

TRANSIT TRANSFORMATION:

FROM OPERATORS TO
MOBILITY INTEGRATORS



TRANSIT TRANSFORMATION: From Operators to Mobility Integrators

Final Report
August 2020

For:
Public Transit Office
Florida Department of Transportation
www.fdot.gov/transit



"The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the State of Florida Department of Transportation."

ACKNOWLEDGMENTS

The study team extends its sincerest appreciation to the following contributors who work diligently each day to “transform” the mobility ecosystem of their own communities for the better. During these unprecedented times, we would additionally like to thank the University of South Florida’s Center for Urban Transportation Research (CUTR) for hosting the virtual “scenario planning” workshop and express gratitude to each participant whose thoughtful perspective and insight helped shape the recommendations of this study.

AGENCY SURVEY AND INTERVIEW PARTICIPANTS

Broward County Transit

Tara Crawford, Luis Ortiz Sanchez

Broward Metropolitan Planning Organization

Peter Gies, Renee Cross

City of West Palm Beach

Uyen Dang

Collier Area Transit

Zachary Karto

Downtown Fort Lauderdale Transportation Management Association

Robyn Chiarelli

Gainesville Regional Transit System

Jesus Gomez

Hernando/Citrus Metropolitan Planning Organization

Steve Diez

Jacksonville Transportation Authority

Suraya Teeple, Paul Tiseo, Jeremy Norsworthy

LYNX

Tomika Monterville, Myles O’Keefe, Patricia Whitton

MetroPlan Orlando

Nick Lepp, Sarah Larsen

Palm Beach Transportation Planning Agency

Valerie Neilson

Pinellas Suncoast Transit Authority

Heather Sobush, Jacob Labutka

St. Lucie Transportation Planning Organization

Marceia Lathou

StarMetro

Andrea Rosser, Ronnie Lee Shelly, Jr.

Tampa Bay Area Regional Transit Authority

Brian Pessaro

STUDY TEAM

Michael Baker International

Fred Jones, Brad Thoburn, Catherine Koval, Dara Osher

GLOSSARY OF TERMS

Application (App)

An application, especially as downloaded by a user to a mobile device (smart phone, tablet, laptop) (NCMM, 2020).

Application Program Interface (API)

An application program interface (API) is a set of routines, protocols, and tools for building software applications. Basically, an API specifies how software components should interact. Additionally, APIs are used when programming graphical user interface (GUI) components (Beal, 2020). Using APIs, different systems can be connected to create an integrated network.

Automatic Passenger Counter (APC)

An electronic device available for installation on transit vehicles including buses and rail vehicles which accurately records boarding and alighting data. This technology can improve the accuracy and reliability of tracking transit ridership over traditional methods of manual accounting by drivers or estimation through random surveying. These devices are becoming more common among American transit operators seeking to improve the accuracy of reporting patronage as well as analyzing transit use patterns by linking boarding and alighting (disembarking) data with stop or station location (www.transitwiki.org, 2020).

Autonomous Vehicles

A vehicle that can sense its environment and guide itself without human input. AVs are sometimes referred to as HAVs (Highly Autonomous Vehicles) or as having ADS (Automated Driving Systems) (NCMM, 2020).

Buy America

Federal transportation law which requires that all purchases of vehicles, equipment or any other manufactured item be of U.S.-made and assembled components, unless the purchase price is less than \$100,000 or the U.S. Department of Transportation has given the purchaser a Buy America waiver (NCMM, 2020).

Demand-Response Service

The type of transit service where individual passengers can request transportation from a specific location to another specific location at a certain time. Transit vehicles providing demand-response service do not follow a fixed route, but travel throughout the community transporting passengers according to their specific requests. Can also be called "dial-a-ride." These services usually, but not always, require advance reservations (NCMM, 2020).

First-Mile/Last-Mile (FM/LM) Access

First-mile/last-mile access describes the beginning or end of an individual trip (walking, biking, or otherwise) made primarily to access public transportation in which there may be a gap from origin to public transit or public transit to destination.

General Transit Feed Specification (GTFS)

The General Transit Feed Specification (GTFS) is a data specification that allows public transit agencies to publish their transit data in a format that can be consumed by a wide variety of software applications. Today, the GTFS data format is used by thousands of public transport providers. GTFS is split into a static component that contains schedule, fare, and geographic transit information and a real-time component that contains arrival predictions, vehicle positions and service advisories (GTFS, 2020).

Micromobility

Utility-focused transport vehicles, most of which are electrically powered and weigh under 500 kg. Encompasses shared fleets of small vehicles like bikes, e-bikes, and scooters. Typically accessed using a smartphone application and geared towards transportation trips with a distance of 5 miles or less (Halfon, 2019; Runnerstrom, 2018).

Microtransit

IT-enabled private multi-passenger transportation services, such as Chariot and Via, that serve passengers using dynamically generated routes, and that expect passengers to make their way to and from common pick-up or drop-off points. Vehicles can range from large SUVs to vans to shuttle buses. Because they provide transit-like service but on a smaller, more flexible scale, these new services have been referred to as microtransit (NCMM, 2020).

Mobile Fare Payment App

A mobile fare payment app refers to a software application on a smartphone or other portable electronic device such as a tablet that allows transit riders to pay for and access public transit services. These software applications are typically downloaded onto the user's device from Google Play for Android devices or the Apple App Store for iOS (Apple's mobile operating system) devices (NASEM, 2020b).

Mobility as a Service (MaaS)

MaaS is essentially the next step in the progression from isolated agency-by-agency information and operations to a one-call/one-click/one-pay transportation network. The philosophy behind MaaS is to direct people to their most appropriate mobility options, in real time, through a single, unified trip planning and payment application (NCMM, 2018).

Mobility Data Specification

Mobility Data Specification (MDS) is set of APIs focused on dockless e-scooters, bicycles, mopeds, and carshare that aims "to provide a standardized way for municipalities and other regulatory agencies to ingest, compare, and analyze data from mobility service providers, and to give municipalities the ability to express regulation in machine-readable formats (GitHub, 2020).

Mobility Ecosystem

The mobility ecosystem refers to the interconnected transportation environment in which all modes (from micromobility, ridesourcing, and shared mobility to fixed-route transit service, microtransit, and cycling/walking) work together to allow for free movement in the access of goods and services by people.

Mobility Integration

The foundation of integrated mobility is public transit. Integrated mobility is used when mobility providers collaborate and promote their travel services as one unified service. It is about linking transportation options together so they can be accessed by commuters as part of a package. Integrated mobility lets passengers create an intermodal trip and use several modes of transport to arrive at their destination, such as an e-bike followed by a train. Alternatively, they can choose from various transportation options, such as a bus, car sharing or a train. The term integrated mobility is also used in relation to supplying information, bookings, reservations, and payments. The goal is to provide a service that integrates all these resources (HERE Mobility, 2020).

Mobility On Demand (MOD)

An integrated and connected multi-modal network of safe, affordable, and reliable transportation options that are available and accessible to all travelers (NCMM, 2020).

Mobility Management

Mobility management is an innovative approach for managing and delivering coordinated transportation services to customers. These customers include, but are not limited to the transportation disadvantaged such as seniors, individuals with disabilities and individuals with lower incomes. Mobility management focuses on meeting individual customer needs through a wide range of transportation options and service providers. It also focuses on coordinating these services and providers in an effort to achieve a more efficient transportation delivery system (Bureau of Transit, Local Roads, Railroads and Harbors, 2015).

Mode, Intermodal, and Multimodal

Mode refers to a form of transportation, such as automobile, transit, bicycle, and walking. Intermodal refers to the connections between modes, and multimodal refers to the availability of transportation options within a system or corridor (NCMM, 2020).

Public-Private Partnerships (PPP, 3P, or P3)

A public-private partnership is a long-term contract between a private party and a government entity, for providing a public asset or service, in which the private party bears significant risk and management responsibility, and remuneration is linked to performance (World Bank Group, 2018).

Ride-Sourcing

Also known as transportation network companies (TNCs), ride-sourcing services utilize smartphone applications and web-based platforms to allow users to book and pay for prearranged, on-demand transportation (Shaheen, Cohen, and Zohdy, 2018).

Section 5307

This section of the Federal Transit Act authorizes grants to public transit systems in all urban areas. Funds authorized through Section 5307 are awarded to states to provide capital and operating assistance to transit systems in urban areas with populations between 50,000 and 200,000. Transit systems in urban areas with populations greater than 200,000 receive their funds directly from the Federal Transit Administration (NCMM, 2020).

Section 5309

This section of the Federal Transit Act authorizes discretionary grants to public transit agencies for capital projects such as buses, bus facilities and rail projects (NCMM, 2020).

Section 5310

The formula program that provides capital assistance to states for transportation programs that serve the elderly and people with disabilities. States distribute Section 5310 funds to local operators in rural and urban settings who are either nonprofit organizations or the lead agencies in coordinated transportation programs. Allocation of funding to states is made on the basis of the number of elderly and persons with disabilities in that state (NCMM, 2020).

Section 5311

The formula program that provides capital and operating assistance grants to public transit systems in rural and small urban areas with populations of less than 50,000. Funding is apportioned by a statutory formula that is based on the latest U.S. Census figures of areas with a population less than 50,000. The amount that the state may use for state administration, planning, and technical assistance activities is limited to 15 percent of the annual apportionment. States must spend 15 percent of the apportionment to support rural intercity bus service unless the Governor certifies that the intercity bus needs of the state are adequately met (NCMM, 2020).

Shared Mobility

Any transportation mode that can be shared by multiple users. Usually an on-demand service that requires users to have a smartphone application to access and pay for docked or dockless micromobility options or request a ride in real-time. Modes include ride-sharing (car or van-pooling), bikeshare (docked or dockless, electric or people-powered), scootershare (electric, docked or dockless), ridesourcing (Uber, Lyft, etc.), carsharing, and fixed/flexible public or private transit and microtransit services (Shaheen, Cohen, and Zohdy, 2018).

Social-Buying Services

Social-buying services, such as Groupon and Venmo, use peer-to-peer payments and eliminate the friction of cash transactions. Many of these services incorporate social media by allowing and encouraging users to publically or privately share the purpose of their transaction with friends.

Sustainable Urbanism

Walkable and transit-served urbanism integrated with high performance buildings and high-performance infrastructure (Farr, 2008).

Transit Capacity and Quality of Service

Quality of service reflects how well transit service meets the needs of its customers, which has ridership implications. However, a balance must be struck between the quality of service that passengers ideally would like and the quality of service that a transit agency (a) can afford to provide or (b) would reasonably provide, given a base demand for transit service. Better quality of service is more attractive to potential passengers and generates higher ridership than lower quality of service, but better quality of service often (but not always) also entails higher costs (Ryus et. al., 2013). Specific performance measures are generally used to evaluate transit quality of service including but not limited to comfort, convenience, reliability and accessibility.

TABLE OF CONTENTS

1 Summary	1
Overview	2
Support of FDOT Mission and Goals	2
Engagement and Messaging	4
2 Discovery	5
What Does the Research Say?	6
Big Data and Public Transportation	6
Transit and Automated Technology	10
Mobility as a Service (MaaS), Shared Mobility, and Transit	12
Multimodal Mobile Payment Integration	14
Integrating and Managing Mobility	15
Labor and Procurement Considerations	17
Safety and Access	18
Transit and COVID-19	20
3 Engagement	23
Stakeholder Engagement Process	24
Represented Agencies	24
What We Heard	25
Technological Changes within Participating Agencies	28
External Technology Integration	29
Desired Resources for Changing Technologies	32
Smallville	34
Middletown	37
Urbanville	39
4 Guidance	41

Key Findings	42
Big Data and Public Transportation.....	42
Transit and Automated Technology	42
Mobility as a Service (MaaS), Shared Mobility, and Transit.....	43
Multimodal Mobile Payment Integration	43
Integrating and Managing Mobility.....	44
Labor and Procurement Considerations	44
Safety and Access.....	44
Transit and COVID-19.....	45
Roles and Opportunities	45
Florida Department of Transportation	45
Metropolitan Planning Organizations	46
Transit Operators.....	47
Big Ideas	47
Shared Regional Vision for New Mobility	47
Mobility Data Collaborative.....	48
“Off the Shelf” Standard Procurement.....	48
Flexible Funding and Pilots	48
Technical Capacity and Training	49
Next Steps and Action Items	50

APPENDICES

A Literature Review	51
What Does the Research Say?	52
Big Data and Public Transportation.....	52
Transit and Automated Technology	53
Mobility as a Service (MaaS), Shared Mobility, and Transit.....	54
Multimodal Mobile Payment Integration.....	56
Integrating and Managing Mobility.....	57

Labor and Procurement Considerations	59
Safety and Access.....	59
Transit and COVID-19.....	60
B Survey Results.....	65
Mobility Stakeholder Survey.....	66
Survey Introduction.....	66
Survey Responses.....	66
Summary of New Technologies Being Adapted or Studied (by Agency).....	69
Summary of MPO Involvement.....	70
Summary of External Agencies Implementing Services Needing Integration.....	73
Summary of P3 Arrangements	74
Summary of Impact of New Technologies	76
Summary of Anticipated Effects on the Workforce.....	78
Summary of Desired Resources	79
C Scenario Exercise	83
Purpose	84
Instructions	84
Scenario A: Smaller Rural Community	84
Issues for Discussion.....	85
Roles	85
Scenario B: Mid-Size “Town and Gown” Community	85
Issues for Discussion.....	86
Roles	86
Scenario C: Large Metro Area	86
Issues for Discussion.....	87
Roles	87
D Agency Research	89
Common Agency Types	90
Metropolitan Planning Organization.....	90

Transit Agency v.s. Transit Authority	91
Regional Planning Councils (Florida Specific)	92
Non-Profit Organizations.....	93
Florida Department of Transportation	93
E Funding Research	95
Funding Research	96
Federal Infrastructure Bills	96
Federal Grant Programs	96
State Grant Programs	97
F References	99

LIST OF FIGURES

Figure 1: Key action items derived from extensive research and stakeholder engagement.....	4
Figure 2: Miami-Dade is using public-private-partnerships to improve transit.....	6
Figure 3: Quick facts from the literature review	7
Figure 4: Uses for public transit data	9
Figure 5: Mobility integration for an Ohio transit authority.....	12
Figure 6: Map of the PSTA's now 26 eligible Direct Connect locations	13
Figure 7: New technologies agencies are adopting by order of response.....	28
Figure 8: The virtual workshop incorporated live participant polling on the concept of transit transformation.....	35
Figure 9: Themes from each break-out room were discussed in a de-brief at the end of the virtual workshop	37
Figure 10: Framework for a collaborative mobility integration program	46
Figure 11: Efforts to standardize mobility data sharing	49
Figure 12: Federal Transit Administration innovative mobility grants	98

LIST OF PHOTOS

Photo 1: The Jacksonville Transportation Authority's MyJTA mobile app facilitates contactless mobile fare payments on all JTA buses, including the First Coast Flyer Blue Line.....	3
Photo 2: Example of an EasyMile automated microtransit shuttle.....	10
Photo 3: Austin's B-Cycle bikeshare program is integrating with transit.....	16
Photo 4: Staff participate in a training course held by the Jacksonville Transportation Authority (JTA) University.....	17
Photo 5: Paul Schroeder, developer of the specialized app, Aira, using his creation to take public transit.....	19
Photo 6: The Jacksonville Transportation Authority's repurposed microtransit shuttle waits to deliver COVID-19 tests to the Mayo Clinic.....	21
Photo 7: Basic design elements (i.e. sidewalks, crosswalks, bike lanes) are vital to have before introducing new technology.....	33
Photo 8: Image of an on-street bikeshare station in an urban area.....	36

1 SUMMARY

Overview

Emerging technologies, such as autonomous and connected vehicles, Mobility as a Service (MaaS), and other innovative, on-demand ridesourcing platforms, are rapidly transforming the transportation ecosystem. This has significant implications for agencies that plan, fund, and operate transit facilities and services. While such technologies and services can be viewed as temporary disruptors to the “business as usual” environment, those agencies seeking to embrace these as opportunities to transform and redefine traditional roles and services will be better positioned to meet the consumer mobility demands of the 21st century.

Public transit service is typically run by cities, counties, and transportation authorities. However, the Florida Department of Transportation (FDOT) and Metropolitan Planning Organizations (MPOs) play important funding, regulatory, planning, and policy roles in advancing transit. Much discussion has occurred around how transformational changes in mobility will impact the position of transit agencies—and specifically how (and if) becoming more of a manager or “integrator” of mobility services incorporates greater operational flexibility and nimbleness and expands consumer choice. A key objective of this study is to explore potential changes to existing relationships between FDOT, MPOs, and public transit providers as their functions evolve in this shifting mobility environment.

To better support a shift to mobility integration, this study evaluates the state of transit innovation in Florida, documenting the many challenges facing transit providers, outlining best practices, and ultimately recommending appropriate guidance around a spectrum of critical components to support successful mobility integration, including: data management; automated technologies; shared mobility; payment integration and fare interoperability; labor and procurement; safety and access; and in these unprecedented times, considerations around COVID-19. As the study will reveal, much of this begins with the adoption of a shared vision and regional collaboration for new mobility and how FDOT and MPOs can more effectively support agencies through this process.

Support of FDOT Mission and Goals

FDOT’s mission is to provide a safe transportation system that ensures the mobility of people and goods, enhances economic prosperity, and preserves the quality of our environment and communities. It is important to note that this study in particular directly supports the Department’s current commitment to the advancement of new technologies that improve safety, ease congestion, and create new mobility solutions. Many of the study components also support specific goals and objectives articulated in the Florida Transportation Plan (FTP) Implementation Element including, but not limited to:

- ◆ Supporting transit agencies’ abilities to “adapt transportation infrastructure and technologies to meet changing customer needs”
- ◆ “Increasing the use of new mobility options and technologies such as shared, automated, and connected vehicles”
- ◆ Providing strategies and solutions that will both “reduce the number of crashes on the transportation system” while “reducing and mitigating transportation-related security risks”
- ◆ New procurement processes to “increase the efficiency and reasonableness of transportation-related regulatory processes”

As the FTP and Strategic Intermodal System (SIS) are currently being updated, this study could serve as a reference to those required updates and specifically the Automated Connected Shared and Electric (ACES) subcommittee component.

Formal study guidance is also designed to provide a set of specific activities and policy actions that the FDOT Public Transit Office can take to ensure these outcomes. The next steps and action items would ideally be prefaced by leveraging the capacity of the Florida Automated Transit and Shared Use Network to form a “New Integrated Mobility” subcommittee led by the FDOT Public Transit Office to

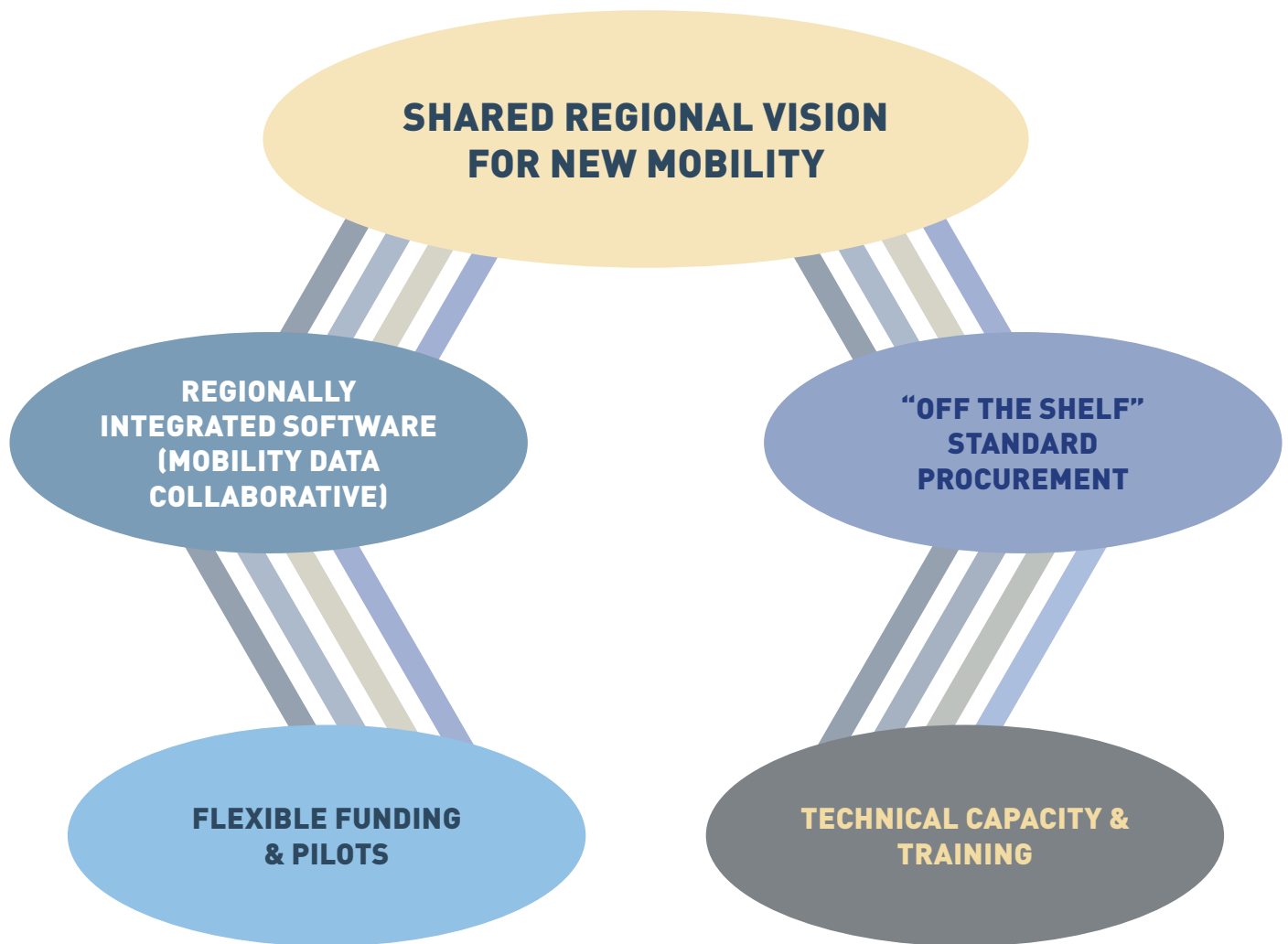
discuss the findings and critical issues from this study. This vital first step would create a statewide committee of transit champions to help establish priorities and a path forward around these action items to support the adoption of new technologies and services to meet changing mobility needs.

