No. of Permitted Vehicles	1

Source: Case Study Interview with Tom Hoban (Kitson & Partners)

Babcock Ranch is a master planned community located near Ft. Myers in Southwest Florida, spanning 18,000 acres and two counties. The property was acquired in 2006 by Kitson & Partners with the intention of creating a sustainable town running entirely on solar power.[6] They do not "typically do anything of this size or scale" so when they acquired the land and were thinking about the future, they were "thinking about it differently." Tom Hoban with Kitson & Partners said they wanted to "chart a new path for Babcock—if we are doing a 20-year project that is essentially creating a new town with 50,000 residents, what are all the things that are needed?" (T. Hoban, personal communication, December 10, 2019). This thinking led them down a path of innovation and they decided early on that they would partner with third party experts to help realize their vision. They partnered with Florida Power & Light to install solar and are now billed as the country's "first solar town." That was one "pathway of innovation" but they were also thinking about the future of transportation. They wanted to create a walkable community but were also interested in capitalizing on developments in technology and introduce automated vehicle technology. They established Babcock Ranch Transportation Services (BRTS), which oversees a variety of mobility options.

[6] *https://www.citylab.com/environment/2018/05/can-a-new-solar-city-make-suburbia-green/558392/*

OPERATING REGULATIONS

Kitson & Partners issued an RFP to identify a transportation partner and were intentional from the outset that they wanted to work with a company that was familiar with the AV space. At the time there were "not a whole lot of folks showing up then" since the industry was still so nascent. They selected Trasdev as their transportation provider, and Transdev was responsible for bringing in EasyMile. The National Highway Traffic Safety Administration (NHTSA) issued a permit to Transdev to import the shuttle to the U.S. NHTSA governs some regulations regarding autonomous vehicles and has issued several guiding documents.

Since acquiring the shuttle in March 2018 (see Figure 4-7), it has primarily been used as a sales and marketing tool. Prospective buyers can ride in the shuttle on one of its fixed routes. A technician employed by Transdev but under Babcock Ranch Transportation Services is on board to ensure safe operations.

DATA REQUIREMENTS

Transdev did negotiate a data sharing agreement with EasyMile and are getting information about total miles driven, number of passengers, and number of safety stops. Most of the data analysis being done by Transdev. While Kitson & Partners has not been working directly with EasyMile, the relationship was described as "symbiotic" and that there is "lots of iterating happening." They started with the first generation of EasyMile shuttles but are now using a second-generation model. He stated that the value of the project "is in the learning."

REVENUES AND EXPENSES

Exact details on the budget are not available, but Babcock Ranch Transportation Services underwrites the shuttle and is responsible for the operation costs. There is no fee to ride.

FIGURE 4-7. BABCOCK RANCH SHUTTLE

Source: Babcock Ranch Telegraph

COMPLIANCE

The rules governing the operations of AVs are still in flux. The U.S. DOT issued its most recent document regarding AVs—Ensuring American Leadership in Automated Vehicle Technologies (Automated Vehicles 4.0)—in January 2020. The vehicles are capable of traveling up to 35mph but the max they are currently operating on Babcock Ranch is 13mph. There is still some question about compliance and rules, though, that has led to some confusion. BRTS did run a short pilot using the shuttle to transport a handful of children to school, but NHTSA ordered the pilot to be discontinued one week before its conclusion, stating that the permit did not cover that use case (Henson, 2018; Transdev, 2018).

HEALTH AND SAFETY RELATED OUTCOMES

While there are not explicitly stated goals, Tom said that the "whole concept of doing this was borne out of an interest in safety and wanting to save lives." They see AVs as a promising technological innovation in this regard. The use cases are currently far too limited to be able to assess the comparative safety of the autonomous shuttle in operation on Babcock Ranch to other vehicles.

ENVIRONMENTAL OUTCOMES

Sustainability is an underlying goal of the entire Babcock Ranch development, so environmental outcomes are of concern. The shuttle is fully electric and is being charged entirely on solar energy. They do have a big picture vision that "they'll have a community where they have households who go from two cars to one over time," potentially moving to be car-free over the long-term if the transportation services they provide fill the needs of the community (T. Hoban, personal communication, December 10, 2019). They hope that AVs will be part of the long-term transportation services they offer.

ECONOMIC OUTCOMES

As developers, they want to provide higher quality services at a lower cost. They see AVs as part of the solution. This is a higher quality option with a zero-carbon footprint (operationally). Tom said that "innovations in technology make their way into the real estate space and in order to be effective, it has to address consumer-based demand." You need a "compelling story for the customer." As developers they are also responding to "a deterioration of desire of younger generations to own/operate a vehicle."

IMPLICATIONS FOR POLICY, INFRASTRUCTURE, OR OTHER ISSUES

They have not made any infrastructure changes as a result of operating the shuttle. However, there are certain things they have been made more aware of since running the shuttle. It is highly sensitive to anything that impacts visibility, so there are "challenges when it's raining, surprises such as construction vehicles on the road or branches that have fallen" according to Tom. Because of the way the vehicles operate using markers to identify its place along a route, they have been mindful not to have large hedges or blockages of signs that would impact the functionality of the vehicle. Streets in the development are otherwise "conventional" and they are not doing anything different to accommodate for AVs.

KEY TAKEAWAYS

Reactions from their residents and visitors has been generally favorable. Kitson & Partners had concerns about people's willingness to get in the vehicle but people have been open to it. Tom said there has been "a general curiosity and excitement, but also lots of misinformation and misunderstanding" about the technology. As of now, its primary value is being able to "educate the marketplace that this is actually happening."

It's been a positive experience for them, overall, and has been good from a PR standpoint. It's helping them with their message that Babcock Ranch and Kitson & Partners is innovative and open to the future. A continuing challenge, however, is understanding which entities can make which decisions regarding vehicle operations. There's still a lack of clarity on what states and local jurisdictions have control over compared to the federal government. A further complicating factor is how the vehicle can operate on private property compared to publicly-owned right-of-ways. In the school bus pilot, for instance, they thought they were operating within the bounds of what had been approved by the federal government but were informed they needed to cease operations.

WHAT'S NEXT

They are working on developing a mobile application that would function as virtual concierge, which would allow residents to be able to hail an on-demand ride in the shuttle. They are planning to start the pilot with 50-60 homes but want to expand beyond the fixed route tour, which is primarily a sales and marketing tool, to more of a long-term transportation operation.

GOODS DELIVERY

REDWOOD CITY PERSONAL DELIVERY DEVICE (PDD) PILOT: REDWOOD CITY, CA

In 2016, Starship Technologies, the creator of an autonomous delivery robot, approached the City of Redwood City, California about launching a pilot program to test their Personal Delivery Device (PDD). They selected Redwood City as a potential launch location due to "the area's acceptance of new technologies, [a] bustling downtown, and the high rate of use of delivery services such as Munchery and DoorDash" (Redwood City Staff, 2016). Starship Technologies' PDD can deliver groceries, prepared meals, and other items and has a load capacity of approximately three grocery bags. In November 2016, city staff recommended that the council adopt a resolution approving the creation of a pilot program, which it did. City staff subsequently drafted the conditions for approval and issued a 9-month permit to Starship Technologies. Following a review of the program at the conclusion of the pilot in November 2017, city staff recommended that the program continue, and Starship Technologies received a 12-month operating permit. During the second phase of the program Starship Technologies discussed the possibility of partnering with the Redwood City Library to deliver library materials, but it did not come to fruition.

OPERATING REGULATIONS

The PDD pilot program happened organically since Starship Technologies approached the City with a request to operate, and the City responded accordingly. Between the first and second phase of the program a second delivery robot operator expressed interest in participating but ultimately did not apply for a permit. To date, Starship Technologies is the only company to have been issued a permit.

City staff developed the "Conditions of Approval for Personal Delivery Device Use Permit," which includes sections on general operations, indemnity, and insurance. Some of the operating regulations include (Redwood City Staff, 2017a):

TABLE 4-15: PERSONAL DELIVERY DEVICE PILOT PROJECT SUMMARY, CITY OF REDWOOD CITY, 2016-2018

Pilot	Personal Delivery Device
Location	Redwood City, California
Service Area	City of Redwood City
Population	86,380
Duration	21 months over 2 phases
Dates	Dec 2016 – Aug 2017; Dec 2017 – Dec 2018
Sponsoring Organization	City of Redwood City
Technology Companies	Starship Technologies
Number of Permitted Vehicles	12
Average Number of Trips per Day	30-40
Trip Length	5-mile radius

Source: Nov. 2016 and Nov. 2017 Redwood City Staff Reports to the Honorable Mayor and City Council from the City Manager

- The device can only operate on sidewalks and crosswalks;
- It cannot operate above a max speed of 10mph;
- It cannot weigh more than 80lbs, excluding cargo;
- It cannot operate on any sidewalk or crosswalk without a PDD operator actively controlling or monitoring the device; and
- It must be operated in a safe and non-hazardous manner so as not to endanger pedestrians, bicyclists, and other lawful users of the public space or property.

The City updated the conditions of approval between the first and second phase of the pilot. The following amendments were made(Redwood City Staff, 2017b):

- They added a requirement that an identifying plate or marker with business and contact information be added to each device;
- They established more defined operating restrictions regarding interactions with pedestrians and other street users;
- They added a requirement that the operator report any incidents or complaints to the City within 24 hours; and
- They required additional insurance provisions relating to the protection of property.

[7] *Source: State of California, Department of Finance, E-1 Population Estimates for Cities, Counties and the State with Annual Percent Change -- January 1, 2017 and 2018. Sacramento, California, May 2018. From Redwood City website.*

Because Redwood City served as the primary U.S. launch location for Starship Technologies, other cities have modeled their permits on Redwood City's conditions of approval. A representative from the City of Redwood City noted that the City of Concord, also in the Bay Area, has established a similar PDD program.

DATA REQUIREMENTS

There are no provisions about data sharing included in the conditions of approval, and city staff said that only minimal data sharing was negotiated with Starship Technologies. They were told that much of information was considered proprietary, including the total of number of deliveries. The City requested more information about performance data in order to better understand the extent to which the devices may be helping to reduce congestion and contributing to a reduction of greenhouse gas (GHG) emissions. Citing concerns about competition, Starship Technologies did not want to share additional performance data. City staff did say that the robots have travelled approximately 12,000 miles in the city. This may include miles that the robot completed during a mapping phase before delivery service was launched.

REVENUES AND EXPENSES

City staff did not charge a permit fee for the first phase of the pilot program. They did include a $3,000 fee for the second phase to pay for staff time spent on program implementation. No information is currently available about the revenue generated by Starship Technologies throughout the course of the program. However, Starship Technologies is no longer operating its devices on city streets and is now operating primarily on university campuses. City staff speculated that this shift in direction may have been due to low revenue generation.

COMPLIANCE AND ENFORCEMENT

During the first phase of the pilot, the City required that Starship Technologies "provide staffing sufficient to respond quickly to inquiries from the public and shall respond to such inquires within 48 hours" (Redwood City Staff, 2017a). In the event of a technological failure, they were also required to remove a device within 12 hours. The City reported that they received two complaints during the first phase of the program (Redwood City Staff, 2017b). They added the provisions about reporting any incidents within 24 hours to the conditions of approval before they issued the second permit. City staff said that they did not receive any complaints or incident reports during the second phase and did not have issues with enforcement.

GOAL OUTCOMES

Though they did not establish stated goals for the PDD program, City staff noted that the devices may have positive impacts on traffic and may help local restaurants meet increasing demand for meal delivery. In their 2016 report recommending adoption of the program, they noted the following:

> "The use of PDDs for delivery will have the potential to reduce traffic in Redwood City and allow for some restaurants and businesses to serve a greater number of customers...The use of the PDD will eliminate some of the vehicles on the road, as the PDD will be able to use city sidewalks and not impede traffic. In addition, staff has heard from some restaurants that they currently have to turn away some delivery orders because there are no delivery drivers available due to the high volume of deliveries being requested in Redwood City. This is particularly true in the later evening hours. The PDDs will help to fill some of this demand" (Redwood City Staff, 2016).

In their report recommending that the program continue into a second phase, city staff noted that their recommendation was based on an interest in continuing to provide "a product delivery option for local businesses that does not add to road congestion"(Redwood City Staff, 2017b). Due to the limited lack of data available, however, it is not possible to quantify the impacts.

When asked about any joyfulness or happiness-related outcomes, city staff noted that people would comment on how they though the robots were "cute." They suggested the robots may have brought some joy in that way. They also noted that they thought there may have been a sense of pride in the City being recognized as an innovator.

EQUITY-RELATED OUTCOMES

There were no specific equity-related goals or outcomes. It's possible that the delivery of groceries and prepared meals may have improved access to people with limited mobility, but it cannot be confirmed. The proposed partnership with the Redwood City Library to delivery library materials may have also helped increase access, but that never came to fruition. The program would have delivered materials within a 3-mile radius of the Downtown branch to people with limited mobility. The City of Redwood City did receive a grant from the state library program to help fund the initiative, but the program fell through due to questions about indemnity.

ENVIRONMENTAL OUTCOMES

There is the possibility that the program helped reduce congestion and contributed to a decrease in GHG emissions, but it cannot be confirmed.

ECONOMIC OUTCOMES

The pilot program may have had a positive impact on local businesses and restaurants who were able to expand their customer base and respond to increasing demand for delivery. City staff said that they encouraged the company to have a local office, but the company has reportedly not maintained a building lease.

IMPLICATIONS FOR POLICY, INFRASTRUCTURE, OR OTHER ISSUES

As of now, the City does not plan to make any changes to either policy or infrastructure as a result of the pilot program. They already have information about where they do and do not have curb cuts from a different program. Had they not already had that information, the pilot with Starship Technologies may have helped them identify those locations.

KEY TAKEAWAYS

Overall, city staff said that they are happy with how the pilot program was implemented. Because they conducted the pilot in two phases, they were able to make changes to the operating permit along the way that improved the program. They did state that they would have liked to receive better data.

City staff said that the City Council enjoyed it and the City received national press coverage as a result of running the pilot. Staff said that it was a good way for the City to be seen as an innovator and open to working with technology companies. They cited the press coverage as the biggest benefit to come out of the project.

In terms of challenges, they noted liability as being a significant hurdle and that the development of the legal language was difficult. The city attorney wanted to err on the side of caution and be conservative with the language. They also had to determine whether it would work within the confines of code or if any amendments would need to be made in order to allow the devices to operate. From the company's perspective, city staff think that the benefit to them was getting to learn about people responded and reacted to the PDDs. They were also able to test their technology on city streets.

WHAT'S NEXT

The City is open to the possibility of issuing additional operating permits, but no company is currently testing their devices on city streets. Starship Technologies is currently testing its devices on private campuses in the area.

URBAN DELIVERY RESEARCH PARTNERSHIP WITH FORD: MIAMI-DADE COUNTY, FL

In August 2017, Ford Motor Co. announced that it would be collaborating with Domino's Pizza in a research partnership to explore the role that autonomous vehicles can play in delivery (Ford Media Center, 2017). As part of the project, select customers in Ann Arbor, Michigan received their delivery from a Ford Fusion Hybrid Autonomous Research Vehicle. The vehicle was manually driven by a safety engineer, so it was not operating autonomously. However, customers were notified when their delivery arrived and received a code to enter in order to retrieve their delivery, simulating the experiences of an automated delivery (Ford Media Center, 2017). This allowed Ford and Domino's to gain an understanding of the customer experience.

In February 2018, Ford and Miami-Dade County announced Miami would be Ford Motor Company's first test city in the world for its autonomous vehicle testing. Miami and Ford decided to partner after a series of positive conversations between representatives from Ford and Miami-Dade County leadership (C. Cruz-Casas, personal communication, March 3, 2020). Ford's work in Miami was divided into two concurrent initiatives. The first was the technical phase during which Ford developed the self-driving technology and engaged in street mapping. This work began in February 2018 and continues to this day. Ford actually began testing its business model through a series of pilot programs delivery with Domino's and later expanded to Postmates, Walmart, and local businesses to gauge customer experience and validate business models. As in Ann Arbor, these vehicles were manually driven but simulated autonomous delivery conditions for research purposes. The research partnership between Ford and Miami-Dade County resulted in valuable lessons learned related to curb management, intersection complexity, and business and community feedback.

TABLE 4-16: URBAN DELIVERY RESEARCH PILOT PROJECT SUMMARY, MIAMI-DADE COUNTY AND FORD, 2018

Pilot	Urban Delivery Research Partnership
Location	Miami-Dade County, FL
Service Area	Cities of Miami and Miami Beach
Population	2.7 million[8]
Duration	About 1 year
Date	2018
Sponsoring Organization	Ford and Miami-Dade County
Additional Companies	Domino's, Postmates, Walmart, Local Businesses
Number of Permitted Vehicles	Unknown
Average Number of Trips per Day	Unknown
Trip Length	Unknown

Source: Miami-Dade County News Release, Feb. 27, 2018.