Some of the key action items include:

- ✓ **Streamline and incorporate greater flexibility and timing into traditional funding sources** making it available for projects when it is needed, capitalizing on innovation and awareness of critical issues and solutions before the technology becomes obsolete.
- ✓ **Assist agencies with adopting mobile payment and real-time transit information smartphone apps**—with the goal of regionally integrated software systems—so customers can use a single app to plan the entirety of their trip, access travel notifications, and receive agency communications.
- ✓ **Establish a statewide “Mobility Data Collaborative,”** or data clearing house, that all agencies and third parties could use as a resource, especially for integrated data exchanges between private and public agencies.
- ✓ **Pursue pilots** to explore partnerships and Memorandums of Understanding (MOUs) between transit agencies, MPOs, and local governments to facilitate mobility integration pilots to better manage risks associated with new technologies.
- ✓ **Curate an “Off the Shelf” standard procurement** process by creating an open source template for transit agencies to use for new mobility technologies and services which includes an FDOT-vetted list of approved vendors and services.
- ✓ **Provide more technical capacity and training** by leveraging statewide expertise and consulting agreements to bolster the technical capacities of transit agencies seeking innovative mobility solutions



Figure 1: Key action items derived from extensive research and stakeholder engagement



Engagement and Messaging

This process would not have been successful without the extensive participation and insights of public agency stakeholders, whose wealth of experience and knowledge shaped a great deal of the overall study direction and guidance. The methodology for engagement was centered upon a robust stakeholder conversation utilizing three major tools: surveys, one-on-one interviews, and a "scenario planning" exercise. This provided the study team with a candid assessment of the challenges and opportunities facing agencies across the state as they work each day to move people safely and equitably. The foundation of integrated mobility is public transit.

Advancing the guidance and action items can better position public transit agencies and mobility providers to collaborate, promoting and linking a variety of travel options as a single, unified service, and thereby accelerating the effectiveness of public transit in the new mobility context.

Equally significant is developing an aspirational narrative and message around this endeavor that resonates with local and regional decisionmakers, particularly those who establish transportation priorities and funding. If the goal is to better serve, satisfy, and grow transit ridership in Florida, the industry should move from being internally focused and operations-centric to externally focused and customer-centric.

2 DISCOVERY

What Does the Research Say?

With technological innovations transforming the way in which people move, the role of transit agencies as traditional operators will evolve. The degree to which this occurs will depend upon many factors, including but not limited to geography and service area; mobility demands and available technology; funding; leadership and workforce adaptation; data collection, analysis, and management; cross-organizational cooperation and support; and regulatory flexibility.

Florida's Department of Transportation (FDOT) and Metropolitan Planning Organizations (MPOs) can play a major role in facilitating this potential transformation, leveraging existing and new financial and technical resources to extend beyond Federal funding pass throughs and regulatory oversight. The research evaluated for this study falls within eight different categories associated with public transportation's shifting mobility ecosystem. These include:

- » Big Data and Public Transportation
- » Transit and Automated Technology
- » Mobility as a Service (MaaS), Shared Mobility, and Transit

- » Multimodal Mobile Payment Integration
- » Integrating and Managing Mobility
- » Labor and Procurement Considerations
- » Safety and Access
- » Transit and COVID-19

This study begins with a focus on key findings from each of the eight research categories listed above, identified after an initial review of the breadth of research available on transit's technological transformation and shift towards integration with multimodal mobility solutions. A formal literature review was conducted as part of the research effort and is included as [Appendix A: Literature Review](#).

Big Data and Public Transportation

From automatic vehicle location and passenger counters to real-time trip planning and mobile fare payment systems, public transportation agencies generate vast amounts of data as part of their daily operations. This data, and its open exchange between public and private sector service providers, helps to create innovative, technology-based mobility solutions that enhance the user's experience in navigating their transportation network.

Figure 2: Miami-Dade is using public-private-partnerships to improve transit

Miami-Dade County's Exploration of Public-Private-Partnerships

The City Innovate Foundation has partnered with the Miami-Dade County Department of Transportation and Public Works and a number of private sector technology companies (Microsoft, Cubic, Lyft, Zipcar, Siemens) to write a policy playbook that will help Miami-Dade build a multi-modal transit network. This "Urban Mobility Collider" has been driven by community input and a 12-week assessment of Miami-Dade Transit's back-end technology and fare system (Friedman, 2016; Robertson, 2019).

By December 2020, Transit Alliance Miami hopes its Better Bus Project will yield a complete overhaul of the bus system so passengers, 2/3 of whom rely exclusively on Miami-Dade's bus fleet, will benefit from a more useful, better-connected, and reliable transit network (Robertson, 2019).

QUICK FACTS FROM THE LITERATURE REVIEW: PART ONE

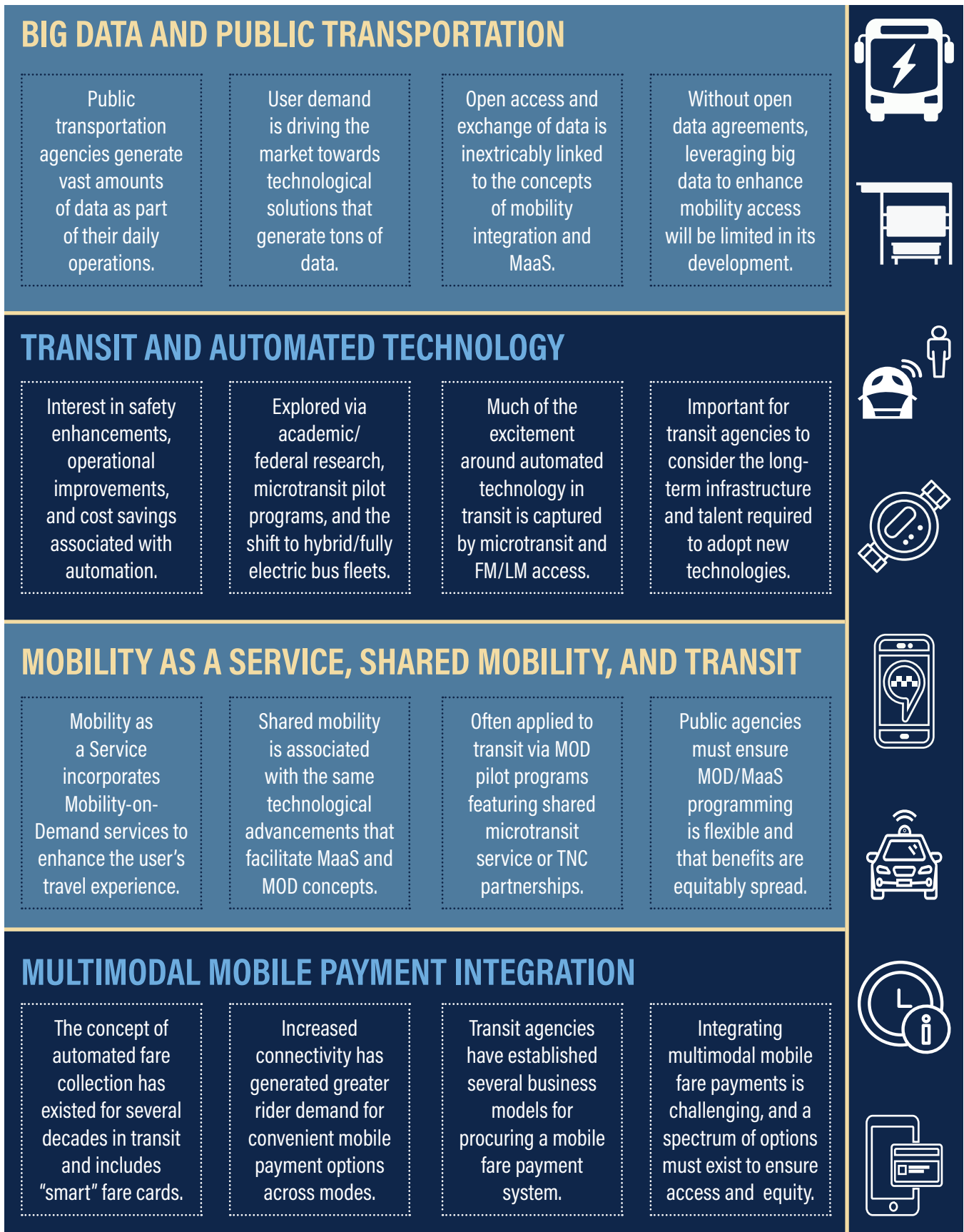


Figure 3: Quick facts from the literature review

QUICK FACTS FROM THE LITERATURE REVIEW: PART TWO

INTEGRATING AND MANAGING MOBILITY

Mobility management does not need to be confined solely to dense urban centers.

Concepts have evolved to consider how to serve all riders and focus on moving people over vehicles.

Major barriers to mobility integration for transit agencies are lack of funding and coordination.

Determining how and when to integrate new technologies (i.e. automation) is a complication.



LABOR AND PROCUREMENT CONSIDERATIONS

Adoption of new technological advancements is affecting both the transit labor force and commuters.

Stringent procurement regulations limit agencies' ability to quickly integrate new technologies.

Concern over new technology's impacts on transit jobs is exacerbating growing declines in the workforce.

Major anticipated labor needs for transit agencies in the near future include data management and IT professionals.



SAFETY AND ACCESS

The stigma that it is unsafe, particularly for women, is a major inhibitor for choosing public transit.

Technology, such as video surveillance, is a key deterrent to harassment and assault on buses.

Access to transit is an ongoing equity issue, with major barriers to increased ridership, particularly unsafe bike/ped infrastructure.

Continuing to develop and invest in technologies aimed at increasing access is important.



TRANSIT AND COVID-19

COVID-19 will have near- and long-term effects on the ways in which transit and transit agencies operate.

Public transit has remained an essential service throughout nation- and state-wide lockdowns.

Looking to the future, transit agencies must restore public confidence in the safety of transit.

A hands-free payment system protects operators and riders by eliminating the need to exchange currency.



The use of smartphone-based fare payment systems, for example, beyond their basic convenience, has the benefit of alerting passengers in real-time to issues that may impact their trip. With so many opportunities to leverage big data (i.e. put it to good use), which is poised to play a larger role in public transit funding decisions, transit agencies must prioritize the long-term investment in infrastructure and talent required for data analysis (Dickens and Hughes-Cromwick, 2019).

The open access and exchange of data is inextricably linked to the concepts of mobility integration and mobility as a service, which encourage multimodal fare convergence to create a convenient, seamless trip-planning and payment experience. Historically, travelers used to “disappear” when they got off a bus or train. Now, mobile phone data is used to determine customers’ route patterns and identify potential transfer and connection points (Dickens and Hughes-Cromwick, 2019). However, while taking advantage of public streets and public application programming interfaces (see the Glossary of Terms for a full definition of APIs), some private sector mobility partners are unwilling to “give back” by openly sharing their data (Transit, 2019).

The future of mobility is tied to enhancing the convenience and integration of transportation services. User demand is driving the market towards smartphone-based apps and other technological solutions that generate tons of data, are convenient and easy-to-use, and capable of multimodal mobile fare payment and real-time trip planning. Without open data agreements across agencies and, more importantly, between public and private sector entities, this trend towards leveraging big data to enhance mobility as a service will be limited in its development. In instances where private mobility providers refuse to play nice, it may be appropriate for DOTs, MPOs, and cities to leverage their influence over private access to the market.

CASE STUDY: PUBLIC-PRIVATE DATA CONCERNS

The Los Angeles Department of Transportation (LADOT) is the original creator of the open-source project known as Mobility Data Specification (MDS), a set of APIs focused on dockless e-scooters, bicycles, mopeds, and carshare that aims “to provide a standardized way for municipalities

Figure 4: Uses for public transit data

Public Transit Data and Advocacy

Transit agencies collect a wide variety of data, from real-time traveler information to automatic vehicle location and electronic fare payments. This data can be used to improve mobility management or even earn money for transit agencies by providing external parties the capacity to tailor marketing messages according to users’ travel patterns. It can also be used for advocacy efforts, such as understanding job accessibility, healthcare access, education, and economic datasets.

In Columbus, Ohio, a connection was discovered between transit and infant mortality rates. To reduce this rate by 40% by 2020, a transportation plan was developed to improve bus frequency, add transit amenities, and develop a specialized transportation pilot to connect expectant mothers to healthcare (Ellis, 2009). This is just one example of how transit agencies can utilize data collection and analysis to identify mobility problems and solutions, and improve mobility as a service.

and other regulatory agencies to ingest, compare, and analyze data from mobility service providers, and to give municipalities the ability to express regulation in machine-readable formats” (GitHub, 2020). In late 2019, Uber’s service permit for operating dockless scooters was revoked in the City of Los Angeles due to the company’s refusal to share real-time location data on riders with LADOT (Coleman, 2020).

After 18 months of trying to resolve the issue, Uber filed a federal lawsuit against LADOT in late March of 2020, alleging that “highly personal” data could be used to target certain

groups, stalk individuals, or commit fraud (Coleman, 2020). City representatives, citing the need to monitor traffic on public streets since abandoned micromobility devices can create hazards, argue that Uber is trying to skirt regulation and control the information shared about its company (Coleman, 2020). The outcome of the lawsuit will likely establish a baseline for other public entities (from cities to transit agencies) juggling data privacy concerns while regulating dockless micromobility devices and other technology-based mobility solutions.

Transit and Automated Technology

There is growing interest in the safety enhancements, operational improvements, and cost savings associated with automating bus transit (FTA, 2018). Bus systems are just beginning to explore and conduct limited testing of certain automated features for mainline operations (Dickens and Hughes-Cromwick, 2019; FTA, 2018). A burgeoning practice at this point, transit automation has largely been explored through academic and federal research, microtransit pilot testing programs, and the shift to hybrid and fully electric bus fleets.

Much of the excitement around automated technology in transit is captured by microtransit, or “IT-enabled private multi-passenger transportation services, such as Chariot and Via, that serve passengers using dynamically generated routes, and that expect passengers to make their way to and from common pick-up or drop-off points” (NCMM, 2020). Around the United States and the world, cities have primarily been testing automated microtransit technologies to solve connectivity issues associated with first-mile/last-mile (FM/LM) access.

In February 2020, the first daily, public residential autonomous shuttle, funded mostly by the federal government, hit the streets of Columbus, Ohio (Miller, 2020). The \$1.13 million year-long project, called Linden LEAP, is designed to help residents of South Linden, a neighborhood historically cut off from the rest of the city when Interstate 71 arrived in the 1960s, access services that have disappeared from the area. The autonomous shuttle’s free service will circulate along a 3-mile route between the Linden Transit Center, a public housing development, a recreation center, and a community house. Data generated by the program will assist other cities considering similar transportation alternatives (Miller, 2020).

Photo 2: Example of an EasyMile automated microtransit shuttle



Automated technologies in bus transit are being tested around the nation and the world, although full-size bus fleets are unlikely to reach full autonomy anytime soon. Before transit agencies can focus on innovation, it is important to first consider the long-term infrastructure and talent required to adopt new technologies. Partnerships with MPOs and the DOT, especially in Florida where AVs (with the appropriate testing) are welcomed on public roads, may help transit agencies overcome some of these issues or, at the very least, identify funding sources for innovation.

CASE STUDY: THE STATE OF AUTOMATED TRANSIT TECHNOLOGY IN FLORIDA

As of July 2019, Florida law (as defined in s. 316.003(3)) allows automated vehicles (AVs) to operate on public roads without anyone behind the wheel, so long as successful testing has been completed and an audible and/or visible alert system has been installed to let humans know if malfunction occurs (Owens, 2019). Florida has been welcoming AVs since 2018, spurring development of the AV test site, SunTrax, in Polk County as well as extensive testing of self-driving trucks, cars, and electric shuttles.

GAINESVILLE

The University of Florida and the Florida Department of Transportation (FDOT) have partnered to launch a \$2.5 million AV pilot project (paid for by the state) in Gainesville. The program is poised around an electric shuttle, created by EasyMile, that will run between the city's Southwest Third Street parking garage and Innovation Square near Southwest Second Avenue. During the initial trial phase of 3-6 months, an operator will remain on board the AV shuttle. The trial, taking place in phases, is expected to take roughly three years with free rides offered to the public during the initial demonstration phase. Mobility company Transdev will operate the service through a contract with Gainesville's Regional Transit System (Gibson, 2020).

JACKSONVILLE

Since 2017, the Jacksonville Transportation Authority (JTA) has been testing driverless shuttles with the aim to replace the existing monorail system with an automated vehicle network. The project, known as the Ultimate Urban Circulator, is viewed as a long-term, cost-effective alternative to the existing system, which generates roughly 5,000 trips per day. Once completed, the Automated Skyway Express (Skyway) will move people throughout downtown Jacksonville on a 2.5-mile bi-directional system with eight stations and a 25,000 square foot operations and maintenance facility (JTA, 2020). The goal of the project is to not only convert existing Skyway infrastructure, but also build at-grade extensions into the neighborhoods surrounding downtown.

TAMPA

The Hillsborough Area Regional Transit Authority (HART) is moving forward with a one-year pilot to provide automated transit service along the Marion Street transit corridor in downtown Tampa. Fully funded by FDOT, the \$915,000 project will feature use of small, 8-person electric shuttles with an operator on board. After three attempts at determining the proper vendor for the service, HART determined Orlando-based Beep was the best candidate, but also evaluated EZ Mile and First Transit. The service is slated to begin in July of 2020 (Brezina-Smith, 2020).

BABCOCK RANCH

Babcock Range is a master planned community in southwest Charlotte County touted as the first solar-powered city in the United States. Through a public-private partnership between the Florida Forest Service and a private real estate development company, the 18,000-acre town of Babcock Ranch was approved after the company's CEO, Syd Kitson, sold 73,000 acres of preservation land to the state to create Babcock Ranch Preserve. With sustainability as the priority, Babcock Ranch has its own bikes, electric and autonomous vehicles, and car/bike-sharing programs. The town's on-demand, electric AV shuttle service, operated by Transdev, take passengers throughout town on a regular basis.

Figure 5: Mobility integration for an Ohio transit authority

Micromobility and Transit Integration in Dayton, Ohio

The Greater Dayton Regional Transit Authority (RTA) is a trend-setter in the world of Mobility as a Service. From micromobility management to vying for integrated multi-modal mobile fare payments and tracking (in a single app) to running a public bike repair shop within its headquarters, RTA is determined to be a “one-stop-shop” for all things mobility.

To provide universal public transportation for all, RTA partnered with Link Dayton Bikeshare, the City of Dayton, and the scooter-sharing transportation network company, Spin, to embrace the entire network of transportation options. Using leftover highway project funds (CMAQ funding would have worked but might have taken two years), RTA was able to establish its bike repair shop, a customer service call center, and get a local match of \$250,000 from the City of Dayton with little to no out-of-pocket cost.

While there is risk in shifting from a mobility provider to a mobility integrator, according to RTA’s CEO, Mark Donaghy (who sold the idea to the Board of Directors as a service that would complement transit by providing first-and-last-mile connections), it’s “no more risk than a 40-foot bus with 50 people on it.”



Mobility as a Service (MaaS), Shared Mobility, and Transit

Mobility-on-Demand (MOD) transportation services are those that can be flexibly arranged almost immediately before a desired travel time, most often through a smartphone app, website, or over the phone. Mobility as a Service (MaaS), which incorporates on-demand services, emphasizes a “customer-focused interface that incorporates multiple mobility options into a single, intuitive and seamless platform or app that allows for choosing the right option, [and] scheduling and paying for that option” (NCMM, 2020).

Shared mobility – or any form of transportation that can be shared (from bikes and scooters to cars and transit) – is often associated with the same technological advancements and smartphone apps that facilitate MaaS and MOD concepts.

Cities that maintain high service standards and develop mobility plans tailored to their specific markets are slated to benefit the most from new technologies (Stanley, 2019). In the world of transit, shared mobility is most often applied to MOD and MaaS through on-demand pilot programs featuring shared microtransit service or partnerships with ride-sourcing transportation network companies (TNCs), like Uber or Lyft. These programs witness varying results and often require agencies to adopt a flexible, “trial and error” approach to the planning process. For example, the Las Vegas Trip to Strip ride-hailing microtransit service, touted as a success, stopped after six (6) months due to financial constraints but helped the local transit agency identify top travel destinations, such as the airport (Akers, 2019). In San Diego, the Oceanside community expanded Hoot Rides, a microtransit ride-share program designed to relieve congestion and parking problems, after generating over 600 trips in six (6) weeks (50% of which had multiple passengers) (Diehl, 2019).

Figure 6: Map of the PSTA's now 26 eligible Direct Connect locations



Shared mobility has a multitude of benefits: supporting multi-modality, improving first-and-last-mile access to transit, enhancing mobility for transportation disadvantaged groups, and helping to reduce greenhouse gas emissions (Shared-Use Mobility Center, 2016). However, concern over safety and the management of public rights-of-way has had cities scrambling to address fatal conflicts between vehicles and people on shared micromobility devices. Additionally, while becoming popular with transit agencies, MOD programs may not perform as well as fixed-route bus service or even dial-a-ride services in terms of cost and ridership. On-demand drivers often serve fewer riders than the poorly performing suburban routes cut to make room for them, achieving 2-4 trips per hour per driver at best (and some pilots generating fewer than one passenger trip per vehicle service hour) (Linton, 2019).

To mitigate the challenges associated with shared mobility and MOD projects, public agencies must ensure program benefits are thoughtfully executed and equitably spread. For some transit agencies, particularly transit authorities, this has meant assuming the role of mobility integrator.

CASE STUDY: THE PINELLAS SUNCOAST TRANSIT AUTHORITY AND MOBILITY-ON-DEMAND IN FLORIDA

In Florida and nationwide, the Pinellas Suncoast Transit Authority (PSTA) is among the forerunners in implementing Mobility-on-Demand (MOD) projects designed to serve the underserved. In

2016, the PSTA launched two innovative mobility programs that rely on TNCs for service provision: Direct Connect and the Public-Private-Partnership for Paratransit Mobility-on-Demand (P4-MOD).

Partially funded through the statewide Florida Commission for the Transportation Disadvantaged and the cutting of two under-performing bus routes, Direct Connect enabled the PSTA to become the first transit agency in the United States to sign a service provision agreement with a transportation network company (i.e. Uber) subsidized by public dollars (Murphy, Karner, and Accuardi, 2019). The program, designed to help low-income residents travel to and from work at night when bus service is not available, functions through a public-private partnership in which Uber, United Taxi, and CareRide (the wheelchair provider) provide up to 25 free rides per month for qualifying, low-income passengers (APTA, 2016; Short, 2019; Murphy, Karner, and Accuardi, 2019).

Direct Connect served nine (9) zones across Pinellas County in 2017 and, in 2018, expanded to 24 locations, boosting ridership to 4,000 trips (Short, 2019). At \$200,000 per year, Direct Connect costs roughly half as much as one of the poorly performing bus routes cut to pay for it (Short, 2019). The P4-MOD program is similar to Direct Connect in that it uses a unique multi-partner service, comprised of United Taxi, CareRide, and Lyft, to make on-demand, door-to-door paratransit service more cost-effective and efficient. In 2016, the PSTA received \$500,000 in grant money from the Federal Transit Administration's MOD Sandbox Demonstration initiative to fund the program.

Since then, more agencies around Florida have realized the value in sourcing on-demand rides. In 2017, five Central Florida cities created the "Municipal Mobility Working Group" to test inter-city travel through an Uber pilot program (Schorsch, 2017). In this arrangement, each city subsidized 1/5 of the fare for Uber rides ending within their borders and 25% of rides beginning or ending at a SunRail station within their city limits. The second phase debuted a 20% subsidy for rides beginning in another city, as well (Schorsch, 2017). In 2019, St. Lucie County used a \$600,000 grant from the Florida Department of Transportation to launch an "Uber-like" ride-hailing service

for southwest Port St. Lucie, where residents have been without access to public transportation (Gardner, 2019). Through the Transloc smartphone app, customers within certain areas of town can now schedule to be picked up or dropped off by a minivan which also allows nearby riders who did not request a ride to hop on (Gardner, 2019). The pilot program's goal is to provide evidence that on-demand ride-share service can be a cost-effective way to expand transit services, especially in suburban environments.

The PSTA and agencies such as these are setting an example with their iterative approach and willingness to try new programs, partnerships, and technologies that make access to public transportation more flexible and reliable. While there are challenges associated with subsidizing these innovative programs (beyond grants, federal funding for transit agencies cannot be applied to solo TNC or taxi rides), the opportunity to collect, analyze, and understand data on travel patterns often outweighs the risk.

Multimodal Mobile Payment Integration

The concept of automated fare collection (AFC) has existed for several decades in transit and includes "smart" fare card systems which allow riders to pay for their fare by swiping a plastic, agency branded card (with pre-paid dollars on it) across a sensor either on the bus or when entering a train station. Today, like in many places around the world, fare payments have shifted from smart cards to smartphones. As new mobility options flood the market and the use of smartphones rises, increased connectivity generates greater rider demand for convenient mobile payment options across available transportation modes. Multimodal payment convergence or mobile payment integration is "the ability to use the same payment medium or technology to pay for services on multiple modes of transportation—which provides a more seamless and convenient experience for users" (NASEM, 2020c).

Integrating fare payments across agencies that offer different services comes with many challenges, including: data privacy and management; negotiation of inter-provider agreements; cybersecurity concerns; and

provisions for equitable access to services (NASEM, 2020c). In exchange for federal funding, transit agencies in the United States are committed to serving all communities within their service area. This requires mindfulness of under- or unbanked users (i.e. travelers without smartphones) when implementing new mobile technologies or payment solutions (NASEM, 2020c). Lower income, elderly, and physically- and mentally-impaired populations traditionally do not have the same access to smartphones and mobile data plans, so multiple payment options must always be provided.

Most transit agencies interested in offering mobile fare payment will procure the service from a private vendor. While public agencies spearhead customer service and marketing of the app to riders, vendors are often responsible for developing and hosting the app, processing payments, and maintaining payment card industry compliance (NASEM, 2020b). In some cases, mobile application options, depending on the business model, can be more cost-effective than an overhaul of existing electronic fare payment systems; however, achieving consensus on decisions surrounding fare reconciliation, data management and sharing, and other issues that affect operations, especially across multiple agencies, can be difficult (NASEM, 2020c).

Smartphone users are adjusting to the convenience of peer-to-peer (P2P) payment mediums (i.e. Zelle, Venmo, Facebook Pay, etc.) that allow easy, fast, and convenient electronic payments. As rates of smartphone ownership increase, heightened demand for mobile fare payment is motivating many transit agencies, despite the associated challenges, to develop a smartphone app with this feature (while still providing other options). Procurement of mobile fare payment apps can follow a variety of business models, so it is important that transit agencies, especially within a single region, coordinate to ensure multimodal fare payment integration.

CASE STUDY: TRANSIT APP

The Transit app, whose slogan is “one app to pay for all mobility in any city,” has become a popular option for transit agencies seeking a universal solution to multimodal

payment convergence and real-time trip planning (Transit, 2019). Functioning in over 175 metropolitan areas worldwide, the Transit app aggregates and maps real-time public transit data through General Transit Feed Specification (GTFS). GTFS is a standardized, shareable format for transit data that contains static information on schedules, fares, and geographic transit information and real-time information on arrival predictions, vehicle positions, and service advisories (GTFS, 2020).

This data, received from transit operators, is then integrated into the application programming interface (API) of the Transit app. An API is a set of routines, protocols, and tools for building software applications that specifies how different software components connect across an integrated network (Beal, 2020). Without open APIs, the average rider must juggle different apps for different mobility services and cannot compare prices and estimate times of arrival between service providers, pay for a combined trip with one app, or plan a combined public transit trip (Transit, 2019). Reconciling how private mobility providers, transit agencies, and government entities collaborate to access the other's data is already at the forefront of the big data and transportation discussion.

Integrating and Managing Mobility

Mobility management focuses on using a wide range of transportation options to deliver coordinated transportation services in an effort to achieve a more efficient transportation system. While this has historically meant managing mobility for those who are transportation disadvantaged, including but not limited to seniors, individuals with disabilities, and/or lower incomes, a more efficient, multimodal transportation network can appeal to most people, especially those interested in non-single-occupancy-vehicle (non-SOV) travel (Bureau of Transit, Local Roads, Railroads and Harbors, 2015; Ellis, 2009). In fact, recent trends have shown that younger generations, like Millennials and Generation Z, prefer not to own a vehicle if they live in a place with good public transportation.

There are many barriers to mobility management – lack of funding, lack of coordination and collaboration across

agencies, service and jurisdictional boundaries, and lack of information. Frequently, local and regional services in one area are maintained by different agencies and report to different leadership, adding to the complexities of integrated management. In a perfect world, overall connected system improvements would be the primary focus but generally each agency works in a “silo” and is only able to consider their individual services. Many believe that mobility management practices work best in metropolitan areas that have the density and population size to make public transportation work well. However, the benefits of providing simplified access to a more efficient transportation system – increased public awareness of mobility options, increased transit ridership, movement of people over vehicles, improvements to the quality of service delivered, transit-oriented development, and reduced service gaps and overlap travel – can be achieved anywhere (Bureau of Transit, Local Roads, Railroads and Harbors, 2015; Ellis, 2009).

A 2018 report from the American Association of State Highway and Transportation Officials (AASHTO) contends that rural and small urban mobility management systems can be considered and replicated by State Departments of Transportation (DOTs) and their sub-recipients across a range of environments by focusing on common

components and strategies deployed by successful practices (Dalton, 2018). Community outreach and engagement, a needs assessment, qualitative and quantitative performance measures, a structured funding approach that incorporates FTA Section 5310 and 5311 funds, and state-level support are some of the key elements required for implementing a successful mobility management program (FHWA, 2015).

The 2018 American Public Transportation Association (APTA) Mobility Survey as well as other research pertaining to the transformation of the American commuter found that 77% of Americans believe public transit to be the backbone of a multi-transit lifestyle and that 74% of millennials would be open to transit agencies being mobility managers and using a multi-transit app (Grisby et. al., 2018). Although technology fuels the ever-changing mobility ecosystem, mobility managers have a role in introducing these changes to the community.

As new transportation options like bike and scooter share become more widespread, there is a natural fit in some locations for cities or transit agencies to take over their management and incorporate them into transit and trail networks. In addition, many areas are pursuing all-in-one mobile payment that allows customers to plan trips

Photo 3: Austin's B-Cycle bikeshare program is integrating with transit



seamlessly across modes. Coordination for this falls on area leadership like mobility managers, in areas where they are available. Likewise, as automated vehicle technologies flood the market, their application to public transportation will become more prominent and commonplace. These advancements complicate the role of mobility managers who must determine the appropriate transferability of automation technologies to transit and other mobility services.

CASE STUDY: AUSTIN'S CAP METRO INTEGRATES BIKESHARE

In some areas where political and administrative circumstances provide a favorable atmosphere, local government and transit agencies are expanding their roles as mobility managers by incorporating new mobility systems like bike- and scootershare into transit. One recent example of this is in Austin, Texas, where the city is entering into a partnership with the transit agency, Capital Metropolitan Transportation Authority (Cap Metro), to integrate Austin's B-Cycle bikeshare program into the existing transit system. The two agencies will share responsibility for the program, with Cap Metro taking on planning, programming, and integrating bikeshare into the existing transit system while the City of Austin will maintain

the right of way, wayfinding, and other public amenities. Cap Metro is already working on a trip planning tool that will revolve around accessing bikeshare (Thornton, 2020).

Labor and Procurement Considerations

Many believe automation in transit will act as a panacea for creating reliable and accessible service for workers at all times of day and night. However, uncertainties around safety, security, funding, user acceptance, labor issues, and legal issues must be addressed at the federal level before automation application can be widely accepted and implemented across all transit agencies (FTA, 2019). For example, the FTA requires transit agencies to protect certain workers' rights in exchange for federal funding, but no one knows the impact automation will have on the bus transit workforce (FTA, 2018).

While some job loss to innovation could be unavoidable, new positions will also be created. Transit agencies and other entities have been collecting large quantities of transit-related data. While this can provide a wealth of knowledge to inform them on the successes and gaps in their services, it also requires skilled employees to manage

Photo 4: Staff participate in a training course held by the Jacksonville Transportation Authority (JTA) University



and analyze that information (Dickens, 2019). Similarly, adaptable operators and technicians will be required for new operations and maintenance techniques.

Procurement creates issues for transit agencies who need to adhere to strict and rigorous methods to secure new technologies. In addition, lengthy acquirement processes can cause problems in an industry where obsolescence occurs relatively quickly. In some cases, with limited options and manufacturers, the standards required for procurement can lead to difficulty for transit agencies seeking to purchase new, innovative equipment. For example, the Buy America Act requires a certain percentage of transit vehicle components be sourced from American manufacturers, but current automated vehicles (AVs) rely on foreign components and may not be able to comply (FTA, 2018).

The current state of automated bus technology largely falls within the pilot testing or early development stages (FTA, 2019). Technology costs associated with prototypes such as these and the applicability to transit service, which differs considerably from the interest in automated highway driving, are unknowns that will continue to shape how bus transit automation unfolds in the U.S. (FTA, 2019). Laws protecting employees and passengers and regulations pertaining to transit systems and vehicle safety will undoubtedly determine the rate at which AV technology enters into public transit service (Gettman et. al., 2017). As of right now, no one really knows how automated technology will disrupt the transit industry and its workforce, only that it will.

CASE STUDY: MAINTENANCE WORKERS & ELECTRIC BUS CONVERSION

In the past few years several cities and counties across the United States have begun replacing diesel and compressed natural gas (CNG)-fueled bus fleets with electric buses as a part of their overall goals to reduce air pollution and move towards cleaner energy (Janis, 2019). In Florida, early-adopters, including Miami-Dade, Broward, and Pinellas Counties, are transitioning to electric fleets and plan to be fully-converted within the next few decades (Perry, 2018). While this is lauded by many as a move

towards cleaner and more efficient fuel, there are concerns about the loss of jobs, particularly for fleet mechanics (Janis, 2019). This is due to the fact that electric vehicles lack combustion engines. Electric motors have about 20 moving parts (compared to an internal combustion engine's 2,000) so they need fewer repairs and do not require the same regular servicing (Kim, 2017). Nationwide over 65,000 transit employees (15% of transit jobs) work in vehicle maintenance and many of them believe that all-electric fleets jeopardize their positions (APTA, 2020). Aside from generally requiring less maintenance, because the design of electric vehicles is vastly different, maintenance personnel will need to be completely retrained. In addition, new vehicles will be under warranty initially and will receive repairs from the manufacturers (Veeder, 2019).

The fear of job replacement is reasonable and there is both a concern that positions will be eliminated, and that training will not be made available (Veeder, 2019). However, while some maintenance will come from the manufacturer, transit agencies will still need teams of professionals trained to diagnose and solve issues (Veeder, 2019). Some agencies have training in place or are developing training. For example, in Jacksonville, the Jacksonville Transportation Authority has an internal training system called JTA University where staff are educated on various new technologies and services. Other agencies have included training in their procurement plans (Veeder, 2019). While it is still unclear how the transit maintenance workforce will ultimately be changed by the conversion to all-electric fleets, skilled training for existing employees is key to retaining and preparing staff.

Safety and Access

While taking the bus is far safer than driving a vehicle as far as a crash is concerned, the stigma surrounding public transportation and the perception of possible harassment or assault is often cited as a major barrier. Technology, particularly video surveillance, is a key deterrent to harassment and assault on buses, as well as identifying and prosecuting assailants and ensuring proper training of staff members (TCRP, 2009).

More in-depth research and data collection, particularly focused on women, is needed to better assess passenger characteristics and travel patterns on transit. Unmaintained pedestrian facilities with overgrown foliage, poorly lit parking lots and structures, isolated bus stops, and crowded transit vehicles and stations all represent stressful settings for women who, as a result, will often change their mode of transportation or travel patterns to avoid feeling unsafe or vulnerable. This issue is particularly salient in Florida, which is ranked as the third-highest human trafficking destination with half of victims being children under the age of 18. Transit agencies can benefit from focusing on women's safety by gaining ridership they may currently be missing (Perk and Antonio, 2019).

Some transit agencies are taking access, particularly for those in wheelchairs, to the next level. A public-private partnership between TheRide, Ann Arbor Area Transportation Authority's bus service, and Q'Straint, a global leader in manufacturing wheelchair securement systems, has led to the testing of Quantum, a virtually autonomous securement system for wheelchairs, on 10 buses as of early 2019 (Smith, 2019). Quantum allows individuals with mobility devices to "secure themselves in under 25 seconds with the push of a button" (Smith, 2019).

This new technology, paid for by a \$187,000 mobility grant from the Michigan Department of Transportation, helps reduce overall passenger boarding time, improve on-time performance, and provide a better customer experience with greater service reliability across the Ann Arbor transit network (Smith, 2019).

Nationwide, late-shift workers bring in roughly \$28 billion in annual wages and issues associated with this demographic's truancy and turnover not only creates challenges for American employers but costs the economy billions of dollars every year (Zalewski et. al., 2019). This means that the needs of this growing segment of the U.S. workforce is and will continue to be an important topic in the world of transit service. A 2019 study considering the commuting patterns of late-shift workers in 381 metropolitan areas identified ways in which public transit can address their commuting needs: extend the span of service, enter into partnerships with on-demand providers, create a special nighttime bus network, and seek employer funding (Zalewski et. al., 2019).

Prioritizing operator safety and enhancing safe access to transit, both at the bus stop and beyond, is essential to maintaining equitable service and attracting riders.

Photo 5: Paul Schroeder, developer of the specialized app, Aira, using his creation to take public transit



Mobility-focused technological advancements may be able to help address these issues. For example, real-time trip planning apps allow the passenger to see in real-time where their bus is and when it will come, a feature that may be particularly reassuring for female riders waiting alone at a bus stop. Additionally, collecting data on ridership demographics can help agencies identify groups that may or may not be riding transit. The use of internal and external surveys and other public engagement tools, such as polling riders via a mobile phone app, can motivate passengers (and operators) to share their experiences directly with the transit agency.

CASE STUDY: USING REMOTE ASSISTANCE TO ADDRESS TRANSPORTATION NEEDS FOR PEOPLE WITH DISABILITIES

People with disabilities often cite transportation as the biggest barrier to employment and full social participation (Brooks, 2020). In recent years, technological advancements have greatly improved the way in which people with disabilities can travel. Today, electronic beacons, which are inexpensive to purchase and maintain and can be used on stationary and moving objects, allow any smartphone user to intercept and play pre-recorded messages with information on how to navigate to and from transit systems as well as within the transit system itself. Beacons can also store multiple messages, including messages in multiple languages, making it possible for one beacon to serve the mobility needs of many different groups of customers (Brooks, 2020).