FIGURE 4-8: AV PROTOTYPE VEHICLE IN MIAMI-DADE COUNTY

Source: Ford

[8]*Source: Population Estimates as of July 1, 2019. QuickFacts for Miami-Dade County, U.S. Census Bureau.*

OPERATING REGULATIONS

The research partnership developed organically between Ford and Miami-Dade County, but it remained informal. Representatives from Miami-Dade were interested in working with Ford, and Ford appreciated Miami-Dade's approach to mobility, as well as their willingness to engage with the private sector (C. Cruz-Casas, personal communication, March 3, 2020). Miami-Dade helped develop use cases during the pilot, but no formal agreement, permit, or contract was issued. Ford did not require any additional provisions from Miami-Dade County since autonomous vehicle testing is permitted by the State of Florida.

Per state requirements, autonomous vehicles must have a safety driver. A second person sat in the passenger seat to monitor what the vehicle was "seeing" (C. Cruz-Casas, personal communication, March 3, 2020). As it relates to the Goods Delivery pilot programs, those vehicles, used for business validation and user experience research, were always manually driven during the course of the research. The front of vehicle was deliberately darkened in order to make it more difficult to see the drive to better simulate the experience of interacting with AV for people outside the vehicle.

DATA REQUIREMENTS

Because there was no formal agreement or contract, Miami-Dade did not establish any data requirements. Ford was in regular communication with Miami-Dade staff, however, and Carlos Cruz-Casas with the Department of Transportation and Public Works said that he felt was "happy with the level of information-sharing" (C. Cruz-Casas, personal communication, March 3, 2020). He noted that building a strong relationship with Ford would better position them to engage in more robust datasharing down the line.

REVENUES AND EXPENSES

There were no fees associated with this pilot. Customers paid for the goods they ordered from the entity with which they placed the order (e.g., Domino's, Postmates, etc.).

COMPLIANCE AND ENFORCEMENT

There were no compliance or enforcement issues due to the nature of the pilot. No permit was issued and Miami-Dade County informally partnered with Ford on this research.

GOAL OUTCOMES

Ford's goals for the Goods Delivery pilot programs focused on user experience research, business model validation and vehicle learnings. Ford's goals related to autonomous vehicle operation included building detailed maps of Miami-Dade County streets while safely developing the self-driving technology itself.

Carlos said that Miami-Dade had several goals. For one thing, they wanted to understand what the potential business case might be for autonomous delivery vehicles. They were also interested in having autonomous vehicle manufacturers test their equipment locally so that Miami-Dade could learn more about the safety of the vehicles, as well as how the public interacted with them. They wanted to know how the vehicle would perform in the right-of-way. Carlos also said they "were thrilled to see pizza delivery as a first step to see how people would interact with the car" and the tablet on the car they used to enter their delivery code. Ultimately, Miami-Dade was most interested in information-gathering, and according to staff, they achieved this goal.

EQUITY-RELATED OUTCOMES

Carlos confirmed that providing equitable access to self-driving services for both the movement of passengers and the movement of goods is a priority for both Miami-Dade and Ford. In the context of food delivery, it's possible that the delivery of groceries and prepared meals may have improved access to people with limited mobility. Carlos said that these types of learnings and community input are a key part of Ford's efforts in Miami-Dade County.

HEALTH AND SAFETY RELATED OUTCOMES

While there were no specific health- or safety-related goals, Carlos did say that there is some

anecdotal evidence that suggests that other road users felt safer near the research vehicle than other vehicles. In one instance, a cyclist tapped on the window of the research vehicle and spoke with the driver. The cyclist said that they felt the car was "steadier" and the cyclist felt more comfortable riding near it than other vehicles. Miami-Dade is hoping that autonomous delivery vehicles contribute to increased safety in the future.

ENVIRONMENTAL OUTCOMES

There were no specific goals or outcomes related to the environment. Carlos mentioned that the autonomous research vehicle requires a lot of power to operate because of all the technology involved. He speculated that it may be too much for an electric powertrain to manage at this stage.

ECONOMIC OUTCOMES

While there were not any specific economic goals or outcomes to the pizza delivery program, Carlos suggested that as this technology develops it may benefit small businesses. They may be able to expand their customer base through delivery services. Ford ran a seperate program with some local florists and dry-cleaning businesses, and it is possible that businesses like this may not need to maintain their delivery vans in the future. This would be an opportunity to reduce expenses and just use a delivery service as needed. All of this remains speculative for the time being.

IMPLICATIONS FOR POLICY, INFRASTRUCTURE, OR OTHER ISSUES

Miami-Dade learned a lot about curb management from this pilot. They found that AVs require loading space on every block in order to have a designated zone, which contributes to an increasing demand for curb spaces. Also, due to current vehicle functionality and efficiency, it is preferrable for AVs to have enough space to be able to pull up and then drive away without reversing. This means that designated loading zones may need to be bigger than other zones and may more closely resemble the amount of space required for a bus. While Carlos did not say that they are making any immediate changes to infrastructure, the learnings were very important and will help guide future policy.

KEY TAKEAWAYS

Even though there was no formal partnership agreement between Miami-Dade County and Ford, Miami-Dade staff suggest that it was very successful. They wanted to have an opportunity to test the technology, to learn more about how it interacted with infrastructure, to gauge public opinion, and to identify potential use cases beyond passenger mobility. They did learn a lot through the pilot, and they identified some interesting questions to consider moving forward. For instance, what are the implications associated with restaurant staff or other businesses to take goods out to autonomous delivery vehicles? Will they need designated loading spaces for those businesses? How might it impact curbside management and street design? In terms of the technological development, what provisions need to be made to handle different types of business needs? By partnering with a local florist, they discovered that the vehicle needs to be able to keep flower arrangements very steady. These are all valuable learnings in the testing and development of autonomous delivery.

Miami-Dade staff spoke positively about working with Ford and appreciated the information that was shared throughout the course of the pilot. However, Carlos did mention that it may have been useful to establish a more formal reporting system rather than the ad hoc approach that was taken. In the future, he hopes that they will be able to negotiate for additional data sharing, but he feels that the relationship development was an important first step.

WHAT'S NEXT

Miami-Dade continues its partnership with Ford on several fronts. Ford's work to test the self-driving technology and map the streets of Miami-Dade County has continued since February 2018. Ford has continued its research with a variety of on-the-ground work to listen to locals through market research, interviews, focus groups and other types of discovery work, with the goal of understanding the community's needs, Carlos said. Ford plans to launch additional pilot programs and execute community engagement and education programs in anticipation of their launch of commercial services in Miami-Dade in 2021.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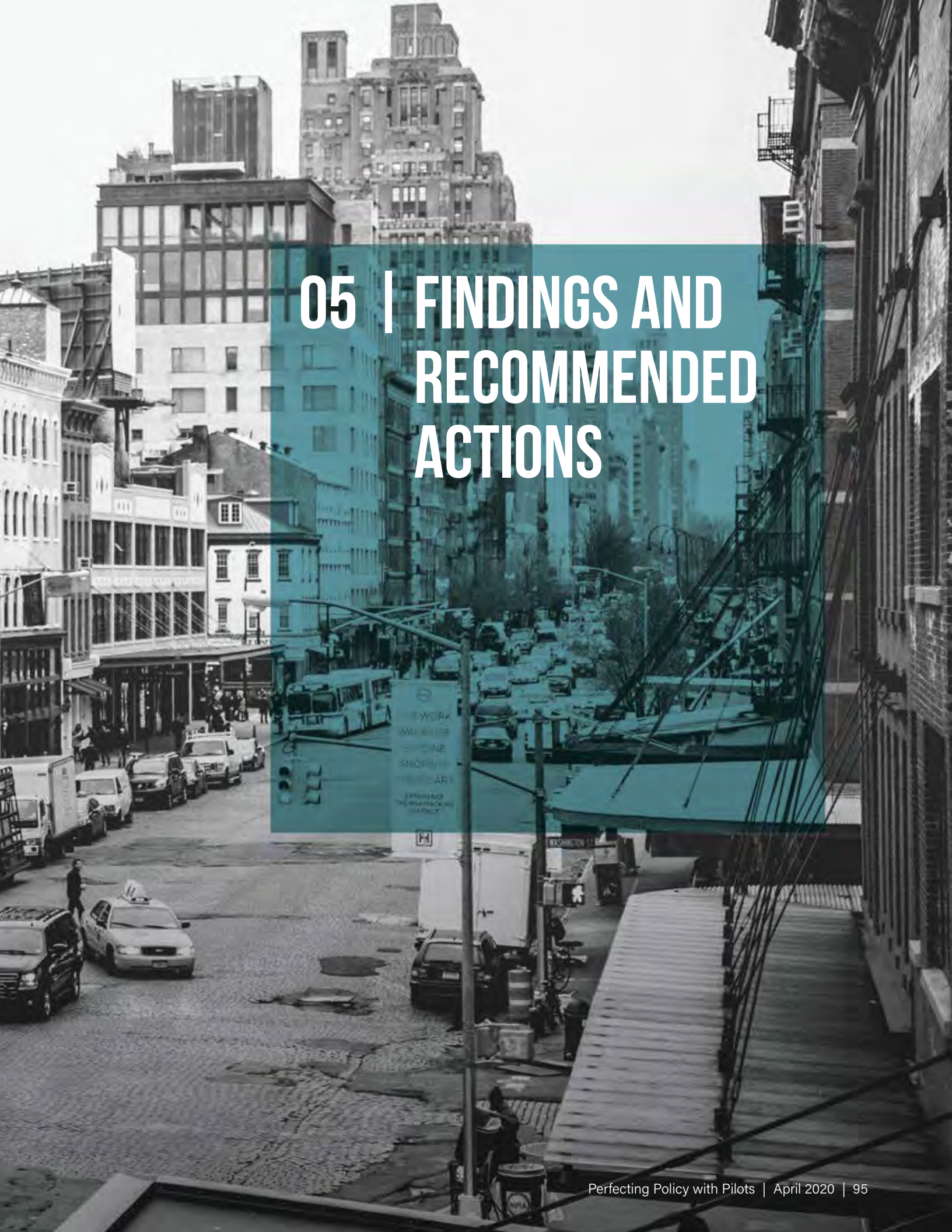


05 | FINDINGS AND RECOMMENDED ACTIONS

INTRODUCTION

Communities across the United States and Canada are learning from their experiences with new mobility and urban delivery pilot projects. This chapter summarizes the lessons learned and provides examples and promising practices emerging from these pilots. In addition, it suggests 10 recommended actions that public agencies should take when designing and implementing a pilot project.

This section is organized into the following sub-sections with lessons learned (LL-#) and specific examples (E-#) of pilots highlighted:

- **Pilot project goals.** We first looked at the most common goals for pilot projects to better understand what they specifically tried to achieve. Some organizations articulated the goals of their pilot(s) more clearly than others.
- **Pilot project evaluations**. Pilot evaluations generally describe what was done, lessons learned, and implications for future pilots and deployments. Based on our findings, evaluations are an important step to summarize what happened and what was learned from conducting the pilot project, but they are not consistently produced.
- **Pilot project implementation.** We compiled lessons learned about four of the most critical elements of implementing a pilot project:
  - » Regulations and contractual agreements
  - » Compliance and accountability mechanisms
  - » Informed decision-making
  - » Pricing and fees
- **Pilot project outcomes.** While not every pilot project identified outcomes related to the following topics, we were particularly interested in the pilot outcomes related to:
  - » Equity
  - » Health and Safety
  - » Environment
  - » Economy
- **Policy and infrastructure considerations.** The pilot projects reveal a number of policy and infrastructure considerations that jurisdictions need to consider after implementing their pilot projects.

SOURCE: Seattle SDOT

LESSONS LEARNED AND EXAMPLES

PILOT PROJECT GOALS

Public agencies and companies conduct pilot projects to learn about the technology and service generally and to create an opportunity to provide new services for specific populations or to meet specific needs or fill specific gaps. Table 5-1 shows the most common goals for new mobility and AV pilot projects by mode.

TABLE 5-1: MOST COMMON NEW MOBILITY AND AV PILOT PROJECT GOALS, 2013-2020

Goals	Micromobility	TNC Partnerships	Microtransit	Passenger AVs	AV Delivery
Facilitate first/last-mile connections	X	X	X		
Improve mobility equity and access	X	X	X		
Access the viability of new technology	X		X	X	
Gauge public interest	X			X	X
Achieve environmental or sustainability goals	X		X		
Increase transportation options	X		X		
Fill service gaps / provide occasional or specialty trips		X	X		
Identify potential use cases				X	X
Test the technology				X	X
Be innovative / part of the new economy				X	X
Evaluate and improve safety outcomes	X				
Operate as a replacement for fixed-route service, especially in rural or sparsely populated areas		X			
Increase transit ridership			X		
Learn how city processes, policies, and programs may need to be adapted for AVs				X	

Source: Urbanism Next analysis of approximately 220 pilot projects, 2020. See Appendix C for the list of all pilot projects.

LL-1. The most successful pilot projects identify goals or outcomes. Developing clear goals and outcomes for pilot projects helps public and private partners to articulate the purpose of the pilot and the methods that will be used, to aid in decision making, and to define what should be measured and evaluated. Without goals, it is difficult to determine if the pilot was successful or achieved its goals. Examples of pilots with clearly articulated goals include:

- **E-1a. 2017 Free-Floating Bike Share Pilot:** Seattle Department of Transportation, Seattle, WA, 2017
- **E-1b. 2018 E-Scooter Pilot Program:** Portland Bureau of Transportation, Portland, OR, 2018
- **E-1c. Shared Mobility Pilot Program:** City of Santa Monica, Santa Monica, CA, 2018-19
- **E-1d. Via to Transit:** King County Metro and Sound Transit, Seattle, WA, 2019-20

PILOT PROJECT EVALUATIONS

Pilot project evaluations generally provide summaries of projects, illustrate the key successes and challenges of a pilot, and discuss to what degree goals were met. It is hard to determine if a pilot was successful without clearly articulated goals and a thorough evaluation.

LL-2. A pilot evaluation is an important tool to describe the pilot and share lessons learned with decision makers and other stakeholders and organizations. Urbanism Next found evaluation reports for only 11% of the completed pilot projects assessed. The lack of easily accessible evaluations of pilot projects can make it hard for self-assessment or to learn from the experiences of others. If the purpose of a pilot is to learn about the impacts of the service and develop an approach to regulation, then an evaluation report is an important step that many public agencies are leaving out. Some of the most comprehensive pilot evaluation reports were:

- **E-2a. 2017 Free-Floating Bike Share Pilot Evaluation Report:** Seattle Department of Transportation, Seattle, WA, 2018
- **E-2b. 2018 E-Scooter Findings Report:** Portland Bureau of Transportation, Portland, OR, 2019
- **E-2c. Shared Mobility Pilot Program Summary Report:** City of Santa Monica, Santa Monica, CA, 2019
- **E-2d. Door-to-Downtown Report:** City of Boulder and Rocky Mountain Institute, Boulder, CO, 2016-17
- **E-2e. Go Centennial Final Report and Fehr and Peers:** City of Centennial, Centennial, CO, 2016-17
- **E-2f. Calgary Autonomous Shuttle ACATS Final Report:** City of Calgary, Calgary, AB, Canada, 2019

LL-3. Surveys are an important tool for understanding users and public perceptions. Surveys allow public agencies to better understand user demographics and why people use the service, as well as to quantify how joyful or satisfactory the experience is for users. Surveys can also reveal public opinion regarding routes, service areas, safety requirements, and regulations. The City of Calgary found that the majority of people surveyed wanted AVs to operate in a dedicated right-of-way, while most micromobility users across a variety of pilot projects requested safe places to ride such as protected bike lanes or shared use paths.

- **E-3a. Dockless Pilot Program:** City of Baltimore, Baltimore, MD, 2018-19
- **E-3b. Ride Share Pilot Program with Lyft & Uber:** City of Mercer Island, Mercer Island, WA, 2018
- **E-3c. ELA Autonomous Shuttle:** Pacific Western Transportation, Calgary, AB, Canada, 2018-Ongoing 2020

LL-4. Surveys reveal that new mobility modes may contribute to feelings of joy or increased happiness among some users. E-scooter and bikeshare users were those most likely to indicate that they used the service for fun or recreation. Some seniors using TNC or microtransit services for medical appointments or social outings may have experienced increased happiness and higher quality of life due to increased mobility and autonomy. Autonomous vehicles and personal delivery robot were exciting to use for some users due to their novelty.

PILOT PROJECT IMPLEMENTATION

Pilot projects are, by definition, an experiment. Public agencies embark on a pilot to explore how a service could work within the public realm. One of the most important aspects to explore is the relationship between the public sector providing the space for the pilot and the companies providing the service. Public agencies are experimenting with a wide range of regulatory tools and program frameworks to bring new mobility and urban delivery services to their communities. In addition, some public agencies are exploring and changing how they institutionalize the management of these services. For example, public agencies may use an outside organization to analyze data during a pilot and then decide to develop the capacity to complete the data analysis in house during later pilots or permanent program implementations.

From permits to contracts to no regulations at all, public agencies are setting a wide variety of expectations for participating companies. This section explores the formal and informal relationships between public agencies and companies.