For people who are blind, the challenges of using transit go beyond wayfinding; access to information can also be a barrier. "Artificial Intelligence + Remote Assistance," or Aira, is a mobile app designed to do exactly what its name suggests: use artificial and human intelligence to help people with disabilities successfully travel on their own. Through the Aira smartphone app (or customized Google glasses), a trained employee works directly with the subscriber to provide navigational assistance, describe visual images, read visible text, and more. Aira can additionally be integrated with the rideshare service apps Uber and Lyft, enabling a subscriber to have Aira contact a rideshare service, book the trip, monitor the trip, and direct

the subscriber to the vehicle once it arrives (Brooks, 2020).

To date, three agencies — the Massachusetts Bay Transportation Authority in Boston, the New York Metropolitan Transportation Authority, and most recently, the Milwaukee County Transit System — have launched pilots to determine the extent to which Aira is able to influence transit use by people (and especially paratransit riders) who are blind or visually impaired (Brooks, 2020).

Transit and COVID-19

The recent COVID-19 crisis caused a massive societal disruption that will affect how transit agencies plan for the future and how they can best serve their employees and customers. Cities and towns across the country shut down in response to outbreaks, causing transit ridership to plummet by 70-90% (Bliss, 2020). In addition, the release of preliminary research and editorials blaming transit for the spread of COVID-19, coupled with the persistent stigma associated with the safety and cleanliness of transit, has created a concern that transit ridership will remain low well after other pandemic-related fears have been assuaged (Bliss, 2020).

The response to COVID-19 has and will result in fundamental changes to how transit operates but may also be a catalyst to innovation with new and varied services. Being an essential resource, public transit continued to provide service during the initial U.S. COVID-19 outbreaks, albeit with precautionary adjustments to reduce the likelihood of transmission and to protect both customers and operators. Some of these changes will eventually be rolled back but others will become part of standard operating procedures, and emerging technologies will play a role in how they are permanently adapted. The long-term industry response to post-COVID transit planning will rely on or be enhanced by fresh innovation, and an agency's ability to adapt could determine their future relevance to riders and their place in the community.

A major issue for transit agencies dealing with decreased ridership will be to regain public trust (Sadik-Khan, 2020).

Articles blaming transit for the spread of COVID-19, coupled with the persistent stigma associated with the safety and cleanliness of transit, make addressing those concerns a top priority now more than ever. On the other hand, even before COVID-19 forced the discussion, many agencies were already contemplating how to reinvigorate public transit due to a trend in declining ridership that began around 2014 (Bliss, 2020). If forward-thinking practitioners and leaders are willing to invest in the existing systems, the current crisis could naturally provide an opportunity to reinvent and reinvigorate existing transit networks and the cities they serve (Sohn, 2020). Many developing technological innovations could effectively work to address the issues of health and safety as well as create more exciting and desirable public transportation networks.

Online and mobile platforms allow for greater dissemination of pertinent information. One way in which transit agencies could enhance public safety is to limit the need for riders to interact with objects like ticketing kiosks and turnstiles. Integrated online or mobile payment apps provide a contactless payment system that eliminates the need to use public touch screens (Sohn, 2020). Pre-booking seats and providing capacity information available through smartphones can allow riders to choose less crowded

train cars and make other trip choices when vehicles are at capacity (Sohn, 2020). In some countries, riders can be tracked and alerted if they have ridden with someone who is later found to have been ill. While this technology is being developed by Apple and Google, privacy concerns make adoption in the U.S. unlikely (Sohn, 2020). Mobile notifications, such as when buses were last cleaned and agency cleaning policies, could provide additional information to help both agencies and riders.

Another option is to integrate alternative modes into existing transportation systems. Bike- and scooter-share could be adopted by agencies to allow transit operators the ability to reposition themselves as mobility managers. This creates a more complete, multimodal network with additional transportation options that can provide more access for those who, even after it is deemed safe and clean, may not want to ride public transit. Integrating those options into an agencies' trip planning app will also provide an easier way to plan whole trips and eliminate the need for users to juggle different sites or make multiple payments to get from one place to another.

Photo 6: The Jacksonville Transportation Authority's repurposed microtransit shuttle waits to deliver COVID-19 tests to the Mayo Clinic



CASE STUDY: EMERGENCY COMMUNITY AID WITH AV

One alternative method for transit agencies to aid their communities in addition to traditional services is via emergency response initiatives. Autonomous vehicle (AV) fleets could be designed not just for everyday customer travel but also to respond to emergencies when the safety of the driver and passengers, or other needs, make unmanned vehicles a better option. This option, which does not put drivers or other emergency responders in harm's way, has been proposed for moving people out of dangerous areas during evacuations for natural disaster like hurricanes and wildfires (Boswell, 2017). Another opportunity involves using AV fleets to deliver food, medical supplies, and other necessities where needed.

During the COVID-19 testing effort, the Jacksonville Transportation Authority (JTA) partnered with the Mayo Clinic to transport tests and supplies between a drive-thru testing site and the hospital laboratory where they were processed (see [Photo 6](#)) (Conway, 2020). Not only did this help to limit exposure to the virus, it freed up vital frontline staff for other tasks. Starting on March 30th, 2020, four fully autonomous microtransit vehicles were sent on a route between the testing site and the laboratory, with no staff on board. The routes were designed to be "isolated from pedestrians, traffic and staff (JTA, 2020).

"Using artificial intelligence enables us to protect staff from exposure to this contagious virus by using cutting edge autonomous vehicle technology and frees up staff time that can be dedicated to direct treatment and care for patients." – Kent Theilen, Mayo Clinic-Florida CEO

"Our innovative team saw this as an opportunity to use technology to respond to this crisis in Northeast Florida and increase the safety of COVID-19 testing."
– Nathaniel Ford, JTA CEO

Contactless delivery can additionally be utilized as needed for other community services. For example, this method can be useful in a variety of public health and safety circumstances: to deliver food, medications, and other supplies to customers who need to limit contact with

other people for health or medical reasons; to distribute necessities after natural disasters; or to assist schools with meal and supply deliveries during emergencies.

3 ENGAGEMENT

Stakeholder Engagement Process

Stakeholder engagement provides a foundation for understanding the impacts of emerging technologies on statewide agencies that provide or support transit operation and service. Due to the COVID-19 pandemic and ensuing stay-at-home orders from the state, it should be noted that all stakeholder engagement conducted for this study occurred over a virtual meeting platform.

This study relies on three avenues for stakeholder engagement:

- » Online survey tool
- » Individual agency interviews
- » Interactive virtual workshop

Prior to circulating the online survey tool, stakeholder engagement for this study began with a kick-off webinar hosted on February 24th, 2020 from 2 PM - 3 PM by the study team and the Florida Department of Transportation (FDOT) Public Transit Office. The webinar included a presentation introducing attendees to the scope of the study, including the timeline for stakeholder engagement and project completion. The online survey tool was introduced and later circulated to the webinar's 46 attendees.

The study team drafted a 15-question Internet-based survey tool that was shared with the Florida Automated Transit and Shared Use Network (ATSUN) and the Florida Public Transportation Network (FPTN) immediately following the kick-off webinar using the web-based Microsoft Forms. The survey was comprised of a mixture of short answer and multiple-choice/ranking questions. A summary of represented agencies who filled out the survey and their accompanying responses are captured in [Appendix B](#). To date, there have been 15 responses to the survey.

Beginning in late March through mid-May during the COVID-19 stay-at-home orders, individual agency

interviews were conducted over a virtual meeting platform with six agencies. In each meeting, the study team gave a brief webinar presentation to attendees, including key findings from the literature review, an overview of the study, and an opportunity for discussion. The study team asked similar questions posed in the survey or expanded upon key details included in agency responses to the survey. In some cases, interviewed agencies had completed the survey tool, and the supplementary interviews allowed for greater in depth discussion around key topics.

The interactive "scenario planning" workshop hosted by the study team was held on June 25th, 2020 from 2:00 PM - 3:30 PM using Adobe Connect, a virtual meeting platform. The workshop was advertised as part of the University of South Florida Center for Urban and Transportation Research (CUTR) Professional Development Workshop. The 84 workshop participants who attended the webinar were provided a general overview of the study project, progress to date, key findings from the literature review, and asked to participate in a break-out scenario planning exercise designed by the study team. For more information on the scenario planning exercise, see [Appendix C](#).

Throughout the stakeholder engagement process, participants have shared their experiences with trying to leverage federal, state, and local funding, regulatory frameworks, and agency champions to enhance transit access and mobility through innovation. This chapter highlights the key themes, roles, responsibilities, opportunities, and obstacles transit and other agencies face in adopting and adapting to new technology-based mobility solutions, as heard across all three avenues for stakeholder engagement.

Represented Agencies

Below are a list of agencies represented in the stakeholder engagement process for this study (excluding workshop attendees):

- » Broward County Transit
- » Broward Metropolitan Planning

Organization

- » City of West Palm Beach
- » Downtown Fort Lauderdale Transportation Management Association
- » Gainesville Regional Transit System
- » Hernando/Citrus Metropolitan Planning Organization
- » Jacksonville Transportation Authority
- » LYNX
- » MetroPlan Orlando
- » Palm Beach Transportation Planning Agency
- » Pinellas Suncoast Transit Authority
- » St. Lucie Transportation Planning Organization
- » StarMetro

What We Heard

The opportunities and obstacles posed by new technologies were solicited from participating agencies throughout the stakeholder engagement process. The experiences of these Florida agencies reflect what much of the research and other key findings have indicated thus far: despite the associated challenges, transit agencies want to incorporate new technologies and emerging mobility solutions to provide efficient, cost-effective service that improves access for their customers. As for the impact these technologies will have, experts and operators agree that while it may be too soon to tell, greater flexibility and nimbleness will be required to successfully adapt in the long term.

OPPORTUNITIES

New technologies can help customers without first-mile/last-mile access connect to transit.

New technologies can help agencies make efficient use of limited resources and reduce costs.

New technologies allow agencies to rely on data-driven decision-making.

New technologies will have an incredible impact on the transit industry with greater flexibility and nimbleness required.

New technologies are constantly evolving and can quickly become obsolete in the face of lengthy procurement processes.

New technologies require the procurement of services that many agencies do not have the flexibility, funding, or finesse to pursue.

New technologies, which may not be equitably distributed, can further “leave behind” transportation disadvantaged customers, especially those who are not technologically savvy.

OBSTACLES

THEMES FROM STAKEHOLDER ENGAGEMENT

Rank the following in terms of highest to lowest priority issue areas for your agency as you face emerging technologies and new mobility solutions:

1 PROCUREMENT OF INNOVATIVE TECHNOLOGIES

CREATING SEAMLESS CONNECTIONS **2**

3 DATA COLLECTION, MANAGEMENT, & QUALITY

WORKFORCE CAPACITY **4**

5 MANAGING RISK

OTHER **6**

What, if any, innovative technological mobility solutions have your MPO/FDOT District planned for or begun to deploy?

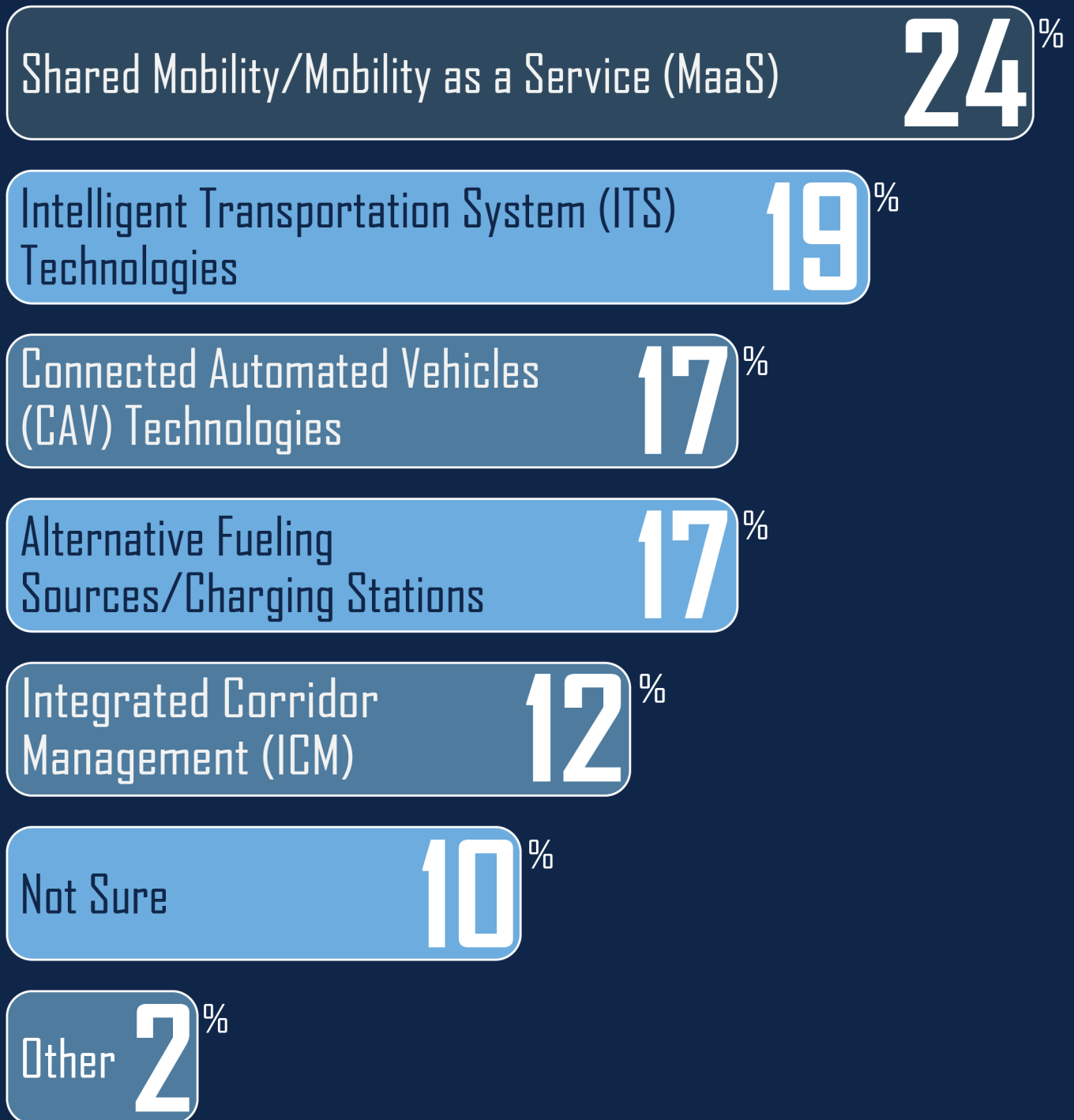


Figure 7: New technologies agencies are adopting by order of response



The following sections provide a more detailed overview of what we heard from participating agencies across the state regarding the opportunities and obstacles associated with incorporating technological transformation in transit. The chapter outlines the technological changes, shared priorities, desired resources, and needs agencies have in navigating a shifting mobility ecosystem.

Technological Changes within Participating Agencies

The icons in **Figure 7**, ordered from left to right by row according to frequency of mentions, represent the new technological changes participating agencies were already using or preparing to implement. Hybrid/electric buses, mobile fare payment systems, and autonomous/connected vehicles were highlighted the most, suggesting

that participating agencies want to adopt technologies that are sustainable, convenient, and can enhance access to transit.

PERCEIVED EFFECTS OF NEW TECHNOLOGY

Almost all of the participating agencies cited new technologies as opportunities to better serve their customers. However, many also mentioned that there will be challenges with funding, procurement, workforce planning, and the equitable distribution of new technology. Overall, the respondents sounded positive about the impacts of new technology on their systems/regions.

Agencies are primarily concerned about new technology's impact on their workforce, transit ridership, and the transportation disadvantaged. Specifically, there is concern that automated buses and vans will replace

Participant Quotes

agency drivers; transportation network companies (TNCs) will siphon away more transit riders over time; and transit technologies will be inequitably distributed or negatively affect transportation disadvantaged programming.

Challenges with finding, retaining, and training a technologically savvy workforce could lead to union concerns as well as the shuffling and creation of jobs. Some agencies are currently experiencing difficulty in finding bus operators and others feel that it is unlikely that automated vehicle (AV) technology will affect operators' job security anytime soon. Bargaining units need to embrace innovative changes and learn how to adapt their traditional labor model to support transformation.

The consensus seems to be that new technologies will affect the entire transit workforce, from administration to operations staff. Some see the impact as inherently negative while others note the opportunities to improve efficiency and streamline services. Training was continuously brought up as a much-needed response to the impacts of new technology. Some agencies, such as the Jacksonville Transportation Authority with its JTA University, are already starting to provide such training internally through their established learning centers. Others cited the opportunity for the FDOT and MPOs to make this provision.

External Technology Integration

Participating agencies indicated that external technology integration was mostly required at the agency level, although aggregated results from the survey question shown on the right additionally suggest an inter-agency disconnect regarding what mobility services others are pursuing or implementing. Agency examples of mobility services requiring integration include: microtransit, bike-share, e-scooters, trolleys, local shuttles, and rail. Integrating mobile fare payment methods across regional transit networks to enhance convenience and access was also highlighted, though as a challenge. It can be expensive, time-consuming, and daunting for transit agencies that need to convert to newer payment systems to support multimodal fare convergence and real-time trip planning.

“While the jury is still out on what type of impact, the consensus is that there WILL be an impact. It is both an opportunity to embrace these new technologies and a challenge to adapt.”



“New technologies present an opportunity to provide first-last-mile connections, increase transit service efficiency, and improve the user experience; however, the challenge is getting past federal funding timing [and] federal-state-local policies and regulations to implement[ing] new technologies, services, and private-public partnerships.”

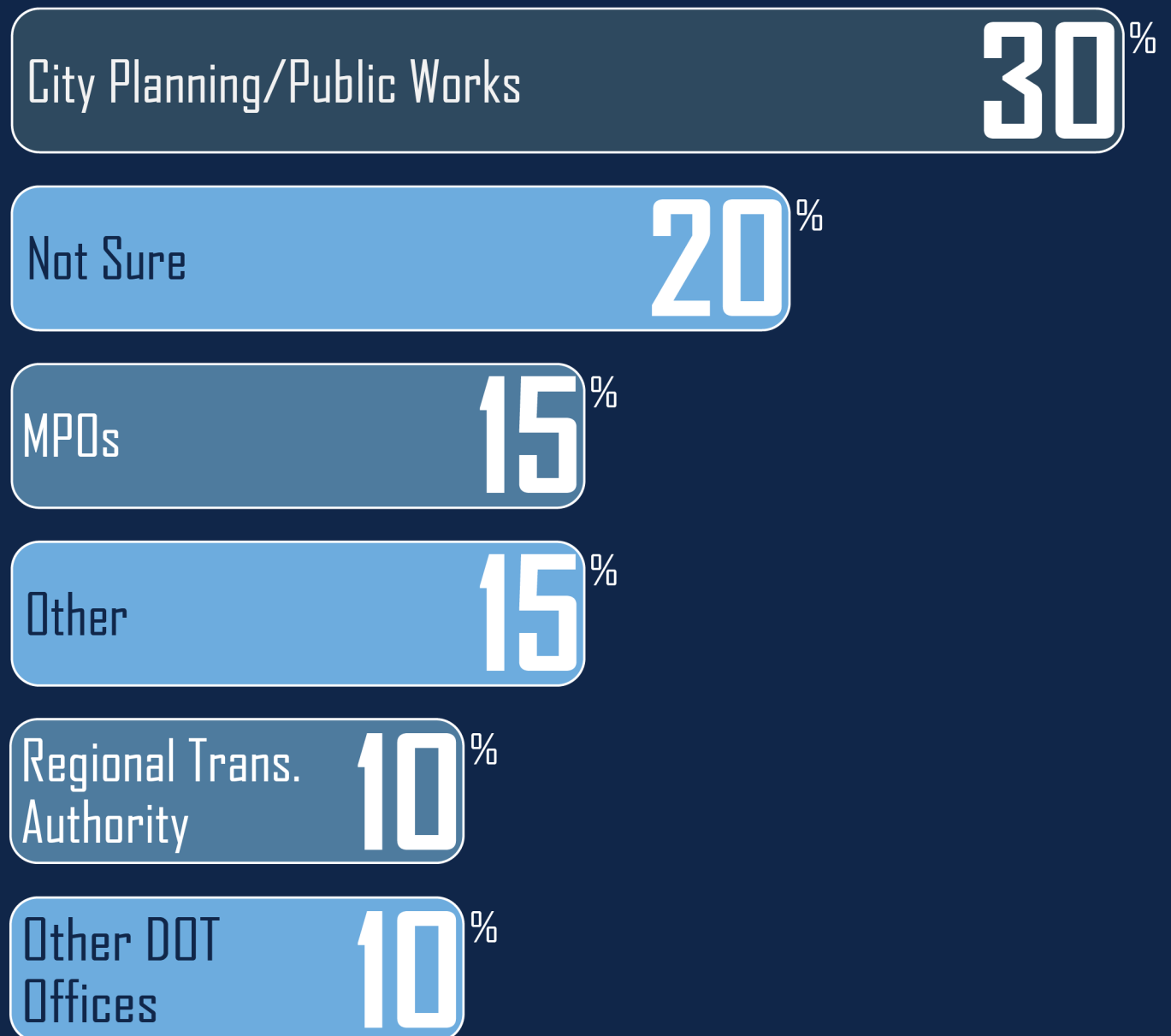


“I see it as an opportunity to expand our footprint in terms of connecting our customers with a first-mile/last-mile transportation solution. It is also for the most efficient use of limited resources.”