REGULATION AND CONTRACTUAL AGREEMENTS FOR PILOTS

LL-5. Lack of regulation of new mobility services is generally viewed as resulting in a "wild west" environment and negative outcomes. From an overabundance of micromobility vehicles and providers and devices obstructing sidewalks (e-scooters) to TNCs contributing to congestion in downtown areas or at the curb, a lack of regulation is seen as creating a messy transportation environment. Company representatives told Urbanism Next that it is difficult to successfully operate in unregulated environments and that some regulation is beneficial for ensuring fair market competition. Company representatives suggested that there is little reward in being a good actor if there are few incentives and no penalty to do so. Large numbers of operators also dilute market share, contributing to a dearth of incentives for the jurisdiction and companies to work together to resolve issues.

LL-6. Communities are still determining what constitutes the "right" level of regulation and the most appropriate way to allow services to operate or bring service providers into communities to conduct specific activities. It seems that depending on the size of the market, demand for services, and the regulatory culture of the jurisdiction, the most common type of regulation is an operating permit (or similar) for micromobility pilots, contracts for microtransit and TNC partnerships, and informal coordination and communication for AV passenger and goods delivery. Pilot projects are experimenting with different regulatory levels and requirements within those categories, many of which are described in this report. The type of regulation is likely to change over time, especially as technologies change and governments move from pilots to deployment.

LL-7. Operating or business permits are often used for pilot projects when service provision is not exclusive to one company. This is most common for e-scooter pilot projects even if an e-scooter pilot began with one company; the permit process sometimes allows more companies to enter the market. However, some cities are considering RFPs and contracting models for regulating micromobility and are using the opportunity to right-size the number of companies and vehicles involved in programs.

- **E-7a. 2018 E-Scooter Pilot Program:** Portland Bureau of Transportation, Portland, OR, 2018
- **E-7b. E-Scooter Share Pilot Program:** City of Chicago, Chicago, IL, 2019
- **E-7c. Shared Mobility Pilot Program:** City of Santa Monica, Santa Monica, CA, 2018-19

LL-8. There is likely a "sweet spot" for the number of e-scooter companies operating in a city that depends, in part, on the size of the market and the ability of local governments to manage numerous providers. City and micromobility company representatives we spoke with recommended having one to two companies operate in smaller cities and three to four for in larger cities. Having some competition between companies resulted in an increased willingness to share data and to resolve issues. However, three or more companies may be too many in suburban or less dense communities for companies to be successful. Given the lower demand, lower density communities may only be able to support one or two companies (Zipper, 2020a). Many cities that began micromobility pilots with larger numbers of companies have since reduced or planned to reduce the number of companies allowed to operate (Zipper, 2020b).

- **E-8a. Dockless Mobility Vehicle Pilot Permit Program:** Denver Department of Public Works, Denver, CO, 2018-19. Based on this pilot project, the next iteration will reduce the total number of service providers through an request for qualifications (RFQ) process.
- **E-8b. Dockless Vehicles in the District**: District Department of Transportation, Washington, DC, 2020
- **E-8c. Dockless Vehicle RFP Process:** City of San Antonio, San Antonio, TX, 2019-Ongoing 2020

LL-9. Requests for proposals/qualifications/ information (RFP/Q/I) are used to ensure transparency and fairness in the procurement process while reducing risk. To the extent possible, they may also identify the outcomes they want the service(s) to help achieve. For example, transit agencies overseeing microtransit and TNC partnership pilot programs often issue RFP/Q/I for the technology component of their services, and either handle operations internally with their own vehicles and employees or contract operations to third parties. Contracts for service are more common than permits for those pilots. This speaks to the point that microtransit and TNC partnership pilots are more often initiated by transit agencies or cities to achieve specific outcomes or activities rather than being seen as something that needs to be regulated or controlled.

- **E-9a. Shared Mobility RFQ Process:** Denver Department of Transportation & Infrastructure, Denver, CO, anticipated 2020 start date
- **E-9b. Dockless Vehicle RFP Process:** City of San Antonio, San Antonio, TX, 2019-Ongoing 2020
- **E-9c. RTA Connect On-Demand:** Greater Dayton Regional Transit Authority, Dayton, OH, 2017-Ongoing 2020
- **E-9d. Arlington On-Demand Rideshare Pilot Program:** City of Arlington, Arlington, TX, 2017
- **E-9e. Salt Lake County Microtransit Pilot:** Utah Transit Authority, Salt Lake City, UT, 2019-20

LL-10. Direct partnerships (formal and informal) are used on a limited basis. Depending on the situation, some companies approach local governments directly to initiate service and contracts or vice versa. In some cases, jurisdictions may be reluctant to regulate or contract with companies directly and choose an informal partnership because of fear of triggering statewide exemption efforts or because there is not political support to regulate. Staff may then turn to an informal partnership and communication with company officials to address issues as they come up. Unlike the vast majority of micromobility, microtransit, and TNC partnership pilots, the majority of AV passenger and goods delivery technology companies did not have a formal relationship with the communities they were operating in. In some cases, informal public-private coordination occurred.

- **E-10a. Innisfil Transit:** Town of Innisfil, Innisfil, ON, Canada, 2017-present
- **E-10b. ELA Autonomous Shuttle Pilot:** Pacific Western Transportation and City of Calgary, Calgary, AB, Canada, 2019
- **E-10c. Urban Delivery Research Partnership with Ford**: Miami-Dade County, Florida, 2018

COMPLIANCE AND ACCOUNTABILITY MECHANISMS

Compliance and accountability mechanisms are resource-intensive and not all public agencies have been prepared to handle these expenses. When it comes to micromobility, public agencies have used both carrot and stick approaches to ensure compliance. They must also decide whether to focus their compliance and accountability efforts on companies or individual users. Examples of carrots include incentivizing companies to meet equitable distribution goals by offering them increased fleet sizes if they deploy more vehicles in equity zones or charging reduced per-ride fees in low-income areas. In terms of rider behavior, some docked bikeshare systems offer riders financial credits if they return a bike previously parked outside a dock to a station. Examples of sticks include fees or suspension of services if companies don't comply with the permit or agreement requirements. Specific regulations may include geofencing zones that e-scooters may not enter, lowering vehicle speeds in specific areas, and checking that fleet deployment criteria are being met using real-time availability data. Public agencies have also enforced rider behavior by fining users who improperly park e-scooters or ride on sidewalks.

LL-11. Using incentives as compliance and accountability mechanisms, such as the ability to increase the overall fleet of vehicles if certain benchmarks have been met, is viewed positively by companies. Several cities are choosing to reward companies that meet the permit or contract requirements. For example, by limiting the number of companies issued operating permits, cities can offer those who do receive permits larger market share and a greater ability to increase revenue. Jonathan Hopkins at Lime said that they would like to see more performance-based outcomes such as cities incentivizing companies by increasing overall fleet sizes in proportion to the number of trips/sign-ups in specific neighborhoods or reducing per-trip or other fees based on meeting prespecified targets. In terms of rider behavior, in the City of Charlotte and the Cleveland suburbs, riders are free to leave their vehicles wherever they like but Spin gives a $0.50 discount to those who leave them in dedicated parking zones (Zipper, 2020a).

- **E-11a. 2019 E-Scooter Pilot Program:** Portland Bureau of Transportation, Portland, OR, 2019-20
- **E-11b. Denver Dockless Mobility Pilot Program:** Denver Department of Public Works, Denver, CO, 2018-19
- **E-11c. Dockless On-Demand Personal Mobility Pilot Program:** Los Angeles Department of Transportation, Los Angeles, CA, 2019-20

LL-12. Accountability mechanisms and the resources to enforce them are critical to even the playing field and ensure that all companies are operating under the same rules. Multiple micromobility representatives shared that enforcement is an essential part of successful pilots as it ensures everyone is operating under the same rules in a competitive market. Jonathan Hopkins at Lime shared that, "Portland has found the right balance of regulator and partner. Partner is not a comfortable place for cities and regulation is not comfortable for companies, but the space is shared. The city can't do everything and [neither can the company, but] together we can do a lot" (J. Hopkins, personal communication, December 3, 2019).

PBOT staff shared that auditing companies to make sure they are following the rules created a significant amount of work and that this was one of their big lessons learned and pieces of advice for other cities: "It's really easy to make rules, but it's harder to ensure compliance with them. What are the really important regulations we need to ensure for consumer protection and safety?" (Public Information Officer, personal communication, November 22, 2019). That said, without enforcement, there is little to no incentive for companies to do the right thing and comply with regulations. Enforcement is important to level the playing field, set expectations, and ensure everyone is operating fairly.

MOST COMMON TYPES OF DATA BY MODE

Micromobility: Most public agencies that require data base their requirements on MDS standards and collect anonymized, aggregated data on trip locations, start and end times, distances and durations, and vehicle locations and maintenance status. Other potential data points are:

- » Systemwide usage data
- » Trip data
- » Route data
- » Availability/distribution of vehicles
- » Anonymized user demographic data/trends
- » Maintenance activities
- » Live data on parked vehicles
- » Collision and safety data
- » Public comments and complaints
- » Total users in system by month
- » Trip revenue by day/week/month
- » Hourly fleet utilization/device quantities
- » Parking incidents
- » Tow records

Microtransit: Data sharing requirements for microtransit pilots may include:

- » Trip origin/destination data
- » Travel time records
- » Real-time location and stop-events per vehicle
- » Vehicle registration and license info

TNC Partnerships: The level of data aggregation varies significantly across TNC pilots. While some public agencies collect the data at a per-trip level, others receive the data aggregated in various ways, for example: a heat map of trip origins and destinations rather than per-trip latitudes and longitudes or average length of trip in a given month rather than the trip length for a specific trip.

- » Trip origin/destination locations
- » Trip length
- » Trip duration
- » Trip time of day
- » Trip subsidy
- » Number of trips

AVs (passenger and/or goods delivery):

- » Number of riders
- » Number of deliveries (for goods delivery)
- » Number of disengagements

- **E-12a. 2018 E-Scooter Pilot Program:** Portland Bureau of Transportation, Portland, OR, 2018
- **E-12b. E-Scooter Sharing Pilot Program**: City of Hoboken, Hoboken, NJ, 2019
- **E-12c. Powered Scooter Share Pilot and Permit Program:** San Francisco Municipal Transportation Agency, San Francisco, CA, 2018-19

LL-13. Some public agencies are requiring companies to respond to public complaints in a transparent and open manner. Many pilot projects required companies to address public complaints, sometimes setting a time limit (within 24 or 48 hours). However, without a requirement to report how the complaint was addressed, it is difficult to know what happened next. Based on their pilot, the City of San Francisco would like to integrate a public complaint system for e-scooters to the 311 system, which the City of San Antonio has already done. In the Redwood City Starship personal delivery device pilot, the City required that Starship respond to public inquiries within 48 hours and remove stalled or dead vehicles within 12 hours.

- **E-13a. Dockless Vehicle Pilot Program:** City of San Antonio, San Antonio, TX, 2018-19
- **E-13b. Powered Scooter Share Pilot and Permit Program:** San Francisco Municipal Transportation Agency, San Francisco, CA, 2018-19
- **E-13c. Redwood City Personal Delivery Device Pilot:** Redwood City, CA, 2016-18

INFORMED DECISION MAKING

Pilot projects are conducted to learn about the technology and operations of new mobility. The box to the left shows the most common types of data requested by mode. It is difficult to learn if data is not collected throughout the pilot. Pilot project data can generally be used for three different purposes: (1) operational analysis, (2) analytical analysis, and (3) pilot evaluation.

Operational data from e-scooter pilots help public agencies understand if the technology companies are complying with the permit or regulations: are the companies deploying the minimum or maximum number of vehicles in the areas they are allowed or required to operate? Are companies adhering to speed limits and ensuring that riders are not riding on sidewalks or other areas of exclusions? Are companies paying the required fees per ride or vehicle? Almost real-time data is extremely valuable to agencies that want to respond to citizen complaints or concerns in a timely fashion.

Analytical data helps to understand the demand and utility of the service: How many rides are completed each day? What is the average distance? What time of day do most rides occur? What is the spatial distribution of rides? How much longer do riders needing wheelchair-accessible vehicles wait compared to ambulatory riders? Are there ramps where people in wheelchairs need to enter or exit a vehicle? This information helps the public agency make decisions about infrastructure to improve safety or consider actions designed to support transit.

Both operational and analytical data help to inform the **evaluation of the pilot**. Public agencies need to understand how the volume of rides impacts management of the program, from responding to public complaints to paying for police officers. In addition, many public agencies are augmenting data collected from companies with additional information collected through rider surveys or by working with health agencies and organizations to learn about the characteristics and frequencies of rider-sustained injuries, for instance. Public agencies may also include demographic data available through the U.S. Census and observational data to determine helmet compliance. All this information is valuable to include in an evaluation of the pilot.

LL-14. Data sharing requirements are most common in micromobility pilots.
This assessment found that data requirements were most common for bikeshare and e-scooter pilots, less common for microtransit and TNC partnerships and very infrequent for AV pilots. Initially, unregulated TNC deployment without any data sharing was an important factor in public agencies realizing they needed more information about other new mobility services and AVs in their cities (Reynolds, 2019). Urbanism Next found very few examples of data sharing in AV pilot projects. TNCs seem particularly reluctant to provide data but given the costs of subsidizing TNC partnerships public sector agencies should consider stronger datasharing requirements. The Via to Transit pilot was an example of a jurisdiction choosing a company in part because of their willingness to share data.

- **E-14a. Dockless On-Demand Personal Mobility Pilot Program:** Los Angeles Department of Transportation, Los Angeles, CA, 2019-20
- **E-14b. Powered Scooter Share Pilot and Permit Program:** San Francisco Municipal Transportation Agency, San Francisco, CA, 2018-19
- **E-14c. Marin Transit Connect:** Marin Transit, Marin County, CA, 2018 - Ongoing 2020
- **E-14d. Via to Transit:** King County Metro and Sound Transit, Seattle, WA, 2019-20

LL-15. Data sharing requirements are highly variable, depending on the public agency, mode, and when the pilot project began.
Trip-level data is the most sought after data, whether or not a public agency requires that level of granularity. Many public officials interviewed for this study indicated that if their jurisdiction had not required data from companies, they wished that it had. Pilots that started before 2018 are less likely to have comprehensive datasharing requirements than those that started after. The introduction of e-scooters spurred more comprehensive data requirements, and e-scooter pilots generally have more data requirements than other modes.

- **E-15a. 2018 E-Scooter Pilot Program:** Portland Bureau of Transportation, Portland, OR, 2018
- **E-15b. Dockless Mobility Vehicle Pilot Permit Program:** Denver Department of Public Works, Denver, CO, 2018-19
- **E-15c. Dockless On-Demand Personal Mobility Pilot Program:** Los Angeles Department of Transportation, Los Angeles, CA, 2018-19
- **E-15d. Free-Floating Bike Share Pilot:** Seattle Department of Transportation, Seattle, WA, 2017
- **E-15e. Powered Scooter Share Pilot and Permit Program:** San Francisco Municipal Transportation Agency, San Francisco, CA, 2018-19
- **E-15f. Via to Transit:** King County Metro and Sound Transit, Seattle, WA, 2019-20

LL-16. Both public and private sector representatives expressed concerns about protecting data privacy. Private sector representatives are also concerned about protecting proprietary company data, though scooter companies have been willing to provide data at a level of granularity that TNC and other technology companies have not. It's important to note that the Freedom of Information Act (FOIA) requires public entities to provide public information to those that request it, which has been a concern for privacy advocates when it comes to potentially sensitive information at the trip-level. Public agencies can also protect this information from FOIA requests by using non-disclosure agreements like Los Angeles Metro and Via used in their first- and last-mile partnership in 2019. Public agencies working with third parties such as private vendors, universities, or other organizations may help address some of those concerns. This is a topic that is rapidly evolving and is expected to change in the future.

- **E-16a. Metro/Via Mobility on Demand Pilot:** Los Angeles County Metropolitan Transportation Authority, Los Angeles, CA, 2019-20
- **E-16b. Flex Service Pilot:** Alameda-Contra Costa Counties, Alameda-Contra Costa Counties, CA, 2017-18
- **E-16c. Via to Transit:** King County Metro and Sound Transit, Seattle, WA, 2019-20

PRICING AND FEES

There is significant variation in how much public agencies charge micromobility companies to operate in the right-of-way compared to the subsidy provided for microtransit and TNC companies to provide services. Several of the public agency representatives interviewed by Urbanism Next questioned the long-term financial model of pilot projects and whether they will continue to be financially viable. Public agencies are responsible for thoroughly considering what types of services should be subsidized. Increasing access to transportation for low-income populations, seniors, persons with disabilities, and other vulnerable travelers is the most common argument for subsidizing transportation services. But it begs the question, should public agencies also subsidize micromobility or first- and last-mile connections for all services that begin or end at transit? Would other investments, such as transit hubs, result in more people using transit? It is important for public agencies to consider the goals and outcomes they hope to achieve, and the number of travelers served when deciding which services merit public subsidies.

Private sector micromobility company representatives expressed that pilot fees charged by some cities can become excessive and noted that other modes such as TNCs have not always been burdened with comparable fees. Jonathan Hopkins at Lime shared that "we think a per trip fee is the most appropriate. Like charging sales tax, [per trip fees are] based on kind of business you're doing (J. Hopkins, personal communication, December 3, 2019)."

Given that pilot projects are designed to test technology and services, full recovery of expenses may not be an appropriate goal for determining pilot pricing schemes or long-term financial feasibility. That said, most public agencies devote more resources to managing emerging technologies than the revenue collected from companies running a business in the public right of way. Public agencies have shown a willingness to subsidize the cost of pilot projects to learn from the experience and make informed decisions about new mobility options.

Ultimately, public agencies should understand the full costs of managing private transportation services in the public right-of-way. Previous work by Urbanism Next suggests that a fee structure could cover the costs of one or more of the following activities:

- Public agency program management and compliance
- Infrastructure investments for access and impact on the ROW
- Congestion management (in a district, at the curb, or for special events)
- Incentives for desirable outcomes (such as equity or low-income programs or to reduce GHG emissions) (Lewis & Steckler, 2020)

It remains to be seen how much local governments will, on average, charge new mobility companies to operate in their cities. Uber and Lyft are challenging claims that they negatively impact cities by comparing the additional VMT they are contributing compared to personally owned vehicles (Balding et al., 2019). Given the relative impact, new mobility providers are questioning the fairness of fees applied to their services compared to personally owned vehicles.

LL-17. While pilot prices vary by service and location, all micromobility companies charge users fees to utilize their services and most microtransit and TNC partnerships charge users fees. Some jurisdictions require companies participating in a pilot to provide a low-income or reduced fare program. Public agencies also subsidize the cost of rides in some TNC partnership, docked bikeshare, and microtransit pilots. Examples of pilots that provide low-income, reduce fare programs include:

- **E-17a. TD Late Shift:** Pinellas Suncoast County Transit Authority, Pinellas County, FL, 2016-17
- **E-17b. FlexLA:** FASTLinkDTLA, Los Angeles, CA, 2018-19
- **E-17c. On-Demand Shuttle Pilot Program:** City of Cupertino, Cupertino, CA, 2019-Ongoing 2020

PILOT PROJECT OUTCOMES

EQUITY

Many pilots share common goals of increasing equitable outcomes, but few public agencies have defined specific equity outcomes or experienced significant success in achieving this goal. While public agencies may require low-income and accessible programs, sign-ups for these programs have been modest at best. In addition, limited follow up has been conducted by agencies and companies to find out why participation in such programs is lacking. That said, specific marketing and outreach and direct engagement with underserved groups has often been insufficient. Very few communities have conducted a needs assessment that included new mobility or urban delivery and may have limited views of how new mobility and emerging technology services can address underserved populations' mobility needs.

ADA accessibility was an important criteria for microtransit and TNC partnership pilots. A limited number of micromobility pilots included ADA accessibility. Multiple TNC partnership pilots focused on improving transportation service for seniors and users with limited mobility. The pilot assessment identified several areas where infrastructure improvements were necessary to improve ADA accessibility. Examples of this include poor road quality and a lack of curb cuts. New mobility public-private partnerships need to continue to improve accessibility for wheelchair and other mobility-constrained users.

There are likely a number of use cases for subsidized food and goods delivery. TNCs are already working with nonprofits to connect lower-income residents to grocery stores and medical appointments. For instance, the Redwood City personal delivery device pilot introduced the possibility of subsidizing delivery of library books to residents though it ultimately did not come to pass. Public agencies may want to explore how they can help underserved residents through emerging technologies.

From the private sector perspective, cities tend to focus on location when they are creating equity goals, especially for micromobility pilots. However, Joe Deshotel at Lime shared that their equity program is income-based rather than location-based because "low-income people live everywhere" (J. Deshotel, personal communication, December 20, 2020). While equity requirements are commonly generated by the public sector, private companies appreciate incentivized equity programs that help them meet their goals through increased fleet sizes or lower per-vehicle fees in low-income neighborhoods. Left to their own devices, micromobility companies will put vehicles where they think they will be ridden the most, but there are opportunities for the private sector to help achieve public sector equitable outcome goals.

LL-18. Public agencies are implementing various mechanisms to help meet equity-driven goals and outcomes, with mixed results. This often includes low-income programs that reduce the cost of services, deployment requirements in low-income or underserved neighborhoods, providing options for users that do not have access to smartphones or bank accounts and credit cards, and apps in multiple languages. A lack of evaluation of these programs makes it difficult to determine why utilization is often low or what could be done to improve them.

- **E-18a. Shared Active Transportation Program:** City of Fremont, Fremont, CA, 2019-20
- **E-18b. Metro/Via Mobility on Demand Pilot:** Los Angeles County Metropolitan Transportation Authority, Los Angeles, CA, 2019-20
- **E-18c. Via to Transit:** King County Metro and Sound Transit, Seattle, WA, 2019-20

LL-19. Equity programs are unlikely to be effective without a robust marketing and outreach plan. Go Monrovia (TNC partnership) is an example of a pilot that devoted significant resources to public outreach and education that resulted in substantial utilization among the target users. Examples pilots that conducted robust marketing and outreach include:

- **E-19a. Go Monrovia:** City of Monrovia, Monrovia, CA, 2018-19
- **E-19b. LA Metro/Via Mobility on Demand Pilot**: Los Angeles County Metropolitan Transportation Authority, Los Angeles, CA, 2019-20
- **E-19c. Wheels2U:** Norwalk Transit District, Norwalk, CT, 2018-19

LL-20. Universal design at the curb (not just corners) where people are regularly picked-up or dropped-off should be considered to make sure that new mobility deployment accommodates all people, regardless of physical ability. In TNC partnership and microtransit pilots, getting individuals with mobility devices from the street onto the sidewalk after being dropped off was a challenge. Public agencies can opt to improve infrastructure by adding curb cuts or by using vehicles with ADA compliant ramps where drop-offs occur.

- **E-20a. SmaRT Ride Microtransit Pilot Project:** Sacramento Regional Transit District, Citrus Heights, CA, 2018-19
- **E-20b. ELA Autonomous Shuttle Pilot:** Pacific Western Transportation and City of Calgary, AB, Canada, 2019

HEALTH AND SAFETY

Research on the health and safety of new mobility pilots is very limited. A Centers for Disease Control study found 1 in 5,000 e-scooter rides in Austin, Texas resulted in a rider injury (Harduar Morano et al., 2019). Another example of a local government collaborating with health officials is the City of Portland working with the Multnomah County Health Department to quantify injuries from micromobility pilots.

In addition to crashes, there is the possibility that e-scooters, microtransit, and TNC partnerships, and eventually AV passenger and goods delivery trips will replace some walking and biking trips. It is too early to know how using these services will impact health in the long-term, but Urbanism Next believes that opportunities to increase exercise and decrease the use of carbon-intensive should be encouraged.

LL-21. E-scooter pilots had difficulty combating sidewalk riding. E-scooter riders (as well as many bicycle riders) often ride on sidewalks when riding on streets feels unsafe. User studies found that perceptions of safety on streets depends on how experienced users are, levels of traffic, and automobile speeds. E-scooter riders have indicated in numerous surveys that they mostly ride on sidewalks when there are no safe-feeling alternatives. However, public agencies are still attempting to enforce sidewalk riding bans. In San Francisco, SFMTA requires companies to implement an escalated warning system for repeat sidewalk riding offenders. For the first improper riding or parking offense users get warned, then they get fined, and finally potentially banned from the operator's system. Infrastructure changes such as separated/protected bike lanes and multi-use paths are likely the best way to decrease sidewalk riding on streets that feel unsafe.

LL-22. It has been difficult to enforce helmet laws and some public agencies are not prioritizing enforcing this safety requirement. While helmets are required for e-scooter riding in many communities (often due to state laws), it is not uncommon for many users to ride without helmets. Many public agencies are hesitant or unable to actively enforce helmet requirements because they do not want to discourage use or do not have staff capacity or budgets for enforcement. The public and private sectors have also gone back and forth about who is ultimately responsible for enforcing personal safety requirements.

LL-23. Improperly parked and broken or vandalized devices left on sidewalks can create barriers for people with limited mobility. Micromobility devices blocking or impeding ADA access is a widely publicized issue, although some researchers have found that cars block ADA access more frequently than e-scooters (Brown et al., 2020) including dockless e-scooters and bikes (i.e., "micromobility"). That said, public agencies acknowledge the issue and have employed three strategies to encourage proper parking behavior including:

- **E-23a. Creating parking zones and micromobility corrals** (usually painted boxes on streets or in sidewalk furniture zones designated for dockless bikes and e-scooters). The cities of Santa Monica, CA; Los Angeles, CA; Washington, DC and many others are using this strategy.

- **E-23b. Requiring all e-scooters to have a lock-to mechanism**. The City of San Francisco, CA implemented this strategy in their permanent program which resulted in a high demand for additional bike racks.
- **E-23c. Working with companies to fine or ban riders who ride on sidewalks or improperly park their devices**. The City of Portland, OR began using this strategy in their 2019 E-Scooter Pilot.

LL-24. Door-to-door services may increase traveler safety by reducing wait times at bus or other stops and reducing service gaps such as the first- and last-mile and late-night transit gaps. While microtransit and TNC partnership do not generally discuss health or safety aspects of services, curb-to-curb service will likely benefit women and other vulnerable populations that may feel unsafe waiting for transit late at night.

- **E-24a. Direct Connect**: Pinellas Suncoast Transit Authority, Pinellas County, FL, 2016-18
- **E-24b. UNT Lyft Pilot Program**: Denton County Transportation Authority, Denton, TX, 2018-19
- **E-24c. Woodward2Work:** Detroit Department of Transportation, Detroit, MI, 2018-Ongoing 2020

LL-25. In some microtransit pilots, transit agencies operate the service in-house or through third-party contractors, who generally must undergo rigorous hiring processes and background checks. This may help ease concerns regarding personal safety and increase passenger safety. For example, Marin Transit contracts with Whistlestop, a nonprofit organization who also provides their paratransit services. Marin Transit staff shared that having an operator that was known and trusted by the community helped the success of their pilot. Whistlestop drivers were also paid for all of their working hours regardless of ridership, which provided more stable employment than gig work but cost more to operate. Additionally, when transit agencies have to hire their own drivers and workers, they must comply with any superseding hiring regulations passed by local municipalities. For example, drivers hired for the Via to Transit pilot in Puget Sound were subject to King County's Living Wage Ordinance.

- **E-25a. Flex Service Pilot:** Alameda-Contra Costa Transit District, Alamada-Contra Costa Counties, CA, 2016-17
- **E-25b. Marin Transit Connect:** Marin Transit, Marin County, CA, 2018 – Ongoing
- **E-25c. RideKC:** Bridj Pilot: Kansas City Area Transportation Authority, Kansas City, KS and MO, 2016

ENVIRONMENTAL

LL-26. While environmental concerns were noted in several pilots, most public agencies struggled to quantify the impacts. Most concluded that if the service reduced transit ridership, overall GHG emissions would increase. Microtransit pilots create an opportunity to replace large diesel buses with electric minibuses with reduced nitrous oxide and GHG emissions and research suggests that this could be a successful strategy (Canales et al., 2017). While e-scooters and bikeshare are commonly seen as ways to increase active transportation and decrease privately owned automobile use, more research is needed to determine the emissions and mode shift associated with micromobility operations and device lifecycles.

- **E-26a. EmGo Electric Shuttle Pilot:** Lane Transit District, Eugene, OR, 2019-20
- **E-26b. Green Raiteros and Van y Vienan**: Valley Latino Environmental and Advancement Policy (Valley LEAP) and The Leadership Counsel for Justice and Accountability, Cantua Creek and Huron, CA, 2017-18
- **E-26c. Last Mile Microtransit Service Pilot:** Downtown STL, Inc., St. Louis, MO, 2018

ECONOMIC

LL-27. Some new mobility pilot projects are exploring how they can increase access to jobs. Late night TNC partnership pilot projects are an example of how public agencies are hoping to improve economic opportunities by increasing access to transportation. Micromobility services are also helping to fill first- and last-mile service gaps and are being used for commuting purposes. More research is needed to understand the impact of these services on access to work.

- **E-27a. Direct Connect:** Pinellas Suncoast Transit Authority, Pinellas County, FL, 2016-18
- **E-27b. UNT Lyft Pilot Program:** Denton County Transportation Authority, Denton, TX, 2018-19
- **E-27c. Woodward2Work:** Detroit Department of Transportation, Detroit, MI, 2018- Ongoing 2020

LL-28. New mobility pilot projects can increase employment and contracting opportunities. Micromobility pilots often hire or contract with individuals to manage their fleets and charge/rebalance devices. Some transit agencies are working to increase employment opportunities by purchasing routing software from microtransit companies and hiring drivers to operate their own vehicles. It was not within the scope of this study to assess the quality and risks associated with new mobility employment practices, though Urbanism Next is aware of considerable concerns regarding compensation, working conditions, and wages for gig-workers. In addition, urban delivery schedules and warehouse conditions are also a topic of concern (Barbaro, 2018) and area where additional research is needed.

- **E-28a. FlexLA pilot in Los Angeles solely employs military veterans as drivers and they receive salaries and benefits.**
- **E-28b. Marin Transit Connect pays contractors for all scheduled hours, not just for rides completed as is standard practice for TNCs.**

OTHER POLICY AND INFRASTRUCTURE CONSIDERATIONS

LL-29. Liability is a significant issue for AV pilot projects. Given that the federal and state governments have just begun considering AV regulations and there have been limited court cases focusing on liability, questions around liability will take additional time to resolve.

LL-30. Federal and state laws will continue to change the regulatory landscape that new mobility and urban delivery services operate in. Many states have pre-empted the ability of local governments to regulate TNCs and AVs (both passenger and delivery vehicles), meaning eventual deployment of regulated services may be limited by state and federal regulations. Microtransit and TNC partnerships resulting from contracts or other types of partnership may have fewer constraints due to the parameters of the public-private partnerships being more clearly defined.

LL-31. New mobility pilots are showing local governments that they can ask private companies to do more to support the public interest/goals. Public sector representatives Urbanism Next spoke with mentioned that they wished they had been able to regulate the initial deployment of TNCs more similarly to micromobility and felt that they could apply the lessons learned through regulation and enforcement of micromobility to other sectors outside of transportation. The Covid-19 pandemic is challenging local governments and service providers in new and unexpected ways. All partners will need to be innovative and resilient to survive and thrive. This may present new opportunities for the public and private sector to explore together.

RECOMMENDED ACTIONS

Based on the findings in this report, Urbanism Next recommends local governments take the following actions when developing a new pilot project:

1. Define the pilot goals and outcomes at the beginning of the process and make sure *every* pilot activity is designed to achieve them.
The most successful pilots were those that had clearly defined goals or outcomes. By identifying what is most important, communities can ensure that these elements are included in all aspects of the pilot (and every recommended action described here), from the policy framework to what findings are analyzed in the evaluation report. This helps community leaders, the public, and the service providers understand what to expect and reduce conflicts.

2. Study what happened and put those findings into a final evaluation report.
Organizations that collected and analyzed data, surveyed participants, and reported on the outcomes were likely in the best position to learn from the pilots and incorporate those lessons into future pilots and deployments. In addition, evaluation reports are helpful for summarizing lessons learned and sharing information with other communities so everyone can learn from the experience.

3. Foster relationships and build trust.
Public agencies exist to maintain and enforce the public good. Ultimately, everything a public agency does is for the good of the residents that live and work within it's boundaries. It is important for public agencies to engage with residents to understand their needs and desires, especially as new technologies are deployed in the public right-of-way. In addition, public agencies should work directly with organizations and individuals that advocate for the most vulnerable populations to ensure that inequities are propagated or created through the introduction of new technologies. Finally, agencies should develop and foster relationships with the companies and their representatives to help guide them through the process and enable them to address issues as well as make it possible to support all players in achieving their goals.

4. Create a policy framework (i.e., regulations, contracts, agreements) for each pilot project that advances the public good and is easy to understand.
There is no one policy framework that is appropriate for all pilots — the level and type of regulation, contracting, or other formal or informal agreement between the public and private sector will depend on the type of pilot initiated and the capacity and inclination of the public sector agency and leadership. The important point is that the agency focuses on the pilot goals and outcomes to ensure these are met through compliance of the policies and regulations enacted. Having a pilot may make it easier to experiment with different (temporary) forms of market entry.

5. Build in compliance mechanisms.
Public agencies should ensure that the private sector complies with the policies and regulations outlined in their policy framework. Some of the most successful compliance methods included both incentives and penalties. Data collection should inform compliance requirements so public agencies can track the most important outcomes of pilot activities.

6. Measure the impact on equity, health and safety, the environment, and the economy.
The introduction of new mobility and urban delivery services impacts equity, health and safety, the environment, and economic opportunities. If new mobility modes can overcome the technological, regulatory, and financial challenges they currently face, they could accelerate changes in transportation behaviors, including rates of personal vehicle ownership and use. In addition, new mobility has the potential to reduce the second most costly household expense after housing, but it remains to be seen if the benefits of these alternative modes of transportation outweigh the costs.