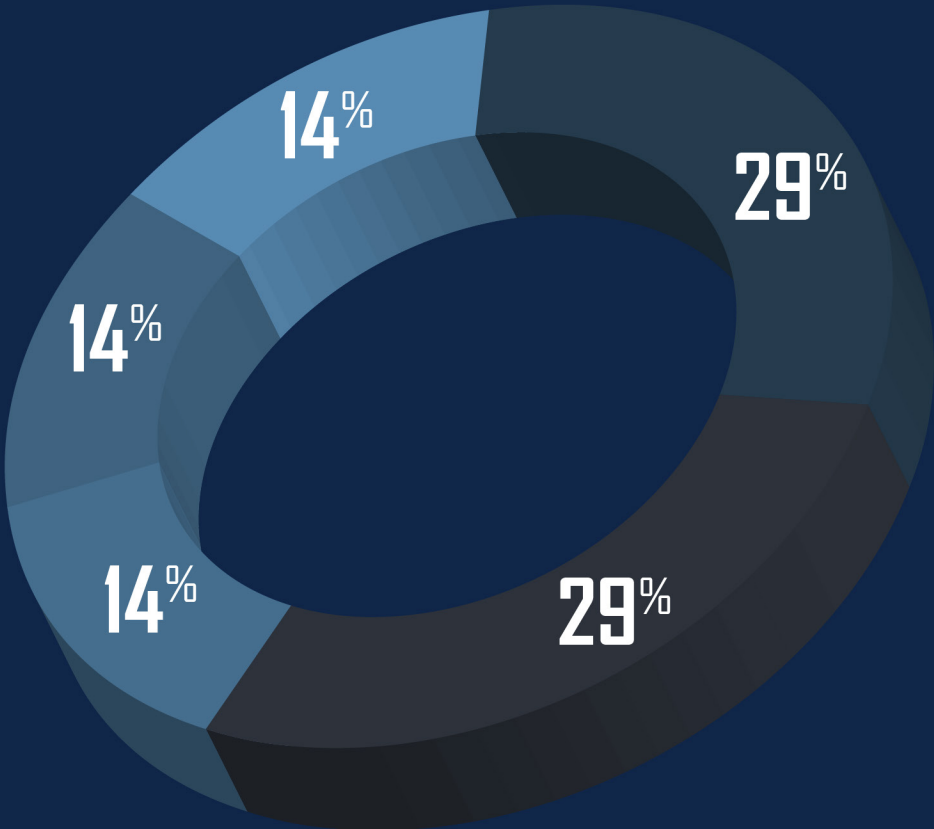


“On the technology side, our organization [will be able] to make data driven decisions to employ our resources more effectively. Some of the emerging mobility solutions represent an opportunity for our organization to fill gaps within our existing service in a cost-effective manner.”

Are there other government agencies implementing mobility services that need to be integrated with your transit service?
If yes, which ones?



Is there a type of data or technology that is not currently being collected or utilized at your agency that could improve analytics and mobility integration?



- Passenger Counting Systems
- Automatic Vehicle Location System
- Not Sure
- Other
- Fare Collection Automation

PUBLIC-PRIVATE-PARTNERSHIP (P3) ARRANGEMENTS

Sixty percent (60%) of respondents indicated their represented agency had considered or entered into public-private-partnership (P3) arrangements to integrate mobility solutions, such as for operation of microtransit services.

Examples of private partners mentioned across the stakeholder engagement process include: Transloc, FreeBee, Circuit, Via, Lime, and Bird. Some agencies cited local government concerns with TNCs as inhibitors to P3 arrangements. For example, there is inherent risk involved in partnering with Uber or Lyft because of their lax regulations regarding background checks and drug and alcohol screenings for drivers. Instead of allowing the TNC to take responsibility once the rider moves to their service, some local governments simply will not consider the idea of such P3 arrangements.

OBSTACLES TO INTEGRATION

The top three obstacles associated with integrating technological changes were cited as funding, staff resources/training, and data acquisition and management. Procurement was also mentioned as a challenge, especially for transit agencies that operate as a department of county government. In these instances, local government protocols or lack of familiarity with the specific needs and language of transit operations and technology can lengthen the procurement process or limit the ability to adopt innovative technology solutions. Many agencies feel that 20th century institutional frameworks for funding and procurement are being used to meet the needs of 21st century technology and consumer demand. By the time the agency actually procures new equipment or services, years have passed and the technology procured is once again outdated. For many transit agencies, mobility integration is better kept at the city level until there is enough money and staff to support it.

Desired Resources for Changing Technologies

“Layers of strategy” are required to push innovation through and create funding opportunities for new technologies. As quoted directly from a survey response: agencies need dedicated funds for technology; otherwise, funds will be shifted to operational necessities or to deal with safety concerns. Participants mentioned that while surface transportation funding can be diverted away from roads, there are strings attached that need to be unlocked at the state level to use that money as needed for transit. Lastly, funding needs to be flexible enough to cover not just capital costs, but operational costs, as well.

Specific feedback was provided by participating agencies recommending that FDOT:

- ✓ Expand the Automated, Connected, Electric, Shared (ACES) program to transit.
- ✓ Help with testing new equipment.
- ✓ Approve equipment for state contracts.
- ✓ Support agency research.

General needs included:

- ✓ Public-private-partnership (P3) flexibility.
- ✓ More collaboration between various stakeholders.
- ✓ Application Program Interface (API) integration agreements.
- ✓ Fully integrated apps across platforms including TNC services and real-time trip planning.
- ✓ Help with purchasing fixed-route and other mobility services.
- ✓ Open data arrangements.
- ✓ Training:

- Widespread training and education for bus operators supported by the state.
- Prepare high school students to enter the workforce.
- Industry-specific for IT and planning staff to navigate new technologies and big data management.

MPO INVOLVEMENT

Although each agency and MPO relationship has a unique structure, almost all responses indicated that they work well together. In some cases, MPOs act as change agents or “regional conveners”: persuading the local transit agency to adopt new technologies, consider public-private-partnership (P3) arrangements, or share their data openly.

In most cases, agencies coordinate and collaborate with their MPO as needed: coordinating project priority lists, getting funding for research and studies, and generally helping to fulfill the MPO’s federal requirements for long-term transportation planning. In one case, an agency’s MPO was involved in its process for vetting a bikeshare/ scooter share vendor by sitting on their Request For Proposal (RFP) Selection Committee.

While any level of involvement is ideal, transit agencies can benefit considerably from having a champion at the regional level.

Participant Quotes

“Our approach is to have technology be the integrator, not the agency.”



“Our transit agency established the bike share program but later transferred the program to the city.”



“It doesn’t make a lot of sense for transit agencies to spend a lot of money creating a [smartphone] app that is solely for their service and becomes outdated shortly.”



“It is really hard to do service planning when you are looking at data that is 6 years old.”



“There’s a feeling that transit agencies are on their own to some extent.”



“[Our] TPO is pursuing an Integrated Data Exchange for the region to handle transportation data.”



Photo 7: Basic design elements (i.e. sidewalks, crosswalks, bike lanes) are vital to have before introducing new technology

84 PARTICIPANTS IN THREE BREAK-OUT ROOMS FOR A FACILITATED SCENARIO PLANNING EXERCISE

Scenario Planning Workshop

The virtual scenario planning workshop enabled the study team to conduct the last piece of stakeholder engagement in a safe and appropriate way, given nationwide social distancing measures.

After a brief presentation which included some preliminary live polling (see [Figure 8](#)), the workshop's 84 participants were randomly assigned to a break-out room in which two facilitators guided each group through a scenario taking place in one of three fictitious municipalities: Smallville, the smaller rural community; Middletown, the mid-size "town and gown" community; or Urbanville, the large metro area. The three scenarios were designed to reflect the variety of geographies and service area types in which Florida's transit agencies typically operate, many of which participated in the study team's survey and one-on-one interviews.

In each scenario, participants considered a prompt with associated issues for discussion and roles for the key players likely to be involved (see [Appendix C](#) for the full descriptions). Issues pertained to those transit agencies may face in adopting or adapting to mobility solutions, including but not limited to interagency coordination, data collection and management, procurement, labor and workforce development, policy and planning, and operations. Examples of the key players involved include the town planner, the transit agency's transit manager, the mayor, the DOT district transit unit manager, government liaisons of private vendors, and MPO staff.

Participants responded to each scenario's issues for discussion by first answering questions prepared by the study team to guide the conversation. In a de-brief at the end of the workshop, themes from the discussion were summarized by each scenario's facilitators and shared with the entire group (see [Figure 9](#)). These themes mainly came from three (3) of the prepared discussion questions:

1. What are the obstacles to adopting innovative mobility solutions and creating seamless connections in your scenario?

2. What opportunities are created by technology in your scenario?
3. From the perspective of each role, what could the MPO or DOT do to support technological innovation in a technical, institutional, and funding capacity to address these issues?

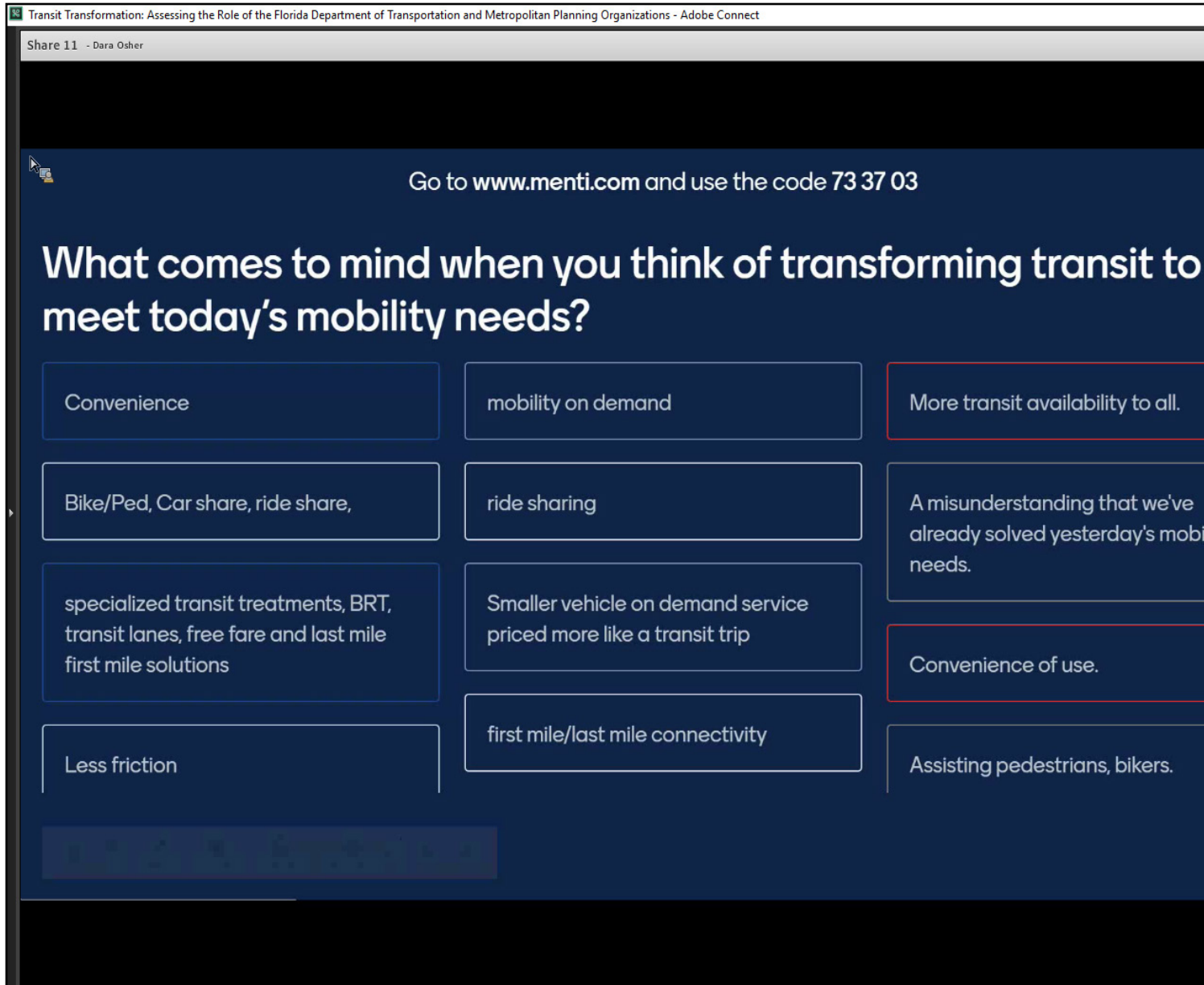
The themes that came from the workshop are best understood in the context of each scenario. The hypothetical issues for discussion and the resulting "Obstacles, Opportunities, and Support" reflect the comments and dialogue elicited during the virtual breakout rooms.

Smallville

HYPOTHETICAL ISSUES FOR DISCUSSION

- » Smallville wants to expand paratransit service and improve mobility options around the town center area where Main Street is being redeveloped.
- » The Regional Planning Council is working with the DOT District and Middletown's MPO to determine funding sources for a regional transit option.

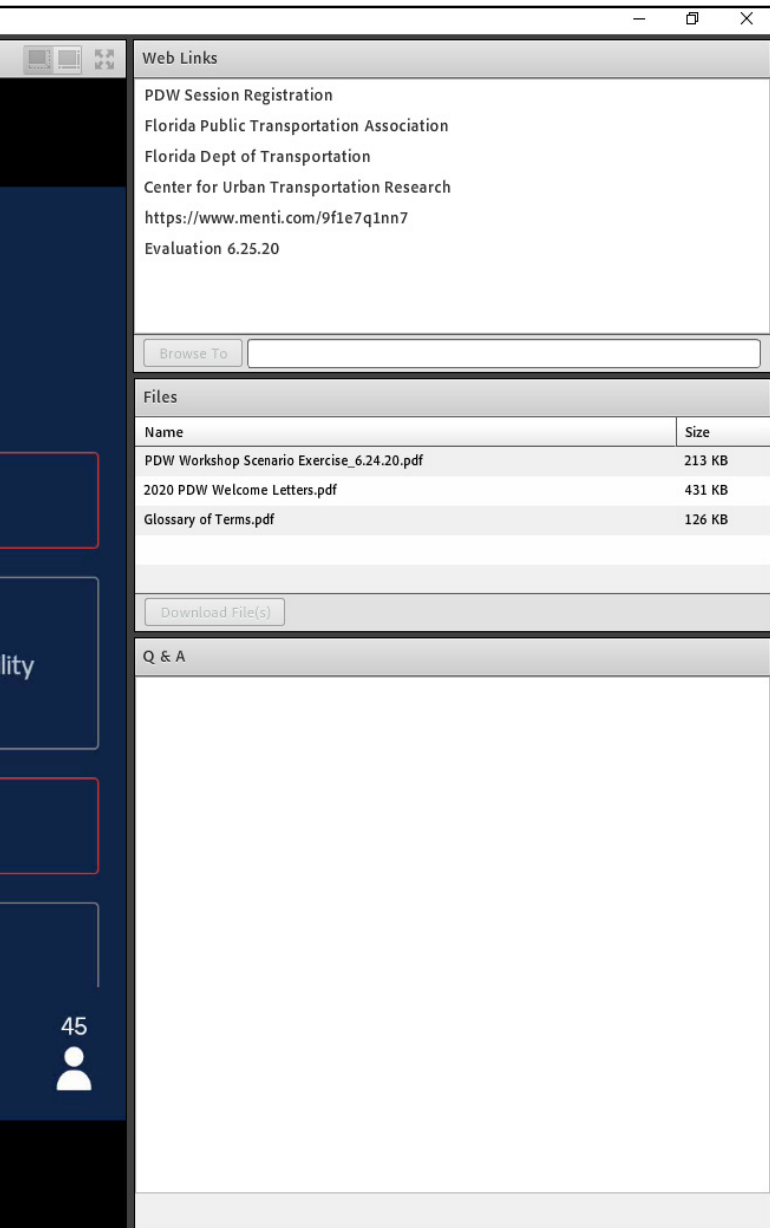
Figure 8: The virtual workshop incorporated live participant polling on the concept of transit transformation



THEMES

OBSTACLES

- ◆ Understanding the market transit is serving: residents are older and retired, so proposing innovative mobility solutions will require an outreach campaign to garner public support.
- ◆ Funding is an obstacle for a rural community since urbanized areas have 5307 and other funding sources.
- ◆ Rural communities are more spread out, which can inhibit planning and designing adequate transit service.
- ◆ Lack of interest in and knowledge of new technologies by those who would implement them (i.e. transit agencies).
- ◆ Timing and coordination are keys to successful and efficient programs, especially when projects overlap or can fulfill mutual interests.



OPPORTUNITIES

- ◆ Community partnerships, economic development, and innovation.
- ◆ The ability to improve and add mobility options, especially lower-cost mobility options, as opposed to expanding traditional and special transit services, which are very expensive.
- ◆ Job creation and comfortable rides for customers.

SUPPORT

- ◆ Opportunity for funding in the work program and to identify and set aside extra funding for innovation like this.
- ◆ Give a higher mark to applications that are more innovative and use technology options for enhanced mobility.
- ◆ Provide continuous training or workshops and other education to understand new technology options.

- ◆ If there are different ticketing options used across services in other regions, then these must be streamlined for integration to create seamless connections.
- ◆ Ensuring the agency is ready to move forward with the project once funds are received and, therefore, understanding when funding would be available for the agency to use.
- ◆ Existing resources and equipment within the transit industry is often outdated, thus creating obstacles from the project's outset.