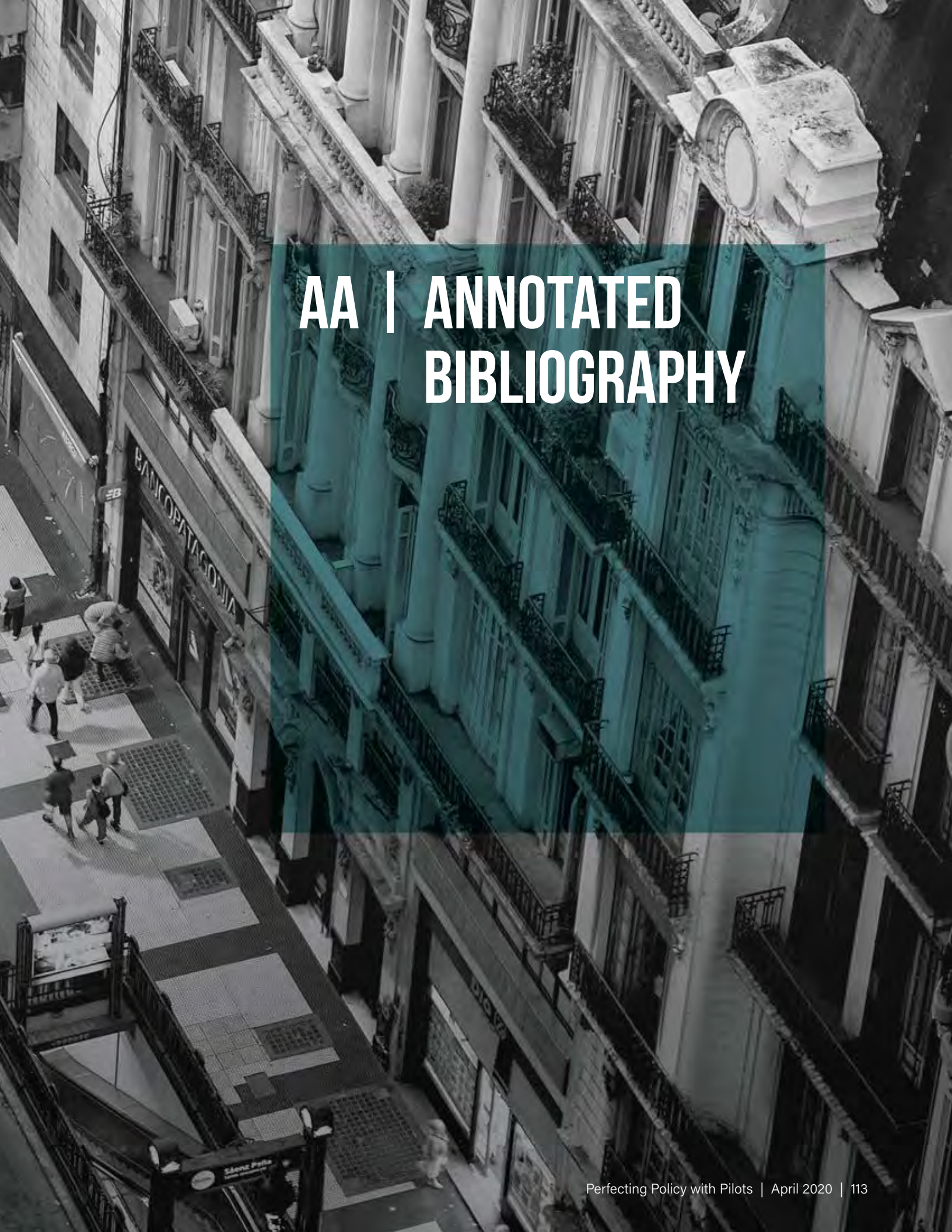
7. Measure the impact of the pilot project on transit.
Transit plays an important role in reducing congestion, providing equitable mobility, reducing greenhouse gas emissions, improving health and safety, and increasing access to opportunity and jobs. The ability of transit to deliver on these key livability outcomes cannot be overstated. Public agencies should examine how new technologies impact transit during pilot projects and consider how their policies and programs can be modified to support transit.

8. Collect the information needed to ensure the public good (while protecting privacy) and produce useful information to make relevant policy decisions.
It is difficult for community leaders to make good decisions if they don't have the information they need about impacts and outcomes of pilot projects. Data requirements should be designed to provide (1) operational data that reports almost realtime data to understand what is happening on city streets and if service providers are complying with the regulations; (2) analytical data to understand the demand and utility of the service; and (3) pilot evaluation data such as coordination with the local health authority on health data or public surveys. This information is critical for community leaders to make informed decisions during and after the pilot. To the extent that raw (anonymized) data can be made openly available, it would generate greater transparency and opportunities for independent analysis of the pilots.

9. Apply these lessons learned and recommendations to AV and other types of pilots.
The recommended actions are applicable to all types of pilots, not just existing technologies. While AV pilot projects are currently focused on learning about and testing the technology, at some point very soon, communities and companies will want to move beyond testing technology to understand a variety of case uses. Communities should use the lessons learned and apply the recommended actions in this study to AV and other future pilot projects.

10. Plan for volatility.
It is important to note the rapidly changing new mobility space and uncertainty of these markets. There was volatility in the market before the outbreak of Covid-19, and some of the companies that participated in pilot projects were already out of business by the time we finished the report. In addition, some companies that rapidly deployed their services in communities exited the market just as quickly. The industry will likely continue to be volatile as companies attempt to figure out the business case for operating in different communities across the country. The public health crisis presented by the Covid-19 pandemic has further exacerbated the volatility of the market and it will take ingenuity and resiliency to continue conducting successful pilot projects as we emerge from this crisis.


Sáenz Peña



AA | ANNOTATED BIBLIOGRAPHY

NEW MOBILITY (MULTIPLE MODES)

Between Public and Private Mobility: Examining the Rise of Technology-Enabled Transportation Services, Chapter 8: Equity and Access
Brian Taylor, Ryan Chin, Melanie Crotty, Jennifer Dill, Lester Hoel, Michael Manville, Steven Polzin, Bruce Schaller, Susan Shaheen, Daniel Sperling, Marzia Zafar, Susan Zielinski, Katherine Kortum
Committee for Review of Innovative Urban Mobility Services, Transportation Research Board, The National Academies of Sciences, Engineering, and Medicine (2016)

Chapter 8 of this report examines equity and access issues of shared mobility. The shared mobility modes studied in this report include bikeshare, carshare, microtransit, and transportation network companies. The authors focused their research on transportation network companies, which they identified as an area needing more research. In Chapter Eight, the authors first define the different "dimensions" of equity issues. The dimensions related to equity include firms, markets, and competition; regulations subsidies; social services; geographies and jurisdictions; and stakeholder groups. Next the researchers looked at equity and access issues faced by different disadvantaged groups, including racial and ethnic minorities, individuals with disabilities, low-income individuals, unbanked individuals, individuals without smartphones, and rural residents. The authors identified that the mobility of some of these minority groups can greatly improve with the advent of shared mobility. However, in order to reap the benefits of shared mobility public policy is required to address issues head-on.

Connected Urban Growth: Public-Private Collaborations for Transforming Urban Mobility
Diego Canales, Shannon Bouton, Elaine Trimble, Julia Thayne, Larissa Da Silva, Srikanth Shastry, Stefan Knupfer, Martin Powell
Coalition for Urban Transitions (2017)

In the first section of this working paper, the authors present their definition of new mobility services and present their findings from a global survey of new mobility services. The authors highlight trends and opportunities of these new mobility services and partnerships. In the final sections of this paper, the authors present their findings and process for modelling three new mobility applications. The three new mobility applications modelled include: a dynamic trip-planning and ticketing app, on-demand minibuses (microtransit), and first and last-mile ride sharing partnership. The authors modelled each of these applications in three cities, London, Mexico City, and San Francisco. The authors are optimistic that these services will lead to an increase in access to and use of shared rides and reduce the number of solo car trips, thus resulting in lower environmental impacts and increased revenues from transit agencies. The authors acknowledge that transit agencies should not be hasty when implementing these services-- transit agencies need to first assess their current transportation systems and identify specific areas that need to be improved before integrating new mobility.

Private Transit: Existing Services and Emerging Directions
Sharon Feigon, Colin Murphy, and Taylor McAdam
Transit Cooperative Research Program (2018)

This research report published by the Transportation Research Board examines new and old shared private transit services in the United States, including shared taxis, shared transportation network company services, microtransit, jitneys, dollar vans, and employer-based and property-based commuter services. This research report heavily relies on interviews with individuals working in both the public and private spheres of the transportation industry. In the first section of the report the authors define and give examples of private transit services in the United States. The authors then examine what existing literature says about the benefits and impacts of private transit services. In the following section, the authors discuss the federal regulations that affect private transportation services in the United States. The authors find that

the two federal regulations that most commonly affect private transit are the Civil Rights Act of 1964 and the Americans with Disabilities Act of 1990. Next, the authors identify three private transit case studies in the United States. In the case study section, the authors investigate how private transit impacted and was regulated in different communities. The authors end with a set of conclusions about existing and future private transit services. The authors find that private transit services can complement public transit and reduce solo vehicle trips and overall vehicle-miles-travelled. Additionally, the authors find that private transit is especially useful to fill gaps in public transportation, notably in areas that are hard to serve or are underserved. Finally, the authors recommend that local governments regulate private transit to limit right-of-way and street space conflicts.

The New Automobility: Lyft, Uber and the Future of American Cities
Bruce Schaller
Schaller Consulting (2018)

Transportation consultant Bruce Schaller analyzes recently published research and data on microtransit and transportation network company (TNC) usage and ridership in the United States. Schaller specifically investigates how TNCs and microtransit can address public goals relating to sustainability, safety, equity, and mobility. First, Schaller identifies ridership and usage patterns of TNCs and microtransit in the United States. Schaller finds that early TNC data indicates that TNC riders most often live in large metropolitan areas and that they skew wealthier, more educated, and younger than the average population. Next, Schaller examines the common claim made by TNCs that their services will complement public transportation rather than take away from its ridership. Schaller is highly skeptical about this claim. Schaller believes that an increase in TNC and microtransit offerings will lead to an increase in congestion and traffic. Schaller does not believe that many people will make the switch from using personal vehicles to microtransit or TNC services for commuting. Finally, Schaller examines pilot programs in the United States. Schaller finds that some applications of pilot programs have potential, such as those that subsidize rides for low-income, elderly, and disabled persons. However, Schaller does not believe pilot programs involving the replacement of fixed-route buses with TNC rides or microtransit have thus far been successful.

In contrast to many other reports, Schaller presents many criticisms about TNC and microtransit services, and brings up many important considerations.

Transit and Emerging Technologies
Lauren Mattern, Geoff Slater, and David Perlmutter
Nelson\Nygaard (2018)

This report published in 2018 by Nelson\Nygaard provides a very thorough overview of emerging technologies in automation and how new, automated technologies might affect public transit. First, the authors present a timeline of autonomous technology. The authors propose that fully autonomous technology will first be found in personal automobiles and subsequently in mass transit vehicles. Next, the authors describe the "levels of automation" and give the current status and examples of both autonomous technology in public transport and in personal automobile market. The authors then discuss potential impacts of autonomous technology. The authors propose that widespread personal AV ownership will likely lead to an increase in traffic and a decrease in public transportation usage if personal AVs are loosely regulated. Additionally, the authors propose that autonomous transit will likely result in a reduction of operating costs and will likely be more efficient and more accessible. The authors believe that early partnerships between public agencies and microtransit companies, transportation network companies, and AV shuttle companies can shed light on future partnerships with autonomous vehicle companies, and the authors investigate each kind of partnership. The authors conclude that public agencies need to be proactive and improve infrastructure and conduct policy to ensure that AVs will not negatively impact existing transportation systems.

Shared Mobility and the Transformation of Public Transit
Sharon Feigon and Colin Murphy
Transit Cooperative Research Program, Transportation Research Board (2016)

This report created by the Transportation Research Board examines the impacts of new, shared mobility options, including bikesharing, carsharing, microtransit, and ridesourcing, on public transportation use. The authors created the report specifically to assist transit agencies wanting to learn about shared mobility options and how to approach regulation and implementation of new mobility options. This study draws on interviews, surveys, and data collected from transit agencies and ridesourcing companies. The authors also collected information on current practices and regulations of new mobility options. The authors propose that a greater use of shared modes is associated with greater likelihood to use transit frequently, own fewer cars, and lower personal spending on transportation. In addition, the authors found that shared modes largely complement public transit, finding that public-private partnerships can be particularly effective in enhancing paratransit service. Finally, the authors recommend that public entities should explore public-private partnerships to fill gaps in existing transit service.

MICROMOBILITY

Are e-scooters polluters? The environmental impacts of shared dockless electric scooters
Joseph Hollingsworth, Breanna Copeland, Jeremiah Johnson
Department of Civil, Construction, and Environmental Engineering, North Carolina State University (2019)

Researchers at North Carolina State University performed a life cycle assessment to measure the total environmental impacts of e-scooters. Using a Monte Carlo analysis, the researchers found that the largest components of an e-scooter's global warming impacts (measured in CO2-eq/passenger-mile), in order include materials and manufacturing, distribution and collection, electricity for charging. The researchers found a trivial environmental impact from transporting the e-scooter from the manufacturer. The authors compared the overall environmental impacts of e-scooters with other modes of transportation per passenger-mile driven. Compared to other modes, the researchers found that e-scooter shares have higher global warming impacts per passenger-mile traveled than buses with high ridership, electric bicycles, and bicycles. They found that e-scooter shares had lower global warming impacts per passenger-mile traveled than some kinds of personal automobiles and bicycles part of dockless bikeshare systems. The researchers concluded their paper with recommendations for cities and scooter companies to reduce the overall environmental impacts of e-scooter share systems, which include using limiting the amount of collection and distribution of e-scooters, using less environmentally-harmful materials, and charging vehicles less frequently.

Evaluating public transit modal shift dynamics in response to bikesharing: a tale of two U.S. cities
Elliot Martin and Susan Shaheen
Transportation Sustainability Research Center, University of California, Berkeley (2014)

The authors conducted a survey in Washington, D.C. and Minneapolis, MN and analyzed the data to identify ridership changes in public transportation associated with the creation of new bikeshare systems. The authors found that bikeshare systems can reduce the use of both for-hire and personal automobiles. The authors also found that the impacts on public transportation from bikeshare systems is variable. In areas with higher population density, the authors noted that bikeshare often replaced public transportation. In high-density areas bikeshare can be faster, cheaper, and more direct than public transportation. In lower density areas, including areas with limited rail networks, bikeshare can improve access to public transportation by creating a first and last-mile connection to public transportation, thus complementing public transportation rather than substituting it.

Governing Dockless Bike Share: Early Lessons for Nice Ride Minnesota
Frank Douma and Austin Hauf
University of Minnesota Center for Transportation Studies (2019)

Researchers at the University of Minnesota in 2018 created this report to provide recommendations to cities for regulating and implementing dockless bikeshare systems. In addition to providing generalized advice for unspecified cities, the authors also created a detailed evaluation of the Nice Ride Minnesota dockless pilot operating in the Twin Cities region of Minnesota. To inform their recommendations, the researchers analyzed six dockless bikeshare case studies in major U.S. cities (Boston, Chicago, Dallas, San Diego, Seattle, and Washington D.C.) and documented the major challenges these cities faced with their bikeshare system. Common challenges the researchers identified include improperly parked bicycles, uneven regulations across neighboring municipalities, issues caused by unrestricted supplies of bikes (e.g., too many bikes not enough demand) and collecting fees. The authors identified a different set of challenges of smart mobility (new mobility) based on past literature. Challenges gleaned from the literature include the tendency for public agencies to focus on technology rather than public goals, navigating how to collect taxes and use tax revenue, ensuring that data be reported, and ensuring equitable practices from the providers. Finally, the authors evaluated Nice Ride's proposed approach to a dockless bikeshare pilot, and the challenges and success specific to the program.

Micromobility in Cities: A History and Policy Overview
Nicole DuPuis, Jason Griess, and Connor Klein
National League of Cities (2019)

The National League of Cities published this report to provide recommendations to cities for regulating micromobility. In the report, the authors provided a definition of micromobility, history and background information, and analyzed micromobility pilots in San Francisco, CA; Washington, D.C.; New York City, NY; Kansas City, KS and MO; Norfolk, VA; and Los Angeles, CA. Using these six case studies, the authors highlighted challenges unique to each city when they developed and implemented scooter and bikeshare programs. The most common challenges faced by the case-study cities related to pedestrian safety (riding on sidewalk), rider safety (scarce helmet use, insufficient bike infrastructure), curb space management (inappropriate bike parking), and data reporting. The authors reported ways that cities started addressing these problems, including improving bike infrastructure and encouraging helmet use, and specifying data reporting requirements in contracts. The authors concluded their report with a list of recommendations for cities to consider when pursuing bike and scooter share systems. These recommendations include using pilot programs to proactively regulate deployments; identify the best right-of-way policy, cost structure, sustainable practice, and providers unique to the city; and establish data reporting requirements so public agencies can properly evaluate the pilots.