Photo 8: Image of an on-street bikeshare station in an urban area

Figure 9: Themes from each break-out room were discussed in a de-brief at the end of the virtual workshop

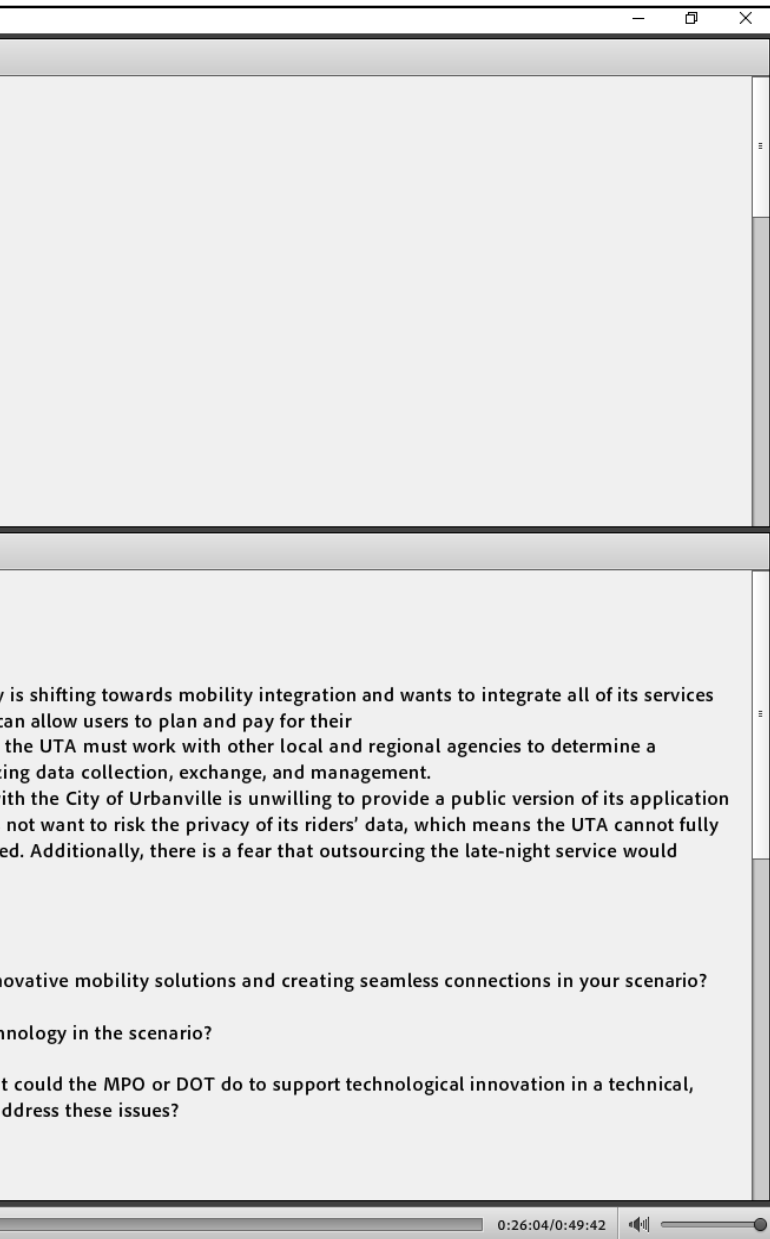
Transit Transformation: Assessing the Role of the Florida Department of Transportation and Metropolitan Planning Organizations - Adobe Connect	
Break Out Room 1	
<p>Session Notes</p> <p>Issues for Discussion</p> <ol style="list-style-type: none"> 1. Smallville wants to expand paratransit service and improve mobility options around the town center area where Main Street is being redeveloped. 2. The Regional Planning Council is working with the DOT District and Middletown's MPO to determine funding sources for a regional transit option. <p>Think through your answers to the questions below, then discuss them together with your group:</p> <ol style="list-style-type: none"> 1. Who are the key players likely to be involved in addressing these issues? Issue 1: Mayor, Transit Manager for Small Tran, Transit Unit Manager, Finance Director, Town Planner Issue 2: 2. What, if any, part does each role play in addressing these issues? Issue 1: Mayor - Decision maker, final say 	
Break Out Room 2 - Breakout 2	Notes 4 - Breakout 3
<p>Session Notes</p> <p><u>What are the obstacles to adopting innovative mobility solutions and creating seamless connections in your scenario?</u></p> <ul style="list-style-type: none"> - creating partnerships between stakeholders - government contract restrictions/guidelines - the mix of stakeholders elected officials vs. government/universities have different expectations; putting the right information together FIRST and allowing for the right opportunities to educate all stakeholders to decide on who will take ownership <p><u>What opportunities are created by technology in the scenario?</u></p> <ul style="list-style-type: none"> - selling applications that have several purposes - utilizing the data that come from different technologies for a variety of purposes - Scooter/Bike share not really acting like an extension of transit for certain areas <p><u>From the perspective of each role, what could the MPO or DOT do to support technological innovation in a technical, institutional, and funding capacity to address these issues?</u></p> <ul style="list-style-type: none"> - Grants and flexibility - have a healthy mix of involvement; if FDOT puts it out there and there is a local leader also pushing it more likely to get through in a successful and timely manner - Local Champion - Pilot all technology implementations and place liability on the service provider - repeating training opportunities from FDOT/MPO to help with educating transit agencies on procedures and how to find/apply for funding. Especially with company/department personnel turnover - understand the market that transit serves 	<p>Session Notes</p> <p>Issues for Discussion</p> <p>The Urban Transportation Authority into one smartphone application that entire trip in the same place. To do so, framework and protocol for standardizing the ride-sourcing TNC partnering with program interface (API). The TNC does integrate all available modes, as planned negatively impact bus operators.</p> <p>Questions</p> <p>What are the obstacles to adopting innovative mobility solutions and creating seamless connections in your scenario?</p> <p>What opportunities are created by technology in the scenario?</p> <p>From the perspective of your role, what could the MPO or DOT do to support technological innovation in a technical, institutional, and funding capacity to address these issues?</p>

- ◆ Focus on “indigenous innovation” to increase wages and living standards, and utilize science and technology to support inclusive growth.
- ◆ FDOT and the MPOs could partner with communities to provide the expertise of their contracted consultants to assist with innovation.

Middletown

HYPOTHETICAL ISSUES FOR DISCUSSION

- » Middletown local government is working with the university and Middletown Regional Transit to find ways to improve alternative transportation options for students.
- » Middletown local government is



submitting a grants application to the DOT District to perpetuate its micromobility pilot program and is also interested in meeting with the university to discuss funding opportunities.

- » Middletown local government is seeking MPO support in facilitating data management and training for local

transit agency staff to manage the new micromobility pilot program.

THEMES

OBSTACLES

- ◆ Creating partnerships between stakeholders.
- ◆ Government contract restrictions and guidelines.
- ◆ The mix of stakeholders, elected officials, and government and university staff all having different expectations creates an obstacle to innovation. First, it is important to put together the right information and allow for the right opportunities to educate all stakeholders to decide on who will take ownership.
- ◆ The need to understand the market that transit serves. Most Florida agencies serve mainly low income/transit dependent folks. This means how we subsidize the first/last mile connection becomes crucial; even an additional \$1-2 will be onerous for most Florida transit riders.
- ◆ Integrating technologies needs funding commitments from all partners, but when it takes 'too long' to get the project off the ground and execute, funding can be in jeopardy as other agency priorities take precedence.
- ◆ Risk is big and would need to move liability off the organization and onto the service provider.
- ◆ There is more burden placed on technology providers during pilots; they shoulder more risk and cost, with the possibility of consistent business partner if pilot succeeds.

OPPORTUNITIES

- ◆ Proposed smartphone applications have several purposes, including real-time trip planning, fare payments, and the ability to generate data.

- ◆ Utilizing the data that comes from different technologies for a variety of purposes.
- ◆ Scooter/bikeshare can better serve as an extension of transit in particular areas.
- ◆ Public-private-partnerships (P3s) would be a good approach; new technology should be implemented using a collaborative effort.
- ◆ Pilots can facilitate quick demonstration of a project.

SUPPORT

- ◆ Grants and flexibility.
- ◆ Have a healthy mix of involvement; if FDOT puts support out there and there is a local leader also pushing technological innovation, then projects recommending these types of solutions are more likely to get through in a successful and timely manner.
- ◆ Local champion.
- ◆ Understand the market that transit serves.
- ◆ Repeat training opportunities from the FDOT and MPOs to help with educating transit agencies on procedures and how to find and apply for funding, especially in light of company and department personnel turnover.
- ◆ Pilot all technology implementations and place the liability on the service provider.
- ◆ Pilots programs have huge funding potential, especially for innovative technologies and Electric Vehicles (EVs)/Automated Vehicles (AVs), but from my research, the transition off the pilot to being self-sufficient has been the barrier.

Urbanville

HYPOTHETICAL ISSUES FOR DISCUSSION

- » The Urban Transportation Authority (UTA) is shifting towards mobility integration and wants to integrate all of its services into one smartphone application that can allow users to plan and pay for their entire trip in the same place. To do so, the UTA must work with other local and regional agencies to determine a framework and protocol for standardizing data collection, exchange, and management.
- » The ride-sourcing TNC partnering with the City of Urbanville is unwilling to provide a public version of its application program interface (API). The TNC does not want to risk the privacy of its riders' data, which means the UTA cannot fully integrate all available modes, as planned. Additionally, there is a fear that outsourcing the late-night service would negatively impact bus operators.

THEMES

OBSTACLES

- ◆ The root goal of the project at hand has been lost. The friction is around the data. Focus on the customer and ease of use.
- ◆ If the public cannot know how the cost is derived (for a trip), then this could be an issue.
- ◆ Bus operators and unions might object to outsourcing drivers; that can be seen as competition.
- ◆ Standardization of data formats. Data should be able to talk to each other. Also, more options to avoid excluding any riders.

- ◆ If I wasn't riding the system already, then this new technology might not be enough to get me to ride the system; however, it may be enough to keep me riding transit.

OPPORTUNITIES

- ◆ Gamification elements included in a smartphone app to improve usage.
- ◆ Efficiency of having one system for all services.
- ◆ Ease of use more than pricing.
- ◆ Safety is important for micromobility users.
- ◆ Opportunity to collaborate with other agencies.
- ◆ Develop a template contract that will cover the obstacle of transportation network companies and sharing data.
- ◆ Need to focus on basic design elements, like sidewalks, bike lanes, etc., instead of shiny, new technology.

“All of these mobility-related technologies and bells and whistles mean little if the infrastructure doesn't support safe walking and biking.”
—Workshop Participant

SUPPORT

- ◆ Not sure how an MPO or DOT could serve some back room needs.
- ◆ State-level travel needs coordination rather than just within a district.
- ◆ Many opportunities for DOT and MPOs: roles of coordinating operations, size, knowledge sharing, and funding of research projects.

“The future of public transit hinges on shifting from a supply model to a demand model and embracing emerging modes and technologies to better serve, satisfy and grow ridership.”

—Workshop Participant

4 GUIDANCE

Key Findings

Public and private sector innovation is rapidly changing the mobility ecosystem within which traditional transit service functions. Customer demand for real-time access to transit information and convenient mobile payment options is influencing a shift towards mobility integration for transit operators.

The COVID-19 pandemic has additionally accelerated the need for transit operators to question and rethink their approach not only to operations but also to customers. In a scenario in which no one feels safe or comfortable riding transit, transit is still an essential service and has continued to serve those (including essential and other workers) who have no other means of transport. To mitigate concerns associated with public health and riding transit, operators are realizing the importance of focusing on the rider. New technologies and mobility solutions can be leveraged to promote public health and safety as well as mobility as a service. If implemented regionally, these tools can work together to create conveniently integrated services and a seamless transportation experience for the user.

Key findings from the review of existing literature and the study team's extensive stakeholder engagement have been grouped into the same eight areas of research as captured in [Chapter 2: Discovery](#).

Big Data and Public Transportation

Management of data and information is a fundamental element of emerging mobility. Transit operators generate tons of data but do not necessarily have the ability or expertise to analyze and use this data to benefit operations or service provision. However, there is potential for transit agencies to sell their data as a new revenue source, similar to the selling of advertisement space on the side of buses.

Some private sector vendors or partners for procuring new mobility solutions are averse to openly sharing data due to privacy concerns, while public agencies seek to improve public transportation and other services based on travel behavior and patterns gleaned from these data sources.

“Sometimes we overestimate technology disruption in the short term, but underestimate it in the long-term.”

—Bill Gates

Larger public agencies, such as state departments of transportation (DOTs), metropolitan planning organizations (MPOs), or transit authorities, can leverage their size and expertise to procure services with open data agreements. Smaller agencies seeking to implement innovative mobility solutions would benefit from the development of a contracting template that streamlines the procurement process and addresses data sharing concerns.

Transit and Automated Technology

Much of the discussion concerning transit and automated technology is focused on microtransit pilot programs for first/last-mile connectivity. Many transit operators around the nation and the state are implementing microtransit pilot programs with electric shuttles that, despite having an operator on board, function in a fully automated fashion. In Florida, several of these automated microtransit pilots are funded by the Florida Department of Transportation (FDOT) and facilitated through public-private-partnerships with private vendors who maintain and operate the vehicles and technology associated with the pilot.

For many smaller transit agencies, whose funds are already dedicated to core transit functions and operations, few opportunities exist to fund microtransit and other innovative pilot programs. Federal Transit Administration innovative mobility grants are incredibly competitive; formula funds, such as FTA 5307 eligibility, have little impact in promoting innovation; and subrecipient agreements can be too cumbersome for smaller cities and transit operators to realistically navigate. Enhancing the availability of state-level funding for innovation can encourage collaboration

between agencies to pursue regional pilot programs, which can later be leveraged to win federal funding for future iterations.

Mobility as a Service (MaaS), Shared Mobility, and Transit

One of the issues continuously identified by external resources and stakeholders throughout the study was risk mitigation for pilots involving mobility on demand, shared mobility, microtransit, and other mobility as a service concepts. The risk associated with procuring private vendor services complicates the ability for transit operators, especially those situated under county governments, to implement innovative mobility solutions as an extension of traditional fixed-route transit.

Counties may be less inclined to divert dollars toward innovation when their fixed-route transit service is already spread too thin. Additionally, micromobility solutions are more appropriately designed to accommodate shorter-distance travel within cities, so county-level transit agencies may not get the support to implement or even integrate with such services. Subsidized ridesourcing programs, while more appropriate for agencies with large

service areas, are inherently risky. For example, Uber and Lyft have comparatively lax drug and alcohol testing requirements for drivers. For these reasons, risk mitigation is an important issue to address.

Private-public-partnerships (P3s) are a tool for risk management—the private vendor becomes the entity who assumes the most risk—but are complicated to establish. Larger public entities, such as a DOT, MPO, or transit authority, can leverage their size and market access to help facilitate those partnerships for innovation, ameliorating local government concerns and filling in agency personnel or knowledge gaps. Beyond contract and technical capacity issues, “Enterprise Risk Management” can additionally counteract potential threats to systems and security by establishing new protocols on cybersecurity and asset management.

Multimodal Mobile Payment Integration

Multimodal mobile payment integration is at the backbone of service integration as user demand has risen for one, convenient mobile payment option that allows riders to pay a single fare across multiple modes of transportation. The

“We cannot rely on our 20th century financial and organizational frameworks to support 21st century customer needs and innovation.”

—Workshop Participant

“The future is already here, it’s just unevenly distributed.”

—William Gibson

narrow focus of transit agencies on delivering traditional transit services can hinder the integration of mobility services, as can the agency’s desire to own and operate its own smartphone app. For example, one interviewee specifically mentioned Palm Beach, Broward, and Miami-Dade Counties as each pursuing different models for mobile fare payments, thus complicating the ability to integrate regional modes of travel.

Mobile payment integration on a regional scale can be facilitated through Memorandums of Understanding (MOUs) or formal agreements with third party applications capable of integrating cross-jurisdictional transit services. These apps can permit riders to conveniently pay for their trip and track real-time travel information. Open Application Programming Interfaces (APIs) are key to creating these links. On the back end, transit agencies can access and utilize the data and services of private sector specialists, integrate their existing mobile payment options, and incorporate a real-time location feature that keeps operators accountable while satisfying growing customer demand for accurate information on where their ride is.

Integrating and Managing Mobility

Transit agencies are well-positioned to serve as integrators of mobility services since they typically operate and maintain fleets. Even before the COVID-19 pandemic, transit operators across the country have been considering how the future of transit might look under a potential “integrator” role.

Many agreed that taking on new roles as mobility managers and incorporating new technologies like integrated universal transit apps and bike and scooter-share into their existing systems could reinforce their relevance, attract new riders, and provide alternative revenue sources. Since the COVID-19 outbreak began, this has become even more prescient as people seek avenues to identify a new normal and live their lives as safely as possible.

Labor and Procurement Considerations

There are key workforce considerations that need to be addressed in the shifting mobility ecosystem. The nature of the workforce will need to change as mobility changes and the surge of technological solutions, particularly the trend towards automation, calls for additional Information Technology (IT) personnel and operators who can be trained to adapt. Another potential impact on the workforce will likely come from the rise of robotics and artificial intelligence in maintaining and repairing transit vehicles and equipment.

While transit authorities are better positioned to adapt to these shifts, smaller transit agencies will need greater assistance or other mechanisms of support to successfully adapt. Therefore, the contracting out of such services might be a better solution as demand for more flexible service challenges traditional labor agreements and workforce rules. To promote adaptation within existing transit agency workforces, operators must focus on developing the organizational capacity to manage Intelligent Transportation Systems (ITS) and technology applications to enhance mobility. Some agencies, including several in Florida, have already begun to create internal resources or pursue partnerships with local colleges and universities to better position the workforce of the future.

Safety and Access

New technologies offer the ability to enhance safety on buses and at bus stops both for riders and operators. For example, security cameras on buses help deter harassment and investing in the built environment at and leading up to transit stops can reduce some of the stigma for more vulnerable passengers (i.e. women, who often cite security concerns as an inhibitor to taking transit).

“The first and last mile isn’t really a transportation problem, it’s a land use and urban design problem.”

—Workshop Participant

To enhance cleanliness and convenience and attract new ridership, many transit agencies are offering mobile payment options for purchasing transit fares. Integrated transit services can reduce the cost of transit by allowing the user to pay one fare for their entire trip as opposed to paying for each leg of the trip. Additionally, integrating real-time trip planning and information into smartphone apps benefits riders, and especially women, by conveying the exact location of the bus and the timeline for when it will arrive. Transit agencies can also use this medium to directly communicate with passengers.

However, operators must also provide alternatives for less technologically-savvy riders or those without the financial ability to have a smartphone and data plan. There will consistently be a need to identify equity issues and develop strategies to address them in a real way. As was mentioned in the engagement effort for this study, flashy new technology means little when basic design elements that provide people with safe access to transit (i.e. sidewalks, cycling infrastructure, lighting, pedestrian crosswalks, clear sight lines, and more) are lacking. A collaborative effort with increased transit agency involvement and oversight of street design within the context of first-mile/last-mile accessibility will be necessary to address this problem, particularly in Florida.

Transit and COVID-19

The COVID-19 pandemic and subsequent economic shutdown has resulted in massive drops in ridership for transit agencies. Being an essential resource, public transit continued to provide service during the lockdown, albeit with precautionary adjustments to reduce the likelihood of transmission and to protect both customers and operators.

With cities reopening and transit services returning to pre-COVID-19 schedules, agencies are imagining a post-pandemic future in which they must rethink their role as operators, refocus on mobility integration, and prioritize better customer service. The need to create a cleaner transit environment, restore public confidence in the safety of transit, and prepare now for future incidents is accelerating the movement towards contactless payment systems, real-time communications with riders, and service integration of bikeshare and scootershare to accommodate customers weary of enclosed shared spaces, like buses and trains.

Roles and Opportunities

Florida Department of Transportation

The Florida Department of Transportation and other state DOTs are well-positioned to mitigate some of the risks transit agencies face in pursuing innovative mobility solutions. Throughout the discovery and engagement efforts completed for this study, several opportunities specific to FDOT were identified:

- » Facilitate shared resources through joint or pooled procurements
- » Offer expertise of consultants and staff personnel at the state and district level
- » Establish standardized Request for Proposal/Request for Qualifications (RFP/RFQ) and other contract templates,

including public-private-partnership guidance, to facilitate and streamline professional service agreements to support mobility integration and pilots

- » Create an approved vendor list
- » Pursue changes to Florida statutes to encourage grant flexibility for mobility studies

Pilot projects are tools that eliminate risk by allowing the agency to test out new programming before dedicating limited resources to it full-time. The FDOT could create its

own pilot for transit agencies and MPOs that focuses on mobility integration, recognizing that there needs to be an entrepreneurial culture shift to allow transit operators greater bandwidth to experiment and learn. **Figure 10** provides an example framework through which the FDOT could pursue a Collaborative Mobility Integration program.

Metropolitan Planning Organizations

Metropolitan planning organizations are uniquely poised to convene the various agencies within their jurisdiction in developing and pursuing a regional plan for mobility integration.