Micromobility Policy Toolkit: Docked and Dockless Bike and Scooter Sharing
Susan Shaheen and Adam Cohen
Transportation Sustainability Research Center, University of California, Berkeley (2019)

This peer-reviewed toolkit was published by researchers at the Transportation Sustainability Research Center at the University of California, Berkeley in 2019. The toolkit is broken up into four sections. In the first section, the authors defined "shared micromobility" and outline some of the first reported impacts. Early impacts of shared micromobility in cities include increased mobility, reduced environmental impacts, decreased personal automobile use, increased economic development, and health benefits. In the following section, the authors present patterns in user characteristics. The authors found that recent surveys and early literature provide conflicting characteristics of the average user. In the third section, the authors identify common micromobility policies and practices, especially those related to curb space management, equity, and data sharing. In the final section, the authors summarize their key findings and provide readers with a list of recommended reading.

Public Bikesharing in North America During a Period of Rapid Expansion: Understanding Business Models, Industry Trends and User Impacts
Susan Shaheen, Elliot Martin, Nelson Chan, Adam Cohen, Mike Pogodzinski
Mineta Transportation Institute (2014)

The study looks at current practices, different business models, membership demographics, and environmental and social impacts of public bikeshare systems in North America. The authors conducted interviews with representatives from transit agencies, bikeshare operators, and other bikeshare experts in Canada, Mexico, and the United States between 2011 and 2013. The authors also performed on-street and online surveys on-street of bikeshare users in multiple cities. The authors found that public bikeshare systems are often run as nonprofits and are primarily funded by sponsorships, membership fees, and usage fees. The authors also found that compulsory helmet laws adversely affect ridership. With regards to modal substitution, surveys conducted by the authors indicated that bikeshare users most often replaced bus trips in four of the five cities. Users most frequently stated that they chose bikeshare in lieu of public transportation because it was faster and cheaper than public transportation. The surveys conducted by the authors also provided information relating to vehicle-miles-travelled, safety, and user demographics. A key finding from the surveys is that bikeshare users are more likely to be male, Caucasian, wealthier, younger, and have higher educational degrees than the general population of the city where the bikeshare operates.

The Micro-Mobility Revolution: The Introduction and Adoption of Electric Scooters in the United States
Regina Clewlow
Populus (2018)

This study published by Populus presents findings on adoption patterns and public opinion of e-scooters in the United States. The author's findings are largely based on a survey conducted in 11 U.S. cities. One key finding presented in this report is that the majority of respondents, approximately 70%, viewed e-scooters favorably. Additionally, the author found that users adopted e-scooters at a faster rate than other new mobility services, including bikesharing and carsharing. However, the author found that ride-hailing services, such as Uber and Lyft, experienced a faster rate of adoption than e-scooters. Some factors the author believes contributed to the fast adoption of e-scooters are an increase in smartphone use, the increase in congestion (and desire to avoid it), and the private financing which led to an increase in supply and greater access to e-scooters. Another interesting finding of this report is that the gender gap between male and female riders is lower for e-scooter shares than observed in bike shares.

TRANSPORTATION NETWORK COMPANIES

Partners in Transit: A Review of Partnerships Between Transportation Network Companies and Public Agencies in the United States
Joseph Schwieterman, Mallory Livingston, Stijn Van Der Slot
Chaddick Institute for Metropolitan Development at DePaul University (2018)

Researchers at the Chaddick Institute for Metropolitan Development at DePaul University identified 29 partnerships between transportation network companies (TNCs) and municipal governments, metropolitan planning organizations, and transit agencies in the United States. The researchers summarized each of the 29 partnerships and took note of when the programs occurred, how the program changed since the planning stage, the cost structure, and publicly available performance audits. The researchers categorized the partnerships into five common categories of partnerships. These categories of partnership include first- and last-mile connections and alternative to traditional public transit, the integration of transit and TNC service in a trip planning app, temporary and long-term parking infrastructure relief, on-demand service for the elderly or disabled, and programs such as guaranteed ride home programs that indirectly complement public transit usage. In the majority of observed partnerships, the researchers noted that the government or transit agency subsidized all or part of the trip cost for users. Some subsidies had constraints, for example subsidies only applied at certain times of day, in certain geographic areas, or for certain groups of users.

Partnerships Between Transit Agencies and Transportation Network Companies
Terra Curtis, Meg Merritt, Carmen Chen, David Perlmutter, Dan Berez, Buffy Ellis
Transit Cooperative Research Program; Transportation Research Board; National Academies of Sciences, Engineering, and Medicine (2019)

Using interviews, surveys, past literature, and an analysis of case studies, researchers created this multidimensional overview of partnerships between transit agencies and transportation network companies (TNCs). First, the authors identified their purpose and scope of work. Next, the authors examined 20 TNC-partnership case studies in the United States, paying close attention to the goals, development, outcomes, and lessons learned from different transit agencies. From the set of 20 case studies, the authors identified common motivations, target markets, partnerships designs, approaches to contracting, approaches to marketing and outreach, data sharing agreements, and methods of complying with federal regulations. The report ends with a set of areas for further research and a "Partnership Playbook," a guide for transit agencies looking to engage in partnerships with TNCs.

Partnerships with Technology-Enabled Mobility Companies: Lessons Learned
Marla Westervelt, Joshua Schank, Emma Huang
Transportation Research Record: Journal of the Transportation Research Board (2017)

The authors created this report for cities and transit agencies looking to engage in partnerships with transportation network companies and microtransit companies. The authors wrote a literature review and then analyzed two case studies to inform a set of recommendations and a list of lessons learned. The literature review covered three topics: the potential benefits of partnerships, the role of the public sector, and barriers to forming partnerships. Benefits of partnerships the authors identified include late-night service and service to areas that are not served by transit. The authors concluded from the literature that cities and transit agencies need to be assertive in partnerships to ensure equitable access for services. They found that the most common barriers for riders in using this service include being unbanked/underbanked, smartphone access, and data plans. Next, the authors analyzed two case studies, a pilot partnership between a TNC and a transit agency in Pinellas County, Florida and a microtransit pilot partnership between a microtransit provider and a transit agency in, Missouri. The authors concluded their report with lessons learned from the literature reviewed and the case studies.

Public/Private Partnerships in Transit: Case Studies and Analysis
Moira Blodgett, Alireza Khani, Diana Negoescu, and Saif Benjaafar
University of Minnesota (2017)

Researchers at the University of Minnesota published this report in October 2017. The Minnesota Council on Transportation Access commissioned the report to help guide future public-private partnerships in the Twin Cities region of Minnesota. The report identified five case studies the United States where local governments subsidized TNC trips, either partially or fully, for certain users to fill a specific transportation need. The study found that most TNC-transit partnership pilots in the United States fell under three main categories: providing on-demand paratransit services, creating first- and last-mile connections, and providing a transportation option in areas with low density and low ridership. The study identified other, less common, use-cases which include to provide rides for seniors, to address temporary peaks in transportation or parking demand, and to use for non-ambulatory medical transportation. The report identified most pilots conducted in the United States involved the same two TNC companies, Uber and Lyft. A recurring barrier to service observed in the case studies includes a lack of technological literacy. Much of the negative feedback during pilots stem from individuals having difficulty using technology. The authors found that adding phone-call service to book trips and a technology help service is one way to mitigate this issue.

Westchester County Bee-Line System First and Last Mile Connections Mobility Study
Craig Lader and Naomi Klein
Planning Division – Westchester County Department of Public Works and Transportation (2018)

Planners in Westchester County, New York created this study to determine if current gaps in their transportation system could be filled by transportation network companies (TNCs). The authors first identify potential issues the county might face when implementing a TNC partnership. The authors proposed challenges such as complying with ADA regulations, providing access to those without smartphones, keeping the price for service low, mitigating union-related labor issues, securing data from TNCs, and respecting existing operating arrangements. The authors identify 13 case studies to see how different transit agencies and local governments addressed the potential issues previously identified. The authors collected in-depth information on these case studies, including information about existing local transportation services, ridership information, and outcomes of each partnership. The authors concluded that the most viable partnership application for the City of Westchester is a partnership where a TNC provides an alternative to service currently provided by shuttle and loop networks as well as transit service in areas that are under-served.

MICROTRANSIT

Microtransit or General Public Demand-Response Transit Services: State of the Practice
Joel Volinski
Transit Cooperative Research Program, Transportation Research Board, National Academies of Sciences, Engineering, and Medicine (2019)

This is a "state of the practice" report on microtransit, also referred to as general public demand-response transit. This report draws on existing literature, surveys, interviews, and case studies. Author Joel Volinski first gives a brief history of microtransit services and reviews existing literature related to microtransit. In the following chapter, Volinski discusses results from surveys and interviews from public transit agencies that implemented microtransit services. The surveys provided information relating to the procurement and contracting process and the program design of microtransit systems. In the next chapter, the author studies five case examples of microtransit in the United States. The case studies contain detailed information on the setting, program design, provider, vehicles, marketing, funding source, fares, customer feedback, ridership data, outcomes, and lessons learned of each program. In the last chapter, the author states his conclusions from his research. The author believes that although microtransit generally has a high cost-per-trip, it can be cost-effective in certain areas and address issues of jurisdictional and socioeconomic equity by providing rides to those in underserved areas, typically low-income or rural areas.

UpRouted: Exploring Microtransit in the United States
Marla Westervelt, Emma Huang, Joshua Schank, Nolan Borgman, Tamar Fuhrer, Colin Peppard, Rani Narula-Woods
Eno Center for Transportation (2018)

In January 2018, the Eno Center for Transportation published this report to provide recommendations to transportation agencies that are interested in pursuing partnerships with microtransit companies. The report begins by providing background information and summarizing the history of microtransit in the United States and then compares three case studies. The case studies included two discontinued pilots and one successful pilot. The case studies include information on the different agencies' approaches for developing and deploying microtransit service, the different goals for the pilots, ridership data and characteristics, and staff opinions of the pilot projects. The Eno found that high operating costs and low ridership were the primary reasons for the discontinuation of two of the case study pilots. Other characteristics that contributed to the failure of the pilots included the prioritization of technology over customer needs, lack of flexible contracts, insufficient marketing, and inability of vendors to fulfill public goals of the transit agency.

AUTONOMOUS VEHICLES

Autonomous Vehicle Pilots Across America
Lucy Perkins, Nicole DuPuis, Brooks Rainwater
National League of Cities (2018)

Authors Perkins, Dupuis, and Rainwater created this municipal action guide on behalf of the National League of Cities in 2018. The guide provides cities with analysis of current autonomous vehicle regulation, pilots, and a summary of city approaches to autonomous vehicles. The report draws on autonomous vehicle pilots in various stages in Arlington, TX; Boston, MA; Portland, OR; Pittsburgh, PA; and Chandler, AZ. The authors identify a lack of federal and state regulations of autonomous vehicle testing, causing much of the decision making regarding autonomous vehicles to happen at the city-level. The authors found that the degree that cities involve themselves in pilot projects is quite varied. While some cities (Arlington) conduct pilots themselves, other cities (Chandler, Tempe, Mesa, Pittsburgh) choose to let technology companies and universities conduct the pilots independently, without any formal agreements with the organization leading the pilot. The authors note, however, that most pilots involve some level of involvement by the city or local municipality. The authors find that many cities want to attract companies to perform pilot programs in their cities so cities can better understand the technology, learn about public acceptance, and demonstrate innovativeness which city officials sometimes believe can lead to further technology investment in their city. By and large, autonomous vehicle pilots are not conducted primarily to create new transportation options according to the authors. Low-Speed Automated Shuttles: State of the Practice

Low-Speed Automated Shuttles: State of the Practice
Joshua Cregger, Margo Dawes, Stephanie Fischer, Caroline Lowenthal, Elizabeth Machek, and David Perlman
John A. Volpe National Transportation Systems Center, U.S. Department of Transportation (2018)

The Volpe National Transportation Systems Center, part of the US Department of Transportation, created this report in September 2018. The report specifically draws from autonomous shuttle pilots operating in Dublin, CA; San Ramon, CA; Gainesville, FL; Jacksonville, FL; Weymouth, MA; Ann Arbor, MI; Detroit, MI; Las Vegas, NV; Greenville, SC; and Arlington, TX. Authors created the report to review the current state of practice of low-speed automated shuttles. The researchers first identified common characteristics of autonomous shuttles. These characteristics include full automation (SAE level 4), simple or sometimes controlled operating environments, speeds between 10 and 15 mph, a carrying capacity between 4 and 15 passengers, and operate under shared right-of-way (share road with other vehicles, persons). The authors identified areas where current shuttles are lacking, which include a lack of accessibility features, limited technical capabilities, poorly defined goals for pilots and demonstrations, and highly controlled operating environments.

NON-AUTONOMOUS GOODS DELIVERY

A New Move for Business: Electric Cycle Logistics in European Cities
Željka Fištrek and Randy Rzewnicki
Energy Institute Hrvoje Požar (2016)

This report provides an overview of the Pro-E-Bike pilot, a pilot involving 40 public and private organizations using e-bikes, e-cargo bikes, and e-scooters to provide goods and service deliveries. The pilot took place in seven European countries in 20 different cities. The partners involved in the pilot provided a great variety of services and included restaurants, delivery companies, a national post service, home-care services, child-care services, municipal inspectors, and waste companies. The authors concluded that many pilots were successful and many of the businesses that participated in the pilot decided to continue or expand their use of e-bikes. The authors noted that municipal codes and regulations helped determine the advantage that the electric micromobility can provide. E-bikes and e-cargo bikes had the highest competitive advantage, in terms of cost advantage and speed and efficiency, in dense urban areas. Along with sufficient bike infrastructure, local policies such as low-emission zones, congestion taxes, and delivery time restrictions increased the desirability of e-bikes and e-cargo bikes for deliveries. Three components of the e-bikes were cheaper overall than traditional vans, including purchase price, maintenance costs, and fuel costs. However, vans performed better in rural areas because the e-bikes had a limited range, which meant it was not cost effective in these areas.

E-bikes and E-scooters for Smart Logistics: Environmental and Economic Sustainability in Pro-E-bike Italian Pilots
Roberto Nocerino, Alberto Colorni, Lia Frederico, Luè Alessandro
Transportation Research Procedia (2016)

Researchers at the Transportation Research Procedia studied the environmental and economic impacts of using e-cargo bikes, e-bikes, and moped-style e-scooters (e-scooters) for goods deliveries in pilots taking place in Italian cities. Companies involved in the pilots included an express courier company, a bike messenger company, a print shop, and a large logistics company. During these pilots, e-cargo bikes, e-bikes, and e-scooters replaced normal scooters or vans for completing urban deliveries. The companies that replaced traditional delivery vans with e-bikes and e-cargo bikes experienced reductions in carbon dioxide emissions. Researchers found that the money saved by the companies was quite varied. One company saved 57 euros during the 12-month pilot period while another company saved over 9,000 euros. The company with the highest cost savings operated in Milan, where there is a congestion charge in the city center that electric vehicles are exempt from. The researchers pointed to this congestion charge as a large portion of the cost savings for the company. Researchers pointed out that initial concerns over battery life of the vehicles turned out to be unwarranted because the average km per day was much lower than the battery's capacity.

Measuring delivery route cost trade-offs between electric-assist cargo bicycles and delivery trucks in dense urban areas
Manali Sheth, Polina Butrina, Anne Goodchild, Edward McCormack
European Transport Research Review (2019)

Researchers at the University of Washington in Seattle, Washington explored how changes in route and delivery conditions affected the cost advantages of using an electric-assist cargo bike versus a truck for urban deliveries. To learn more about operating costs and other limitations of electric-assist cargo bikes, the researchers conducted interviews with individuals in the cargo bike industry. To learn more about truck delivery routes in the city, the researchers shadowed a courier company for one day. The researchers changed the following variables to see how they would affect the costs associated with each delivery mode: distance between distribution center and neighborhood, number of stops, distance between stops, and number of packages delivered per stop. Two scenarios where cargo bikes were more cost effective than trucks include: where deliveries occur close to the distribution center and where there are many individuals that live closely together and a small volume of packages to be delivered. Trucks were more cost effective for deliveries that took place farther from the distribution center and where there was a large volume of deliveries to a single stop. The researchers proposed that cargo bikes are likely to be advantageous over trucks for delivery in congested cities, especially those with established bike infrastructure and limited truck parking. Further, they believe that having distribution centers closer to city centers will improve deliveries made by cargo bike by making them cheaper and faster.

AUTONOMOUS GOODS DELIVERY

Influences on Energy Savings of Heavy Trucks Using Cooperative Adaptive Cruise Control
Brian McAuliffe, Michael Lammert, Xiao-Yun Lu, Steven Shladover, Marius-Dorin Surcel, Aravind Kailas
SAE International (2018)

To learn more about the potential energy savings associated with autonomous freight technology, researchers tested two automation features in heavy-duty trucks, adaptive cruise control (ACC) and cooperative adaptive cruise control (CACC). These two technologies, ACC and CACC enable what is known as "platooning," where trucks drive closely together and aerodynamic influences cause the vehicles in the group to gain fuel efficiency. The researchers tested different separation distances, numbers of vehicles in the platoon, trailer configurations, speeds, and traffic interactions. To validate their results, the researchers compared their own results with results from past tests and found most of the outcomes from their test to be consistent. Some notable findings from the platoon tests include measurable fuel savings for all vehicles in a three-truck platoon and that the fuel savings increased when the trucks drove at shorter separation distances. The researchers also found that trucks operating in a two-truck platoon had lower net fuel savings than trucks operating in a three-truck platoon. Compared to the two-trailer long combination vehicle, the two-truck platoon had lower fuel savings. Finally, the researchers found that other road traffic can change the fuel savings of trucks in a platoon.