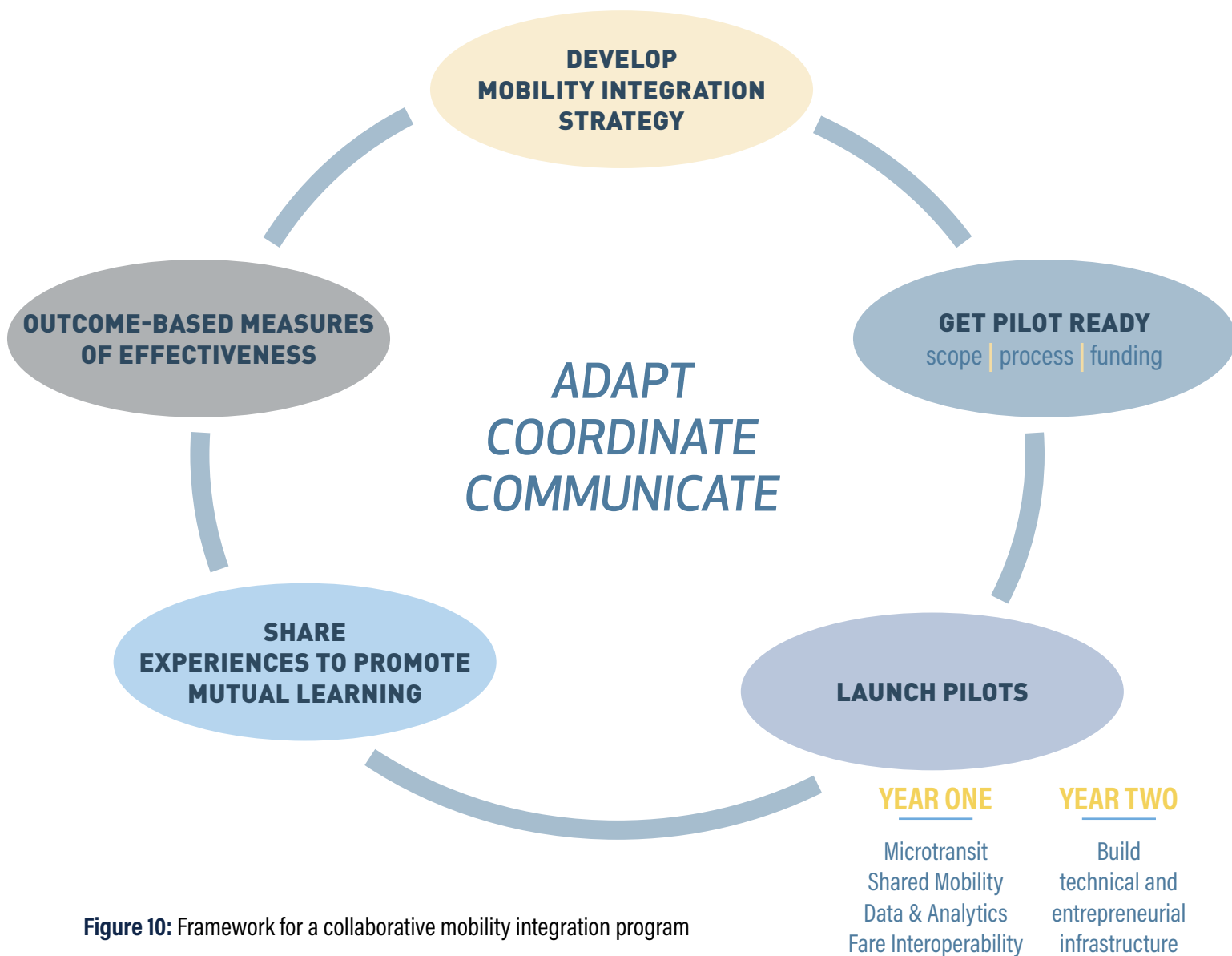


Figure 10: Framework for a collaborative mobility integration program

MPOs already leverage technical and citizen-based committees to review and weigh in on long-range transportation planning documents. Therefore, MPOs have the existing frameworks in place to establish an approach to regional mobility integration, including standardizing the nomenclature, identifying funding resources, and determining the roles various agencies can play in the integration process.

While MPOs are typically not operators or implementers, they can own the maintenance of regional mobility plans and be the managing entity over the exchange of data and resources. Additionally, by supporting funding for mobility services through the long-range planning process, MPOs can act as advocates for strategies and services that leverage federal funds (i.e. surface transportation/SU and Congestion Mitigation and Air Quality/CMAQ funds) to prioritize regional integration.

Transit Operators

The governing structure of public entities that operate transit affects their ability to integrate mobility services. Therefore, it is vital to make the distinction between transit agencies and independent authorities.

Transit agencies that function as a department of county government are often restricted by shared procurement policies, competing priorities, and an underlying emphasis on risk management or aversion. Micromobility and often microtransit solutions tend to be driven by cities, not counties, further complicating the feasibility of some transit agencies becoming mobility integrators. Additionally, the infrastructure that best supports micromobility seldom occurs on county roads or is under county control. For transit agencies housed within city governments, there is more opportunity for multimodal integration and other innovative mobility solutions.

Independent transit authorities have greater flexibility in procuring services and taking on risk. With more sophisticated staff and expertise, they are more likely to have experience with transit-focused procurement and contracting. Transit authorities have the added benefit of approaching transit on a regional scale, thus well-poised

to focus on the mobility needs of their ridership. For these reasons, independent transit authorities can more easily take on mobility integration as a strategic priority.

Big Ideas

Incorporating new technologies in transit creates a variety of benefits for both operators and riders, enhancing quick and convenient access to multimodal options while creating avenues through which agencies can learn more about their transportation systems and ridership. However, technology alone cannot adequately address and resolve public concerns with safely accessing transit and alternative transportation modes. To improve transit access and mobility as a service, it is vital to leverage complete streets and infrastructure changes to make systems and technologies more accessible and safer. Only through a systemic process that prioritizes the safety and accessibility of all users, from initial planning through to design, construction, and maintenance, will we begin to increase awareness, support, and encouragement of walking, biking, and taking transit.

Transit agencies nationwide have redesigned their systems to improve access and travel time reliability while private mobility companies work with cities to learn more about the travel patterns of their citizens. Yet there is a huge mismatch between the service provided and the infrastructure in place to support accessibility. Without addressing the foundational need to build safe, accessible, and multimodal infrastructure, new technology integration may fail to sustainably and equitably enhance mobility within our communities. We must craft an aspirational vision and narrative to improve and make progress in this space.

Shared Regional Vision for New Mobility

- ✓ Prioritize an acute focus on customer service to compete for ridership and promote vitality of transit

***“The urgency of taking actions
(i.e. pandemic-related or otherwise)
gives us a chance to avoid
resistance to change.”***

—Anonymous

- ✓ Promote a regional framework of cross-jurisdictional collaboration and technological interoperability that mirrors traditional LRTP and TIP planning and funding processes

Mobility Data Collaborative

- ✓ Create a statewide process for sharing mobility data with regionally-integrated mobile payment software at the foundation
- ✓ Facilitate collaboration between agencies with more and fewer resources

“Off the Shelf” Standard Procurement

- ✓ Streamline the statewide technology procurement process by creating an open source template for transit

agencies which includes an FDOT-vetted list of approved vendors and services

- ✓ Establish a single entity or body to update and modify these resources as pilots are conducted, new vendors and services are available, and new technologies evolve

Flexible Funding and Pilots

- ✓ Explore partnerships between transit agencies, MPOs, and local governments to facilitate mobility integration pilots which can utilize MOUs to identify roles for planning, operations, and maintenance
- ✓ Pilots can include integrating multiple mobility options with transit and pursuing an app to plan, book, pay, and track multiple mobility services, potentially conditioning state funds on regionally integrated payment and

mobility tracking systems

- ✓ Pilot frameworks should be established during the shared regional visioning process
- ✓ Streamline funding programs which, as they exist, lack flexibility and timing to support mobility innovation due to personnel turnover and the fast pace of evolving technology; by the time agencies receive actual funds (which can take up to five years), the project may need to be re-championed or revised to address technology obsolescence

Technical Capacity and Training

- ✓ Leverage statewide expertise and consulting agreements to bolster the technical capacities of smaller transit agencies seeking innovative mobility solutions
- ✓ Facilitate a statewide integrated payment and information platform, which can help address a variety of public health and safety concerns associated with taking transit
- ✓ Provide repeat training opportunities from the FDOT and MPOs to help with educating transit agencies on procedures and how to find and apply for funding, especially in light of company and department personnel turnover

Figure 11: Efforts to standardize mobility data sharing

SAE International's Mobility Data Collaborative

The Society of Automotive Engineers (SAE) International, through its Mobility Data Collaborative (MDC), is bringing together private and public perspectives to address the visible tensions around data sharing and aggregation to build consensus around compromise and to improve mobility outcomes and services for all. Public agencies can leverage their expertise and intelligence around demand and high capacity networks, for example, and the private sector can respond by matching services.

The MDC framework for mobility data follows six guiding principles:

- Foster Inclusivity and Equality
- Embrace Collaboration
- Support Wide Adoption
- Complement, Not Duplicate
- Act with Urgency
- Challenge Ourselves

The MDC's Guidelines for Mobility Data Sharing Governance and Contracting aligns the interests of the public and private sectors while addressing privacy, transparency, data ownership, and consumer trust. By compiling a Data Sharing Glossary and Metrics for Shared Micromobility, the MDC is additionally addressing inconsistent definitions and interpretations of performance metrics to establish a common nomenclature around shared mobility (SAE ITC, 2020).

Next Steps and Action Items

Building off of the need for a Shared Regional Vision for New Mobility, these next steps and action items would ideally be prefaced by leveraging the capacity of the Florida Automated Transit and Shared Use Network to form a “New Integrated Mobility” subcommittee led by the FDOT Public Transit Office to discuss the findings and critical issues from this study. This crucial first step would create a statewide committee of transit champions to help establish priorities and a path forward around these action items for transit transformation.

- 1. Change** Florida statutes to allow more flexibility for grants to be used for mobility studies. Streamline funding so that it is available for projects when it is needed, while there is momentum and awareness of the issues and solutions and before the technology becomes obsolete. Provide a source for money to be available immediately for time-sensitive projects.

Create a standardized set of nomenclature and identify funding resources. MPOs can work in regions to clearly identify the roles of agencies and local government. Schedule recurring training for agencies to understand and apply for funding geared towards innovation. FDOT could support or partner with other agencies to facilitate labor force training led by transit agencies.

- 2. Assist** agencies with adopting mobile payment and real-time transit information smartphone apps—with the goal of regionally integrated software systems—so customers can use a single app to plan the entirety of their trip, access travel notifications, and receive agency communications. Establishing this integrated payment and information platform provides a multitude of additional public health and safety benefits that can help attract wary riders now that the world must adapt to COVID-19.

For example, this platform could communicate information about drivers, bike capacity availability, real-time vehicle capacity, the last cleaning of the bus, real-time bus arrivals and

departures, and help to gauge social distancing requirements. Encourage MPOs to establish regional integration mobility plans through mobility management committees with FDOT representation.

- 3. Establish** a Mobility Data Collaborative, or data clearing house, that all agencies and third parties could use as a resource, especially for integrated data exchanges between private and public agencies.

Few agencies have the financial or staffing resources to take on the management of data. Therefore, FDOT and/or MPOs can take on the responsibility of managing and utilizing the data, which will be more useful at the regional or state level in many cases.

- 4. Pursue** pilots managed by FDOT to take on the risk associated with engaging new technology. Help facilitate public-private-partnerships with local agencies, particularly in areas where agencies lack the experience or resources to arrange and enter into those agreements (i.e. rural and county-wide transit operators).

- 5. Curate** a state-vetted list of approved vendors and services to establish a standard procurement process for new technologies, ensuring that state and federal requirements are met. Develop a standardized contract for services that any agency could use, particularly when looking at new technologies that are frequently not developed in the United States.

Templates could specifically include example documents for Requests for Proposals or Requests for Qualifications with legal requirements, approved vendors, and more.

A LITERATURE REVIEW

What Does the Research Say?

With technological innovations transforming the way in which people move, the role of transit agencies as traditional operators will evolve. The degree to which this occurs will depend upon many factors, including but not limited to geography and service area; mobility demands and available technology; funding; leadership and workforce adaptation; data collection, analysis, and management; cross-organizational cooperation and support; and regulatory flexibility.

Florida's Department of Transportation (FDOT) and Metropolitan Planning Organizations (MPOs) can play a major role in facilitating this potential transformation, leveraging existing and new financial and technical resources to extend beyond Federal funding pass throughs and regulatory oversight.

The research evaluated for this study falls within eight different categories associated with public transportation's shifting mobility ecosystem. These include:

- » **Big Data and Public Transportation**
- » **Transit and Automated Technology**
- » **Mobility as a Service (MaaS), Shared Mobility, and Transit**
- » **Multimodal Mobile Payment Integration**
- » **Integrating and Managing Mobility**
- » **Labor and Procurement Considerations**
- » **Safety and Access**
- » **Transit and COVID-19**

This study begins with a focus on key findings from each of the eight research categories listed above, identified after an initial review of the breadth of research available on transit's technological transformation and shift towards

integration with multimodal mobility solutions. The full version of the literature review, minus case studies included in the main body of the report, is captured below.

Big Data and Public Transportation

From automatic vehicle location and passenger counters to real-time trip planning and mobile fare payment systems, public transportation agencies generate vast amounts of data as part of their daily operations. According to a 2019 survey conducted by the American Public Transportation Association (APTA), 75% of public transit agencies collect a constant stream of information in tracking their buses and trains; recording how many people get off and on at each stop; and documenting trips taken, transfers, and travel patterns among transit users (Dickens and Hughes-Cromwick, 2019). This data, and its open exchange between public and private sector service providers, helps to create innovative, technology-based mobility solutions that enhance the user's experience in navigating their transportation network.

Data collection and analysis can also help transit agencies. Historically, travelers used to "disappear" when they got off a bus or train. Now, mobile phone data is used to determine customers' route patterns and identify potential transfer and connection points (Dickens and Hughes-Cromwick, 2019). Data analysis can help limit service disruptions by predicting bus breakdowns or instances when operators may be absent. It can allow for comparisons within and across agencies to develop best practices that improve overall service and operations. Data from security cameras can be used to detect environmental abnormalities and address safety and security concerns on buses and trains. Workers' rights advocates and unions can use data modeling to show the impacts of different scenarios at the negotiation table (22% of transit agencies in APTA's survey have used big data in this way) (Dickens and Hughes-Cromwick, 2019). With so many opportunities to leverage big data (i.e. put it to good use), which is poised to play a larger role in public transit funding decisions, transit agencies must prioritize the long-term investment in infrastructure and talent required for data analysis (Dickens and Hughes-Cromwick, 2019).

Perhaps most importantly, big data plays a vital role in implementing mobile fare payment applications, real-time trip planning, and their integration. The use of smartphone-based fare payment systems, beyond their basic convenience, has the benefit of alerting passengers in real-time to issues that may impact their trip. The open access and exchange of this data is inextricably linked to the concepts of mobility integration and mobility as a service, which encourage multimodal fare convergence to create a convenient, seamless trip-planning and payment experience. However, while taking advantage of public streets and public application programming interfaces (see the Glossary of Terms for a full definition of APIs), not all private sector partners are willing to “give back” by openly sharing their data (Transit, 2019). A perfect example of this issue involves a government entity championing open source mobility tools and a renowned private mobility company notoriously sensitive to data privacy issues.

The Los Angeles Department of Transportation (LADOT) is the original creator of the open-source project known as Mobility Data Specification (MDS), a set of APIs focused on dockless e-scooters, bicycles, mopeds, and carshare that aims “to provide a standardized way for municipalities and other regulatory agencies to ingest, compare, and analyze data from mobility service providers, and to give municipalities the ability to express regulation in machine-readable formats” (GitHub, 2020). Example of how cities use MDS in practice include: informing future capital investments (i.e. dockless vehicle drop zones) and infrastructure planning efforts (i.e. adding bike lanes or street redesign); ensuring compliance with device caps and operating regulations; and verifying the number of scooters/bikes operating and whether they are equitably distributed across neighborhoods, dropped off outside a service area, or being parked in safe and appropriate parking areas (GitHub, 2020). In 2019, stewardship of the project was taken over by the Open Mobility Foundation, an organization governed by cities (of which LADOT is a member) that “develops and promotes technology used in commercial products that either use the right-of-way or that help government entities manage the public right-of-way” (GitHub, 2020; Open Mobility Foundation, 2019).

In late 2019, Uber’s service permit for operating dockless scooters was revoked in the City of Los Angeles due to the company’s refusal to share real-time location data on riders with LADOT (Coleman, 2020). After 18 months of trying to resolve the issue, Uber filed a federal lawsuit against LADOT in late March of 2020, alleging that “highly personal” data could be used to target certain groups, stalk individuals, or commit fraud (Coleman, 2020). City representatives, citing the need to monitor traffic on public streets since abandoned micromobility devices can create hazards, argue that Uber is trying to skirt regulation and control the information shared about its company (Coleman, 2020). The outcome of the lawsuit will likely establish a baseline for other public entities (from cities to transit agencies) juggling data privacy concerns while regulating dockless micromobility devices and other technology-based mobility solutions.

The future of mobility is tied to enhancing the convenience and integration of transportation services. User demand is driving the market towards smartphone-based apps that are convenient, easy-to-use, and capable of multimodal mobile fare payment and real-time trip planning. Without open data agreements across agencies and, more importantly, between public and private sector entities, this trend towards leveraging big data to enhance mobility as a service will be limited in its development. In instances where private mobility providers refuse to play nice, it may be appropriate for DOTs, MPOs, and cities to leverage their influence over private access to the market.

Transit and Automated Technology

There is growing interest in the safety enhancements, operational improvements, and cost savings associated with automating bus transit (FTA, 2018). A burgeoning practice at this point, transit automation has largely been explored through academic and federal research, microtransit pilot testing programs, and the shift to hybrid and fully electric bus fleets. Despite the many challenges, there are significant economic benefits when transit operators, as opposed to merely managing and maintaining facilities and equipment, can devote resources toward expanding and modernizing service in response

to emerging growth and technological advancements (Duncan, Schroeckenthaler, and Blair, 2018).

Bus systems are just beginning to explore and conduct limited testing of certain automated features for mainline operations (Dickens and Hughes-Cromwick, 2019; FTA, 2018). Object detection and collision avoidance systems are ready to be applied to transit, but others, such as automated steering and braking, require significant vehicle redesign and modification prior to adoption (Nasser et. al., 2018). Although transferring existing automation systems from other vehicles is not straightforward, a 2018 Federal Transit Administration (FTA) report concluded that: 1) modifications to powertrain systems are relatively easy to accomplish; 2) automated steering applications may be easier to transfer than other foundational systems; and, 3) automated braking applications, which may require a new communication system architecture, will be the biggest challenge to overcome (Nasser et. al., 2018). Transit agencies that have already begun to shift towards hybrid and electric buses – which come with certain electronic functions, sensors, and communications architecture built-in – are at an advantage since these bus types are better suited for automated technologies (Dickens and Hughes-Cromwick, 2019; Nasser et. al., 2018).

Despite these advancements in bus systems testing, much of the excitement around automated technology in transit is captured by microtransit, or “IT-enabled private multi-passenger transportation services, such as Chariot and Via, that serve passengers using dynamically generated routes, and that expect passengers to make their way to and from common pick-up or drop-off points” (NCMM, 2020). Many microtransit programs use small, 12-passenger electric shuttle buses, like the EasyMile EZ10. Each of these vehicles can run for about 14 hours on a single charge; operate at Level 4 autonomy (i.e. full autonomy with the ability for an onboard operator to take control via a double-joystick controller if needed); and cost upwards of \$300,000 (Miller, 2020). Around the United States and the world, cities have primarily been testing automated microtransit technologies to solve connectivity issues associated with first-mile/last-mile (FM/LM) access.

In February 2020, the first daily, public residential

autonomous shuttle, funded mostly by the federal government, hit the streets of Columbus, Ohio (Miller, 2020). The \$1.13 million year-long project, called Linden LEAP, is designed to help residents of South Linden, a neighborhood historically cut off from the rest of the city when Interstate 71 arrived in the 1960s, access services that have disappeared from the area. The autonomous shuttle’s free service will circulate along a 3-mile route between the Linden Transit Center, a public housing development, a recreation center, and a community house. Data generated by the program will assist other cities considering similar transportation alternatives (Miller, 2020).

Automated technologies in bus transit are being tested around the nation and the world, although full-size bus fleets are unlikely to reach full autonomy anytime soon. Instead, microtransit shuttles, merging autonomous vehicle (AV) features with on-demand transit service, have become the ideal short-term candidate for addressing first-mile/last-mile connectivity issues. Before transit agencies can focus on innovation, it is important to first consider the long-term infrastructure and talent required to adopt new technologies. Partnerships with MPOs and the DOT, especially in Florida where AVs (with the appropriate testing) are welcomed on public roads, may help transit agencies overcome some of these issues or, at the very least, identify funding sources for innovation.

Mobility as a Service (MaaS), Shared Mobility, and Transit

Before the concept of Mobility as a Service (MaaS) came the idea of Mobility-on-Demand (MOD), defined as “an integrated and connected multi-modal network of safe, affordable, and reliable transportation options that are available and accessible to all travelers” (NCMM, 2020). On-demand transportation services are those that can be flexibly arranged almost immediately before a desired travel time, most often through a smartphone app or, for paratransit or dial-a-ride services, on a website or over the phone. Mobility as a Service, which incorporates on-demand services, emphasizes a “customer-focused interface that incorporates multiple mobility options into a single, intuitive and seamless platform or app that allows

for choosing the right option, [and] scheduling and paying for that option” (NCMM, 2020). Shared mobility – or any form of transportation that can be shared (from bikes and scooters to cars and transit) – is often associated with the same technological advancements and smartphone applications that facilitate MaaS and MOD concepts. Cities that maintain high service standards and develop mobility plans tailored to their specific markets are slated to benefit the most from new technologies (Stanley, 2019).