Last Mile Delivery with Autonomous Vehicles: Fiction or Reality?
Sasho Gramatikov, Ivan Kitanovski, Igor Mishkovski, Milos Jovanovik
Ss. Cyril and Methodius University (2019)

Authors of this study researched the business models of companies who began integrating autonomous vehicles for drone-based and ground-based deliveries. The researchers found that most ground-based AV delivery companies operate under a "business to business" (B2B) model, where companies provide delivery services to retailers that need to deliver goods. The researchers found that most of the deliveries involved grocery and meal deliveries rather than other goods. The authors noted that most of the AV companies are private and are privately funded. The authors found that companies who operate autonomous drone delivery services operate more frequently under a "business to consumer" (B2C) model. After conducting a public opinion survey, the authors found that most respondents favored the use of autonomous vehicles for last-mile delivery, especially if they increase the speed of deliveries. A few participants voiced concerns, included the security of the goods and the privacy of the customers. The authors mentioned that there was some selection bias present, the surveys were distributed in a short time frame and the average education of the participants was higher than the average.

Potential Improvements in Safety and Efficiency with Autonomous Trucking
Brian Schoettle and Michael Sivak
Sustainable Worldwide Transportation, University of Michigan (2017)

This white paper analyzed the technology and potential impacts of autonomous technology on large trucks used for delivering freight. The authors specified many potential benefits of autonomous trucks, most of which relate to safety or efficiency improvements caused by autonomous technology. The authors believe that autonomous and connected large trucks will reduce the high crash, injury, and fatality rates per vehicle and per distance of large trucks. The authors mention that sensors will greatly reduce blind spots and increase visibility, especially at night. Compared to light-duty vehicles, including cars and smaller vans, the height and size of large trucks allow sensors to be even more useful for trucks. The reduction in crashes will lead to financial savings for the trucking companies. Further financial savings will be gained due to the ability of autonomous technology to increase fuel efficiency, through managing powertrains and platooning. In addition to these safety and efficiency gains, autonomous trucks might solve long-term problems the trucking industry is facing, including driver shortages and high turnover rates. However, the authors mention that the "first generation" of autonomous trucks will likely not be able to realize all these gains because the first generation of autonomous trucks are likely to only be autonomous on highways or interstates, "from exit to exit," and still require a driver for driving on city roads. However, the time where driver is not driving might not actually be able to be used in a productive way due to motion sickness.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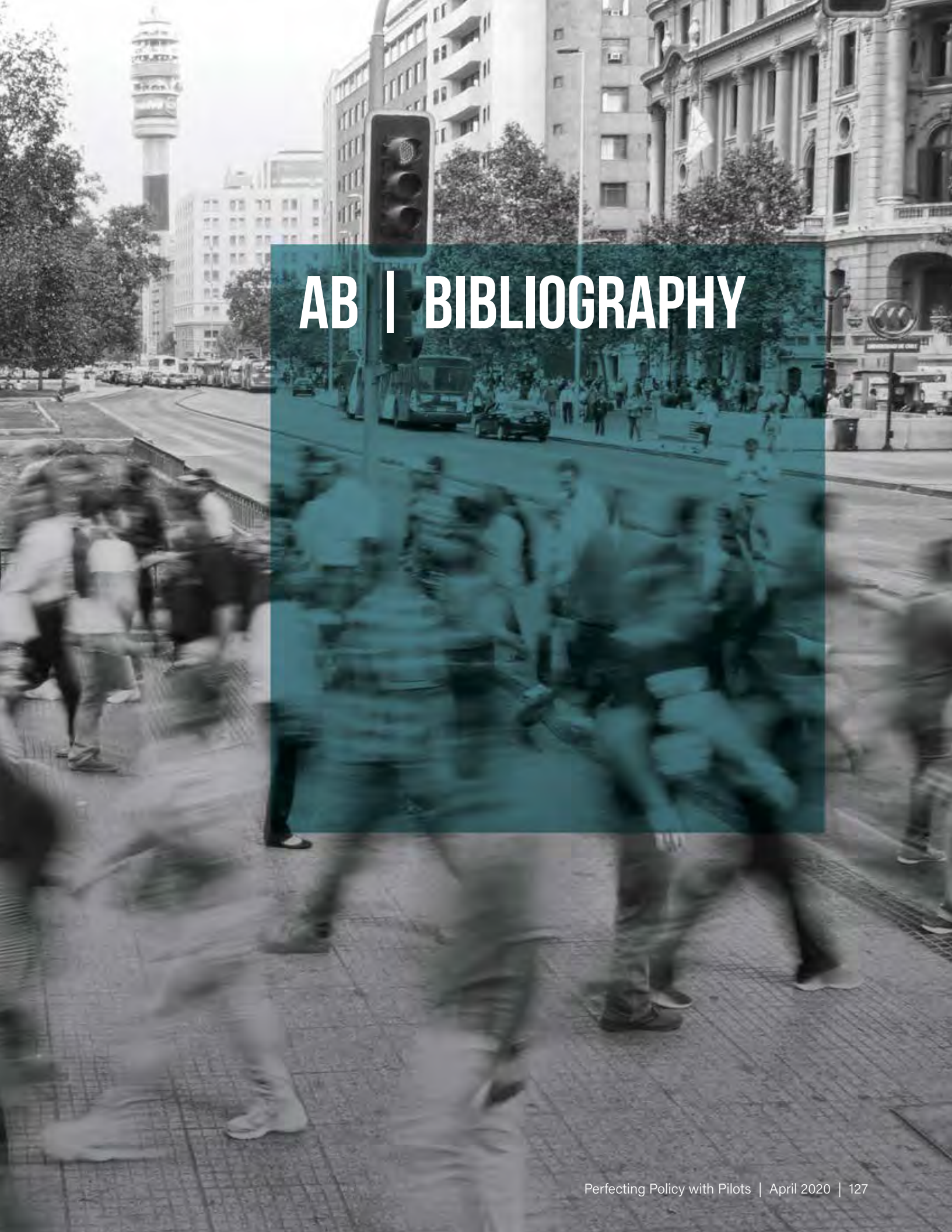

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AC | LIST OF 220 PILOT PROJECTS

MICROMOBILITY PILOTS

- Dockless Mobility Pilot Program, City of Alexandria, Alexandria, Virginia, Jan 2019 - No end date available
- Scooter Pilot, City of Ann Arbor and the University of Michigan (UM), Ann Arbor, Michigan, May 2019 - No end date available
- Shared Mobility Devices (SMD) Demonstration Project, Arlington County, Arlington County, Virginia, Oct 2018 - Jun 2019
- Dockless Vehicle Pilot Program, City of Austin, Austin, Texas, Apr 2018 - No end date available
- Dockless Pilot Program, City of Baltimore, Baltimore, Maryland, May 2018 - Jan 2019
- Bellevue Bike Share Pilot Permit Framework, City of Bellevue, Bellevue, Washington, Jul 2018 - Jul 2019
- Shared Electric Scooter Pilot, City of Berkeley, Berkeley, California - Never launched
- Shared Electric Scooter Pilot Program, Town of Brookline, Brookline, Massachusetts, Apr 2019 - Nov 2019
- Shared Electric Scooter Pilot, City of Calgary, Calgary, Alberta, Canada, Jul 2019 - Oct 2020
- Dockless Bike Share Pilot, City of Calgary, Calgary, Alberta, Canada, Oct 2018 - Oct 2020
- Shared Mobility Pilot Program, Charlotte Department of Transportation (CDOT), Charlotte, North Carolina, Nov 2017 - Sep 2018
- Scooters and Dockless Bike Share, City of Charlottesville, Charlottesville, Virginia, Nov 2018 - Dec 2019
- E-Scooter Share Pilot Program, City of Chicago, Chicago, Illinois, Jun 2019 - Oct 2019
- Dockless Bike Share Pilot Project, City of Chicago, Chicago, Illinois, May 2018 - Nov 2018
- Shared Micro-Mobility Device Program, City of Chula Vista, Chula Vista, California, Oct 2019 - Oct 2020
- Electric Scooter Pilot, City of Coral Gables, Coral Gables, Florida, Aug 2019 - No end date available
- Six-Month Scooter Trial, City of Culver City, Culver City, California, Jul 2018 - Sep 2019
- Dockless Vehicle Program, City of Dallas, Dallas, Texas, Jul 2018 - No end date available
- Dockless Mobility Vehicle Pilot Permit Program, Denver Department of Public Works, Denver, Colorado, Jun 2018 - No end date available
- MoGo Adaptive Bike Share Pilot, MoGo (City of Detroit's bikeshare system), Detroit, Michigan, May 2018 - Oct 2018
- Shared Use Mobility Pilot Program, City of El Paso, El Paso, Texas, Apr 2019 - Apr 2020
- Scooter Sharing Pilot Program, City of Everett, Everett, Washington, May 2019 - No end date available
- Dockless Mobility Pilot Program, City of Fairfax, Fairfax, Virginia, Jul 2019 - No end date available
- Bike Share Pilot Program, City of Flagstaff & Northern Arizona University Bikeshare, Flagstaff, Arizona, Apr 2018 - Oct 2018
- Bikeshare Pilot Program, City of Fort Collins, Fort Collins, Colorado, Jun 2016 - Apr 2018
- Shared Active Transportation Program, City of Fremont, Fremont, California, Aug 2019 - Aug 2020
- Scooter Share Pilot Program, City of Greensboro, Greensboro, North Carolina, Jan 2019 - Jan 2019
- Houston Bcycle Program, Houston Bike Share, Houston, Texas, May 2012 - No end date available
- Dockless Bikeshare Pilot Program, City of Imperial Beach, Imperial Beach, California, Sep 2017 - No end date available
- Bikeshare Pilot Program, Hawaii State Department of Health, Kailua, Hawaii, Apr 2011 - Dec 2014
- Scooter and eBike Pilot Program, City of Kansas City, Kansas, Missouri, May 2019 - No end date available

- Bikeshare Permit Program, City of Kelowna, Kelowna, Canada, Jun 2018 - No end date available
- Dockless Bike-Share Pilot Program, City of Kingston, Kingston, Ontario, Canada, Jul 2017 - Nov 2017
- Dockless Bikeshare Pilot Program, City of Lexington, Lexington, Kentucky, Jun 2018 - Jul 2019
- Electric Scooter-share Pilot Program, City of Little Rock, Little Rock, Arkansas, Jan 2019 - No end date available
- Shared Electric Scooter Pilot Program, City of Long Beach, Long Beach, California, Jul 2018 - Oct 2018
- Dockless On-Demand Personal Mobility pilot program, Los Angeles Department of Transportation (LADOT), Los Angeles, California, Mar 2019 - Mar 2020
- Metro Bike Share E-Bike Pilot, Metro Bike Share (City of Los Angeles, LA Metro, the Port of LA, BCycle, Bicycle Transit Systems), Los Angeles, California, Nov 2018 - No end date available
- Metro Countywide Bike Share Pilot Program, Los Angeles County Metropolitan Transportation Authority (Metro), Los Angeles, California, July 2016 – Ongoing Dec 2019
- County-wide Bikeshare Pilot, McHenry County, McHenry County, Illinois, Jun 2019 - Jun 2021
- Shared Mobility Pilot Program, City of Memphis, Memphis, Tennessee, May 2018 - No end date available
- Free-Floating Bikeshare Pilot Program, City of Mercer Island, Mercer Island, Washington, Jul 2018 - Oct 2018
- Miami Scooter Pilot Program, City of Miami, Miami, Florida, Apr 2019 - Aug 2019
- Dockless Scooter Pilot Study, City of Milwaukee Department of Public Works, Milwaukee, Wisconsin, No date available - Dec 2019
- Dockless Bicycle Share Pilot Study, City of Milwaukee Department of Public Works, Milwaukee, Wisconsin, No date available - Dec 2019
- Adaptive Bike Pilot, City of Milwaukee Department of Public Works, Milwaukee, Wisconsin, Aug 2019 - Dec 2019
- 2018 Scooter Pilot, City of Minneapolis, Minneapolis, Minnesota, Aug 2018 - Nov 2018
- GoMonrovia Bikeshare Pilot Program, City of Monrovia, Monrovia, California, Mar 2018 - No end date available
- Dockless Bikeshare Pilot Program, Montgomery County, Montgomery County, Maryland, Nov 2017 - May 2018
- Electric Scooter Pilot, City of Montreal, Montreal and Westmount, Quebec, Canada, Jul 2019 - Nov 2019
- Dockless Bike Share Pilot Program, City of Mountain View, Mountain View, California, May 2018 - Apr 2019
- Dockless Bike Share Pilot, New York City Department of Transportation (NYCDOT), New York City, New York, Jul 2018 - May 2019
- Shared Moped Pilot, Revel, New York City, New York, Jul 2018 - No end date available
- Shared Scooter Pilot Program, City of Norfolk, Norfolk, Virginia, Jun 2019 - Jun 2020
- Dockless Bikeshare Pilot, North County Transit District and San Diego Association of Governments (SANDAG), North County, San Diego, California, Summer 2019 - Summer 2020
- Adaptive Bike Share Pilot, City of Oakland, Bay Wheels/Bay Area Outreach and Recreation Program (BORP), Oakland, California, May 2019 - No end date available
- IndeGo Electric, Indego, Philadelphia, Pennsylvania, Nov 2018 - Mar 2019
- City of Portland Scooter Pilot (2018), Portland Bureau of Transportation (PBOT), Portland, Oregon, Jul 2018 - Nov 2018
- Adaptive Biketown Pilot Program, Portland Bureau of Transportation (PBOT), Portland, Oregon, Jul 2017 - Oct 2017

- 2019 E-Scooter Pilot Program, Portland Bureau of Transportation (PBOT), Portland, Oregon, Apr 2019 - Apr 2020
- E-Scooter Share Program, City of Providence, Providence, Rhode Island, Aug 2018 - Aug 2019
- Dockless Vehicle Pilot Program, City of San Antonio, San Antonio, Texas, Oct 2018 - Sep 2019
- Stationless Bikeshare Pilot, San Francisco Municipal Transportation Agency (SFMTA), San Francisco, California, Jan 2018 - Jul 2019
- Powered Scooter Share Permit and Pilot Program, San Francisco Municipal Transportation Agency (SFMTA), San Francisco, California, Oct 2018 - Oct 2019
- Bay Area Bike Share Pilot, San Fransisco Municipal Transportation Agency (SFMTA) in partnership with the Bay Area Air Quality Management District (BAAQMD), San Jose, San Fransisco, California, Aug 2013 - Jun 2017
- Shared Mobility Pilot Program, City of Santa Monica, Santa Monica, California, Sep 2018 - Jan 2020
- Free-Floating Bike Share Pilot, Seattle Department of Transportation (SDOT), Seattle, Washington, Jul 2017 - Dec 2017
- Dockless Bikeshare Pilot, League to Save Lake Tahoe and Tahoe Regional Planning Agency, South Lake Tahoe, California, Jul 2017 - Oct 2017
- Shared Mobility Pilot Program, City of Spokane, Spokane, Washington, Sep 2018 - Nov 2018
- Bike Share Pilot Program, St. Lucie County, St. Lucie County, Flordia, May 2018 - May 2020
- E-Scooter Pilot Project, Tallahassee City Commission, Tallahassee, Florida, Jul 2019 - Oct 2019
- Shared Electric Scooter Pilot Program, City of Tampa, Tampa, Florida, May 2019 - May 2020
- Shared Electric Scooter Pilot Program, City of Tucson Department of Transportation (TDOT), Tucson, Arizona, Sep 2019 - Mar 2020
- Pilot Shared Mobility System, City of Waco, Waco, Texas, Jun 2019 - No end date available
- Bikeshare Pilot Program, City of Walnut Creek, Walnut Creek, California, Jan 2018 - Feb 2019
- Capital Bikeshare Plus E-Bike Pilot, District Department of Transportation (DDOT), Washington, District of Columbia, Sep 2018 - Nov 2018
- Pilot for Shared Motor-Driven Cycles, District Department of Transportation (DDOT), Washington D.C., District of Columbia, Aug 2019 - Dec 2019
- Electric Scooter Pilot Program, City of Wichita, Wichita, Kansas, Jul 2019 - Jul 2020

TNC PARTNERSHIP PILOTS

- Central Florida Inter-City Pilot Program, Municipal Mobility Working Group (MMWG), Altamonte Springs, Lake Mary, Longwood, Maitland, Sanford, Florida, Mar 2016 - Jul 2017
- Access AgLanta, City of Atlanta, Atlanta, Georgia, Jun 2019 - Dec 2019
- MetroLink, CapMetro, Austin, Texas, Jun 2018 - Jun 2019
- Lyft Transit Connections, Valley Regional Transit (VRT), Boise, Idaho, Jan 2019 - Jul 2020
- On-Demand Paratransit Pilot Program, Massachusetts Bay Transportation Authority, Boston, Massachusetts, Sep 2016 - Mar 2020
- Service Worker Access Program, Garrett Harker, Boston, Massachusetts, Apr 2019 - Sep 2019
- Door 2 Downtown (D2D), City of Boulder, Boulder, Colorado, Nov 2016 - Feb 2017
- Go Centennial, City of Centennial, Centennial, Colorado, Aug 2016 - Feb 2017

- First Mile / Last Mile Program, Charlotte Area Transit System, Charlotte, North Carolina, Apr 2018 - No end date available
- First Mile / Last Mile Transit Pilot, Regional Transportation Authority (RTA), Chicago, Illinois, Apr 2019 - Apr 2021
- COMET To the Market, Central Midlands Regional Transit Authority (COMET), Columbia, South Carolina, Jan 2019 - Jun 2019
- COMET @ Night, Central Midlands Regional Transit Authority (COMET), Columbia, South Carolina, Jan 2019 - Jun 2019
- Prenatal Trip Assistance Pilot, Smart Columbus (City of Columbus smart city initiative), Columbus, Ohio, Jun 2019 - Nov 2019
- Lyft Work Transportation Pilot, Dakota County, Dakota County, MN, Minnesota, Apr 2019 - Jun 2020
- On-Demand Transportation for Seniors and People with Disabilities, MV Transportation, Dallas, Texas, Oct 2017 - No end date available
- Late Night Ride Service, Denton County Transportation Authority (DCTA), Denton, Texas, Aug 2018 - Dec 2018
- Highland Village Lyft Program, Denton County Transportation Authority (DCTA), Denton County, TX, Texas, Sep 2016 - No end date available
- DU Moves / Lyft Pilot, University of Denver, Denver, Colorado, No date available
- NightShift, Detroit Department of Transportation, Detroit, Michigan, Sep 2018 - No end date available
- Woodward 2 Work, Detroit Department of Transportation, Detroit, Michigan, May 2018 - No end date available
- Go Dublin, Livermore Amador Valley Transit Authority, Dublin, California, Jan 2017 - Jun 2019
- Freedom in Motion, City of Gainesville, Gainesville, Florida, Sep 2016 - Mar 2017
- Georgetown Lyft Rideshsare Pilot, City of Georgetown, Georgetown, Texas, Jul 2018 - Mar 2019
- Lyft & GO pilot program, Metrolinx, Greater Toronto Hamilton Area, Ontario, Jul 2019 - Dec 2019
- Lyft Indy Grocery Access Program, City of Indianapolis, Indianapolis, Indiana, Jul 2019 - Dec 2019
- Innisfil Transit, City of Innisfil, Innisfil, Ontario, Canada, May 2017 - May 2017
- Senior Mobility with Uber, City of Laguna Beach, Laguna Beach, California, No end date available
- RTC Ride On-Demand Pilot Program, Regional Transportation Commission of Southern Nevada, Las Vegas Valley, Nevada, Feb 2018 - Feb 2019
- Metro/Via Mobility on Demand Pilot, Los Angeles County Metropolitan Transportation Authority (LA Metro), Los Angeles, California, Jan 2019 - Jan 2020
- GETSMART17 Pilot Program, Transportation Authority of Marin, Marin County, California, Sep 2017 - Sep 2018
- Ride Share Pilot Program with Lyft & Uber, City of Mercer Island, Mercer Island, Washington, Apr 2018 - Oct 2018
- Hitch Healthcare Lyft Pilot, Hitch Health, Minneapolis, Minnesota, 2017 - 2018
- GoMonrovia, City of Monrovia, Monrovia, California, Mar 2018 - Jan 2019
- RTA Connect On-Demand, Greater Dayton Regional Transit Authority (GDRTA), Montgomery County, Ohio, Jun 2017 - No end date available
- Mid-day Mobility Pilot Program, Mountain View Transportation Management Association (MTMA), Mountain View, California, Apr 2019 - Dec 2019
- PATH Lyft Partnership, Port Authority of NY & NJ, New York City and Jersey City, New York and New Jersey, Jan 2019 - Jul 2019

- Workforce Mobility Program, Regional Transportation Commission of Southern Nevada, North Las Vegas, Nevada, Nov 2018 - May 2019
- First Mile Last Mile, Phoenix Public Transit Department, Phoenix, Arizona, Oct 2017 - Apr 2018
- Direct Connect, Pinellas Suncoast Transit Authority, Pinellas County, FL, Florida, Feb 2016 - Aug 2018
- Paratransit Mobility on Demand, Pinellas Suncoast Transit Authority, Pinellas County, FL, Florida, Nov 2018 - Nov 2019
- TD Late Shift, Pinellas Suncoast Transit Authority, Pinellas County, FL, Florida, Aug 2016 - Jun 2017
- Free $5 to Ride, City of Rancho Cordova, Rancho Cordova, California, May 2019 - No end date available
- RTP Connect, GoTriangle, Research Triangle Park (Includes cities of Raleigh, Durham, and Chapel Hill), North Carolina, Aug 2019 - No date available
- RT Station Link, Sacramento Regional Transit (RT), Sacramento, California, Oct 2016 - Mar 2017
- SC Ride, City of San Clemente, San Clemente, California, Oct 2016 - Oct 2018
- RTD GO!, San Joaquin Regional Transit District, San Joaquin County, CA, California, Jul 2017 - No end date available
- SEPTA and Uber Transit Partnerships, Southeastern Pennsylvania Transportation Authority (SEPTA), SE Pennsylvania, Pennsylvania, May 2016 - Sep 2016
- Lyft Mary's Place Partnership, Lyft, Seattle, Washington, Jul 2019 - Dec 2019
- Solano Mobility First/Last Mile Pilot Program, Solano Transportation Authority, Solano County, CA, California, May 2017 - No end date available
- Summit Ridesharing Program, City of Summit, Summit, New Jersey, Oct 2016 - Mar 2017
- Limited Access Connections, Pierce Transit, Tacoma, Washington, May 2018 - Dec 2019
- Late-Night Transportation, Bay Area Transportation Authority (BATA), Traverse City, Michigan, Jun 2019 - Jun 2020
- After-Hours Commuter Service, Washington Metropolitan Area Transit Authority (Metro), Washington DC, District of Columbia, Jul 2019 - Jun 2020
- Rabbittransit Uber Pilot, Rabbit Transit, York County, PA, Pennsylvania, Aug 2017 - Feb 2018

MICROTRANSIT PILOTS

- Flex Service Pilot, Alameda-Contra Costa Transit District (AC Transit), Alameda-Contra Costa Counties, California, Mar 2017 - Mar 2018
- Arlington On-Demand Rideshare Pilot Program, City of Arlington, Arlington, Texas, Dec 2017 - No end date available
- Demand Response MicroTransit Demonstration Project, Rogue Valley Transportation District (RVTD), Ashland, Oregon, Dec 2019 - No end date available
- Pickup, Capital Metro, Austin, Texas, Jun 2017 - Jun 2018
- Ride2 Park & Ride Pilot, King County Metro, Bellevue, Washington, Oct 2018 - No end date available
- Ride Bend Microtransit Pilot, Oregon State University (OSU) Cascades Mobility Lab, Bend, Oregon, Jul 2019 - Sep 2019
- Green Raiteros and Van y Vienan, Valley Latino Environmental and Advancement Policy (Valley LEAP) and The Leadership Counsel for Justice and Accountability, Cantua Creek and Huron, California, 2017 - No end date available

- Microtransit Pilot Program, Regional Transportation Authority of Northeastern Illinois (RTA), Chicago Region, Illinois, Jul 2018 - 2020
- SmaRT Ride Microtransit Pilot Project, Sacramento Regional Transit District (SacRT), Citrus Heights, California, Feb 2018 - No end date available
- LTD Connector Shuttle Pilot, Lane Transit District (LTD), Cottage Grove, Oregon, Jan 2019 - Feb 2020
- Denton Enterprise Airport On-Demand, Denton County Transportation Authority (DCTA), Denton County, Texas, Aug 2018 - Jan 2019
- Tri MyRide, Eastern Contra Costa County Transit Authority (Tri Delta Transit), Eastern Contra Costa County, California, Jun 2019 - Dec 2019
- EmGo Electric Shuttle Pilot, Lane Transit District (LTD), Eugene, Oregon, Aug 2019 - 2020
- Rapid On Demand, The Rapid, Grand Rapids, Michigan, Aug 2019 - No end date available
- COTA Plus Pilot, Central Ohio Transit Authority (COTA), Grove City, Ohio, Jul 2019 - No end date available
- RideKC Micro Transit Pilot, Kansas City Area Transportation Authority, Johnson County, Kansas, Feb 2019 - No end date available
- RideKC: Bridj Pilot, Kansas City Area Transportation Authority, Kansas City, Missouri, Mar 2016 - Sep 2016
- RideKC: Freedom On-Demand, Kansas City Transportation Authority (KCATA), Kansas City, Missouri, Apr 2017 - Apr 2018
- Trip to Strip Pilot Program, Regional Transportation Commission (RTC), Las Vegas, Nevada, Jun 2019 - No end date available
- FlexLA, FASTLinkDTLA, Los Angeles, California, Sep 2018 - No end date available
- San Francisco and LA Counties First Transit Pilot, First Transit, Los Angeles and San Francisco, California, Jul 2019 - No end date available
- Wheels2U, Norwalk Transit District, Norwalk, Connecticut, Sep 2018 - No end date available
- OC Flex Microtransit Service, Orange County Transportation Authority (OCTA), Orange County, California, Oct 2018 - Oct 2019
- RideACT Microtransit Pilot, Airport Corridor Transportation Association (ACTA), Robinson Township, Pennsylvania, Jan 2019 - No end date available
- Commuter Shuttle Pilot Program, San Francisco Municipal Transportation Agency (SFMTA), San Francisco, California, Aug 2014 - No end date available
- VanGo! Mobility On-Demand (MOD) Pilot, San Joaquin Regional Transit District, San Joaquin County, California, Oct 2018 - Jan 2019
- Marin Transit Connect, Marin County Transit District (Marin Transit), San Rafael, California, Jul 2018 - Jul 2019
- VTA FLEX pilot, Santa Clara Valley Transportation Authority (VTA), Santa Clara County, California, Feb 2016 - Jul 2016
- MVTA Connect Pilot, Minnesota Valley Transit Authority (MVTA), Savage, Minnesota, Jun 2019 - Dec 2019
- Via to Transit, King County Metro, Central Puget Sound Regional Transit Authority, and City of Seattle, Seattle and Tukwila, Washington, Apr 2019 - Apr 2020
- Microtransit Pilot Program, Gwinnett Transit, Snellville, Georgia, Sep 2018 - Apr 2019
- Microtransit Service Pilot, League to Save Lake Tahoe (Keep Tahoe Blue), South Lake Tahoe, California, Jul 2018 - No end date available

- Last Mile Microtransit Service Pilot, Downtown STL, Inc., St. Louis, Missouri, Feb 2018 - Jun 2018
- On-Demand Microtransit Pilot Program, Rock Island County Metropolitan Mass Transit District (MetroLINK), Village of Milan, Illinois, Jun 2019 - Jan 2020
- West Sacramento's On-Demand Rideshare Pilot, City of West Sacramento, West Sacramento, California, May 2018 - No end date available
- Ride On Flex Microtransit Pilot Program, Montgomery County Department of Transportation (MoCo), Wheaton, Glenmont, Montgomery County, Maryland, Jun 2019 - Jun 2020
- The Hopper Microtransit Pilot Project, Rabbit Transit (The Central Pennsylvania Transportation Authority), York County, Pennsylvania, Aug 2018 - No end date available

PASSENGER AV PILOTS

- Downtown Tampa Autonomous Transit Circulator Service on the Marion Street Transitway, Hillsborough Area Regional Transit Authority (HART) and the Florida Department of Transportation, Tampa, Florida, 2018 - 2019
- Mcity Driverless Shuttle, Mcity, Ann Arbor, Michigan, Jun 2018 - No end date available
- Milo pilot program, City of Arlington, Arlington, Texas, Aug 2017 - Aug 2018
- City of Arlington and Drive.ai Pilot Project, City of Arlington, Arlington, Texas, Oct 2018 - May 2019
- Downtown Bryan Self-Driving Trolley, City of Bryan, Bryan, Texas, Oct 2018 - Nov 2018
- Babcock Ranch Driverless Shuttle Pilot, Transdev, Babcock Ranch, Florida, Nov 2017 - No end date available
- City of Boston Autonomous Vehicle Pilot, City of Boston, Boston, Massachusetts, Jan 2017 - No end date available
- Waymo Passenger Vehicle Pilot Project, Waymo, Chandler, Arizona, Apr 2017 - No end date available
- Smart Columbus, Department of Transportation, Paul G. Allen Family Foundation, Columbus, Ohio, Dec 2018 - No end date available
- 61AV pilot project, Regional Transportation District, Denver, Colorado, Jan 2019 - No end date available
- May Mobility Bedrock Pilot, Bedrock, Detroit, Michigan, Jun 2018 - No end date available
- Assembly Project, The Integral Group, Doraville, Georgia, No end date available
- LAVTA self-driving shuttle, LAVTA, Dublin, California, Jun 2018 - No end date available
- ELA in Calgary, Edmonton, Vancouver, Surrey, Beaumont, Calgary, Alberta, Pacific Western Transportation, Telus, ATCO and Federal, ELA in Canada, Alberta, Canada, Sep 2018 - No end date available
- Optimus ride, Optimus ride, Fairfield, California, No date available
- Driverless Car Pilot Program, City of Frisco, Frisco, Texas, Jul 2018 - Jan 2019
- GAToRS, Florida Department of Transportation, Gainesville, Florida, No date available
- Grand Rapids Autonomous Vehicle Initiative, Grand Rapids, May Mobility, Consumers Energy, Faurecia, Gentex, Rockford Construction, Seamless, Steelcase and Start Garden, Grand Rapids, Michigan, Jul 2019 - Jul 2020
- The pilot project at Texas Southern University, Metropolitan Transit Authority of Harris County (METRO), Houston, Texas, Jun 2019 - No date available

- AAA Self Driving Shuttle, AAA Northern California, Nevada & Utah (AAA), Las Vegas, Nevada, Nov 2017 - Nov 2018
- Aptiv and Lyft Robo-Taxi Pilot, Aptiv and Lyft, Las Vegas, Nevada, Jan 2018 - No end date available
- Autonomous Shuttle Project, Bloomberg Philanthropies, City of Lincoln, Lincoln, Nebraska, Jun 2018 - Aug 2018
- Optimus Ride, Optimus Ride, New York City, New York, Aug 2019 - No end date available
- Valley Metro and Waymo Pilot Project, Waymo & Valley Metro, Phoenix, Arizona, Aug 2018 – Aug 2020
- Early rider program, Waymo, Phoenix, Arizona, Apr 2017 - No end date available
- Waymo one, Waymo, Phoenix, Arizona, Dec 2018 - No end date available
- Waymo Lyft Partnership, Lyft & Waymo, Phoenix, Arizona, May 2019 - No end date available
- Little Roady, Transportation Innovation Partnership (TRIP), Providence, RI, Rhode Island, May 2019 - May 2020
- Optimus Ride in Reston, Optimus Ride, Reston, Virginia, Jun 2019 - No end date available
- Connected Autonomous Shuttles, San Francisco County Transportation Authority, San Francisco, California, 2020 - No end date available
- Autonomous ride-hailing pilot program, NA, San Jose, California, 2019 - No end date available
- Shared Autonomous Vehicle Pilot Project, California's Contra Costa Transportation Authority, San Ramon, California, Mar 2018 - No end date available
- Optimus Ride at Weymouth, MA, Optimus Ride, Weymouth, Massachusetts, 2018 - No end date available

AV DELIVERY PILOTS

- Ford Autonomous Delivery, Ford, Ann Arbor, Michigan, Aug 2017 - No end date available
- Farmstead & Udelv pilot, Farmstead, Bay area, California, Sep 2019 - No end date available
- Walmart/Waymo pilot program, Walmart, Chandler, Arizona, Jul 2018 - No end date available
- Nuro autonomous robot, Nuro, Houston, Texas, Mar 2019 - No end date available
- Udelv autonomous van, Udelv, Houston, Texas, 2019 - No end date available
- Amazon Scout, Amazon, Irvine, California, Aug 2019 - No end date available
- Ford Self-driving Pizza, Ford, Miami-Dade County, Florida, Feb 2018 - No end date available
- Robot Delivery Pilot Program, Starship, Redwoods, California, Nov 2016 - Dec 2018
- Udelv autonomous van, Udelv, San Antonio, Texas, 2019 - No end date available
- Marble robot delivery, Marble, San Francisco, California, Apr 2017 - Dec 2017
- Postmate robot delivery, Postmate, San Francisco, California, No date available
- GM's Cruise food delivery pilot, GM's Cruise, San Francisco, California, 2019 - No end date available
- AutoX Autonomous Delivery, AutoX, San Jose, California, No date available
- Draeger's Market & Udelv pilot, Draeger's Market, San Mateo, California, Jan 2018 - No end date available
- Nuro self-driving robots, Nuro, Scottsdale, Arizona, Aug 2018 - Mar 2019
- Amazon Scout, Amazon, Snohomish County, Washington, Jan 2019 - No end date available
- Autonomous Walmart grocery delivery, Walmart, Surprise, Arizona, Jan 2019 - No end date available
- Starship autonomous robots, Starship, Washington, District of Columbia, Mar 2017 - No end date available