Shared mobility has a multitude of benefits, including supporting multi-modality, improving first-and-last-mile access to transit, enhancing mobility for transportation disadvantaged groups, and helping to reduce greenhouse gas emissions (Shared-Use Mobility Center, 2016). Nationwide the popularity of shared modes is growing. In 2018, the number of dockless trips made by Americans on dockless scooters, bikes, and traditional bikeshare systems doubled from 2017, reaching 84 million trips (Shared-Use Mobility Center, 2019). Management of public rights-of-way remains a pertinent topic concerning the electrification of certain alternative transportation modes, such as scooters and bikes (also known as micromobility devices). The speed of these modes is often too fast for sidewalks and too slow for roadways, resulting in safety concerns that have had cities scrambling to address fatal conflicts between people on micromobility devices and vehicles. In 2019, four scooter riders in the City of Atlanta were hit and killed by cars at night. In response, local government banned the operation of e-scooters and e-bikes between the hours of 9 PM and 4 AM and began developing a plan to provide separated facilities for micromobility users (City of Atlanta Mayor’s Office of Communications, 2019).

In the world of transit, shared mobility is most often applied to MOD and MaaS through on-demand pilot programs featuring shared microtransit or partnerships with a ride-sourcing transportation network company (TNC), such as Uber or Lyft. Microtransit programs usually rely on smaller vehicles (autonomous electric EasyMile buses, vans, or shuttles) to pick up and drop off passengers (with a similar route) at a virtual bus stop determined by an algorithm and facilitated through a smartphone app (SmartCitiesWorld, 2019). Los Angeles Metro, a recipient of \$1.35 million in FTA MOD Sandbox grant money, partnered with Via for one year

to run a shared, on-demand pilot program for first-mile/last-mile trips (Linton, 2019). While becoming popular with transit agencies, these programs may not perform as well as fixed-route bus service or even dial-a-ride services in terms of cost and ridership. On-demand drivers often serve fewer riders than the poorly performing suburban routes cut to make room for them, achieving 2-4 trips per hour per driver at best (and some pilots generating fewer than one passenger trip per vehicle service hour) (Linton, 2019).

There have been mixed reviews as to whether shared mobility, ride-sourcing, and microtransit programs, primarily used to reach underserved populations, complement or compete with transit. Whether due to low service quality or competition from services like Uber/Lyft, bikeshare, and electric scooters, the country’s five largest transit agencies have experienced declining ridership over the past three years (Stanley, 2019). According to a study conducted by the Shared-Use Mobility Center, shared modes have complemented public transit and enhanced urban mobility by serving different trip types (Shared-Use Mobility Center, 2016). However, in places like Innisfil, a rural, sprawling town in Canada where a traditional public bus system would cost too much to run efficiently, ride-sourcing (i.e. Uber) has completely replaced the need for transit (Smith, 2017). Ridership data yielded from such arrangements is incredibly valuable, but many experts believe the answer to a city’s mobility needs begins with good governance (Halais, 2020). In Innisfil, Uber had detrimental effects on local taxicab services, many of which claimed that Uber drivers “unfairly avoid expensive and restrictive licensing and insurance rules” (Smith, 2017). Additionally, the gig economy can take advantage of drivers – considered contractors – who do not have sick days, unemployment protection, health care, or other benefits at their disposal and, whether they know it or not, may only be making \$6-7 per hour (masquerading as \$20-30) once vehicle costs and taxes are considered (Bakule, 2020).

Ultimately, shared mobility and other MOD programs begin with good intentions, like providing transit access for the underserved, but witness varying results. For example, the Las Vegas Trip to Strip ride-hailing service, touted as a success, stopped after six (6) months due to

financial constraints but helped the local transit agency identify top travel destinations, such as the airport (Akers, 2019). Designed to relieve congestion and parking problems, San Diego's Oceanside community expanded its ride-share program, Hoot Rides, after generating over 600 trips in six (6) weeks (50% of which had multiple passengers) (Diehl, 2019). Successful or not, it is clear that consumers (particularly "choice" riders) will use on-demand microtransit service as a viable transit option, though transit agencies must address equity concerns and consider the associated financial constraints of such programming. At the same time, advancements in new technology, such as mobility integration, mobile fare payments, and real-time trip planning, have allowed riders to travel seamlessly within a multimodal transportation network.

To mitigate the challenges associated with shared mobility, transit agencies must ensure these benefits are equitably and widely spread. For some, particularly transit authorities, this has meant assuming the role of mobility integrator.

Multimodal Mobile Payment Integration

As new mobility options flood the market and the use of smartphones rises, increased connectivity generates greater rider demand for convenient mobile payment options across available transportation modes. The National Academies of Sciences, Engineering, and Medicine defines multimodal payment convergence, an interchangeable term for mobile payment integration, as "the ability to use the same payment medium or technology to pay for services on multiple modes of transportation—which provides a more seamless and convenient experience for users" (NASEM, 2020c). In an ideal world, there would be one smartphone application that could integrate and streamline the payment process for accessing a variety of mobility options, ranging from short-term bikeshare and scooter rentals to transit fares. However, integrating fare payments across agencies that offer different services comes with many challenges, including data privacy and management; negotiation of inter-provider agreements;

cybersecurity concerns; and provisions for equitable access to services (NASEM, 2020c).

In a recent study, the Federal Transit Administration identified 34 locations around the United States that had deployed or were in the process of deploying some form of Automated Fare Collection (AFC) in their transit systems (Bartinique and Hassol, 2019). The concept of AFC has existed for several decades in transit and includes "smart" fare card systems which allow riders to pay for their fare by swiping a plastic, agency branded card (with pre-paid dollars on it) across a sensor either on the bus or when entering a train station. In Germany, Berlin's unified fare card system (with integrated fares for every mode of local public transit collected and redistributed to operators by a regional agency) has existed since 1999 (Lopez, 2009). Today, like in many places around the world, fare payments have shifted from smart cards to smartphones. As consumer expectations increase and riders are more connected than ever, the number of transit agencies offering mobile fare payment apps to riders has rapidly grown (NASEM, 2020b).

Most transit agencies interested in offering mobile fare payment will procure the service from a private vendor. While public agencies spearhead customer service and marketing of the app to riders, vendors are often responsible for developing and hosting the app, processing payments, and maintaining payment card industry compliance (NASEM, 2020b). There are several common business models transit agencies have used in approaching mobile fare payments: a vendor provides an app shared by multiple transit agencies in different regions (i.e. Transit app); a vendor produces an app that is branded for a particular transit agency; mobile wallets (i.e. Apple Pay or Google Pay) are used as transit accounts that riders can use to refill or purchase a pass through an existing app; or, a vendor creates a software development kit (SDK) for a mobile fare payment app which can then be integrated into other smartphone apps, such as for real-time information or ridesourcing (NASEM, 2020b). In some cases, these mobile application options can be more cost-effective than an overhaul of existing electronic fare payment systems; however, achieving consensus on decisions surrounding fare reconciliation, data management and sharing, and

other issues that affect operations, especially across multiple agencies, can be difficult (NASEM, 2020c).

The Transit app, whose slogan is “one app to pay for all mobility in any city,” has become a popular option for transit agencies seeking a universal solution to multimodal payment convergence and real-time trip planning (Transit, 2019). Functioning in over 175 metropolitan areas worldwide, the Transit app aggregates and maps real-time public transit data through General Transit Feed Specification (GTFS). GTFS is a standardized, shareable format for transit data that contains static information on schedules, fares, and geographic transit information and real-time information on arrival predictions, vehicle positions, and service advisories (GTFS, 2020). This data, received from transit operators, is then integrated into the application programming interface (API) of the Transit app. An API is a set of routines, protocols, and tools for building software applications that specifies how different software components connect across an integrated network (Beal, 2020). Without open APIs, the average rider must juggle different apps for different mobility services and cannot compare prices and estimate times of arrival between service providers, pay for a combined trip with one app, or plan a combined public transit trip (Transit, 2019). Reconciling how private mobility providers, transit agencies, and government entities collaborate to access the other’s data is already at the forefront of the big data and transportation discussion.

While mobile payment integration offers riders enhanced flexibility and convenience, too much focus on technology-based improvements can exacerbate inequities faced by transit-dependent groups. In exchange for federal funding, transit agencies in the United States are committed to serving all communities within their service area. This requires mindfulness of under- or unbanked users (i.e. travelers without smartphones) when implementing new mobile technologies or payment solutions (NASEM, 2020c). Prior to the 2019 debut of their transit payment app, the Los Angeles Metro introduced wristbands allowing transit riders to pay for their fares with a flick of the wrist instead of using a traditional, plastic card. These wristbands were first tested in 2017 after LA Metro began studying their potential benefits for riders with disabilities. The silicone

bands, accepted on 25 transit systems across LA County, work at all Metro validators, gates, and fare boxes, and are still available for use in addition to the new integrated mobile payment option (Fonseca, 2019). Lower income, elderly, and physically- and mentally-impaired populations traditionally do not have the same access to smartphones and mobile data plans, so multiple payment options must always be provided.

Smartphone users are adjusting to the convenience of peer-to-peer (P2P) payment mediums (i.e. Zelle, Venmo, Facebook Pay, etc.) that allow easy, fast, and convenient electronic payments. As rates of smartphone ownership increase, heightened demand for mobile fare payment is motivating many transit agencies, despite the associated challenges, to develop a smartphone app with this feature (while still providing other options). Procurement of mobile fare payment apps can follow a variety of business models, so it is important that transit agencies, especially within a single region, coordinate to ensure multimodal fare payment integration.

Integrating and Managing Mobility

Mobility management is a community-based approach to connecting all available mobility options (transit, private sector transportation companies, community services, biking, walking, etc.) and providing a customer-driven, efficient, and easy to use first-mile, last-mile network (NCMM, 2020). The primary goals of mobility management are coordinating services, assisting customers, and identifying funding but may also include providing additional resources for public outreach and marketing, promoting coordination, providing volunteer training, helping identify customer needs, and providing trip planning information (WisDOT Bureau of Transit, Local Roads, Railroads and Harbors, 2015).

Mobility managers and their partners can come from a variety of groups. While transit system operators are generally the main coordinators, they provide services to human and social services agencies, Aging and Disability Resource Centers (ADRCs), local political bodies, senior centers and assisted living communities, employment and

community action programs, and economic opportunity councils. In addition, private transportation companies and local agencies like MPOs, planning, and public works departments may also participate as contributing partners.

While traditionally mobility management focused on providing assistance for transportation disadvantaged customers such as seniors, individuals with disabilities, and individuals with lower income; today it is expanding to consider needs for all community members and modes. This modification of the previous understanding of mobility management aims to develop coordinated transportation networks, focused on moving people over vehicles, that provide a range of options for widely inclusive communities (Ellis, 2009). Many mobility managers are adopting new philosophies designed to consider individual user needs, entire trips across modes, technological advancements in access and payment, and community enhancements affected by transportation like land use changes, transit-oriented development, walkability, and healthy lifestyle support. As transportation networks continue to grow and develop, mobility managers are working to grow with them and promote comprehensive and seamless transportation experiences for their communities. Because the general concept of mobility management is evolving to embrace new technologies and developing modes, mobility managers across the country are coming to terms with their new roles in adapting and coordinating new technologies and more complete transportation networks.

ENCOURAGE AND DIRECT COORDINATION

Mobility managers lead partners by developing coordination plans and promoting coordination and communication between all participating parties. They generally oversee coordination of services or programs and are the main source for funding coordination.

INDIVIDUAL CUSTOMER SERVICES

One primary philosophy of mobility management is to meet the needs of individual customers. This is done through outreach and planning to identify and develop strategies to meet individual customer needs. They may offer services like trip planning and travel training for

individuals. Mobility managers may also provide volunteer training programs.

COMMUNITY AND NETWORK DEVELOPMENT

Mobility managers enhance their communities by conducting needs assessments and developing inventories of available transportation services and amenities. Distributing information to community members is a key function as well as promoting transit and active transportation through information campaigns and marketing efforts.

INTEGRATE NEW MODES AND TECHNOLOGIES

As new transportation options like bike and scooter share become more widespread, there is a natural fit in some locations for cities or transit agencies to take over their management and incorporate them into transit and trail networks. In addition, many areas are pursuing all-in-one mobile payment that allows customers to plan trips seamlessly across modes. Coordination for this falls on area leadership like mobility managers, in areas where they are available. Likewise, as automated vehicle technologies flood the market, their application to public transportation will become more prominent and commonplace. These advancements complicate the role of mobility managers who must determine the appropriate transferability of automation technologies to transit and other mobility services.

There are many barriers to mobility management, the most prevalent being lack of funding, lack of coordination and collaboration across agencies, service and jurisdictional boundaries, and lack of information. Funding is a common limiting factor, although there are resources available such as the FTA's Enhanced Mobility of Seniors and Individuals with Disabilities (5310 program) and the Fixing America's Surface Transportation (FAST) Act. Frequently, local and regional services in one area are maintained by different agencies and report to different leadership, adding to the complexities of integrated management. In a perfect world overall connected system improvements would be the primary focus but generally each agency works in a "silo" and is only able to consider their individual services. Many

believe that mobility management practices work best in metropolitan areas that have the density and population size to make public transportation work well. However, the benefits of providing simplified access to a more efficient transportation system – increased public awareness of mobility options, increased transit ridership, movement of people over vehicles, improvements to the quality of service delivered, transit-oriented development, and reduced service gaps and overlap travel – can be achieved anywhere (NCMM, 2020; WisDOT Bureau of Transit, Local Roads, Railroads and Harbors, 2015).

Labor and Procurement Considerations

Many believe automation in transit will act as a panacea for creating reliable and accessible service for workers at all times of day and night. However, uncertainties around safety, security, funding, user acceptance, labor issues, and legal issues must be addressed at the federal level before automation application can be widely accepted and implemented across all transit agencies (FTA, 2019). For example, the FTA requires transit agencies to protect certain workers' rights in exchange for federal funding, but no one knows the impact automation will have on the bus transit workforce (FTA, 2018).

While some job loss to innovation could be unavoidable, new positions will also be created. Transit agencies and other entities have been collecting large quantities of transit-related data. While this can provide a wealth of knowledge to inform them on the successes and gaps in their services, it also requires skilled employees to manage and analyze that information (Dickens, 2019). Similarly, adaptable operators and technicians will be required for new operations and maintenance techniques.

Procurement creates issues for transit agencies who need to adhere to strict and rigorous methods to secure new technologies. In addition, lengthy acquirement processes can cause problems in an industry where obsolescence occurs relatively quickly. In some cases, with limited options and manufacturers, the standards required for procurement can lead to difficulty for transit

agencies seeking to purchase new, innovative equipment. For example, the Buy America Act requires a certain percentage of transit vehicle components be sourced from American manufacturers, but current automated vehicles (AVs) rely on foreign components and may not be able to comply (FTA, 2018).

The current state of automated bus technology largely falls within the pilot testing or early development stages (FTA, 2019). Technology costs associated with prototypes such as these and the applicability to transit service, which differs considerably from the interest in automated highway driving, are unknowns that will continue to shape how bus transit automation unfolds in the U.S. (FTA, 2019). Laws protecting employees and passengers and regulations pertaining to transit systems and vehicle safety will undoubtedly determine the rate at which AV technology enters into public transit service (Gettman et. al., 2017). As of right now, no one really knows how automated technology will disrupt the transit industry and its workforce, only that it will.

Safety and Access

While taking the bus is far safer than driving a vehicle as far as a crash is concerned, the stigma surrounding public transportation and the perception of possible harassment or assault is often cited as a major barrier. Technology, particularly video surveillance, is a key deterrent to harassment and assault on buses, as well as identifying and prosecuting assailants and ensuring proper training of staff members (TCRP, 2009).

More in-depth research and data collection, particularly focused on women, is needed to better assess passenger characteristics and travel patterns on transit. Unmaintained pedestrian facilities with overgrown foliage, poorly lit parking lots and structures, isolated bus stops, and crowded transit vehicles and stations all represent stressful settings for women who, as a result, will often change their mode of transportation or travel patterns to avoid feeling unsafe or vulnerable. This issue is particularly salient in Florida, which is ranked as the third-highest human trafficking destination with half of victims being

children under the age of 18. Transit agencies can benefit from focusing on women's safety by gaining ridership they may currently be missing (Perk and Antonio, 2019).

Some transit agencies are taking access, particularly for those in wheelchairs, to the next level. A public-private partnership between TheRide, Ann Arbor Area Transportation Authority's bus service, and Q'Straint, a global leader in manufacturing wheelchair securement systems, has led to the testing of Quantum, a virtually autonomous securement system for wheelchairs, on 10 buses as of early 2019 (Smith, 2019). Quantum allows individuals with mobility devices to "secure themselves in under 25 seconds with the push of a button" (Smith, 2019). This new technology, paid for by a \$187,000 mobility grant from the Michigan Department of Transportation, helps reduce overall passenger boarding time, improve on-time performance, and provide a better customer experience with greater service reliability across the Ann Arbor transit network (Smith, 2019).

Nationwide, late-shift workers bring in roughly \$28 billion in annual wages and issues associated with this demographic's truancy and turnover not only creates challenges for American employers but costs the economy billions of dollars every year (Zalewski et. al., 2019). This means that the needs of this growing segment of the U.S. workforce is and will continue to be an important topic in the world of transit service. A 2019 study considering the commuting patterns of late-shift workers in 381 metropolitan areas identified ways in which public transit can address their commuting needs: extend the span of service, enter into partnerships with on-demand providers, create a special nighttime bus network, and seek employer funding (Zalewski et. al., 2019).

Prioritizing operator safety and enhancing safe access to transit, both at the bus stop and beyond, is essential to maintaining equitable service and attracting riders. Mobility-focused technological advancements may be able to help address these issues. For example, real-time trip planning apps allow the passenger to see in real-time where their bus is and when it will come, a feature that may be particularly reassuring for female riders waiting alone at a bus stop. Additionally, collecting data on

ridership demographics can help agencies identify groups that may or may not be riding transit. The use of internal and external surveys and other public engagement tools, such as polling riders via a mobile phone app, can motivate passengers (and operators) to share their experiences directly with the transit agency.

Transit and COVID-19

The recent COVID-19 crisis has affected how transit agencies will think about the future and how they can best serve their employees and customers. This worldwide focusing event has and will result in permanent changes to how transit operates but may also be a catalyst to innovation with new and varied services. Many of these changes will rely on or be enhanced by new technologies. An agency's ability to respond and adapt will determine their future relevance to riders and their place in the community as every-day and emergency service providers.

Beginning in January 2020, cases of SARS-CoV-2 (COVID-19) began appearing across the United States (CDC 1, 2020). By March, cases had been reported in every state and related deaths were growing in number. Various locales and organizations began shutting down sporting events and large gatherings, imposing travel restrictions, moving schools to virtual learning platforms, requiring work from home when possible, and implementing stay-at-home orders as the federal government passed the CARES Act (US Dept. of Treasury, 2020) and other aid programs to assist economic stability and recovery. While each city and state had its own particular response to the burgeoning crisis, most states with a significant number of cases started implementing various restrictions.

At the same time that many people were adjusting to social distancing protocols and generally avoiding public places, a new employment category was being established: essential workers. Essential jobs are those deemed so vital during the crisis that they were excluded from stay-at-home restrictions and closures. These jobs, which provide irreplaceable services, include doctors, nurses, first responders, police officers, grocery store workers, delivery drivers, and more - including transit employees.

Riders are frequently reliant on transit for transport to and from work and while ridership declined, many people were still using transit. That is because many essential workers also depend on public transit to get to work.

PUBLIC TRANSIT & THE INITIAL RESPONSE

The first-hit areas in the U.S. were coastal regions with regular international travelers, starting in California and Washington and then the East Coast in New York City. As the number of known cases skyrocketed and shutdowns began in cities around the country, general travel, including transit use, plummeted.

In April, a preliminary study conducted by a professor from MIT blaming public transit, specifically the subway, for the spread of COVID-19 in New York City heightened fear among riders across the country. The paper has since been widely debated and criticized for a lack of peer-review and quantitative evidence and now carries a disclaimer stating that the conclusions are the opinion of the author (Harris, 2020). Subsequent studies from around the world have not found a direct correlation between transit use and infection patterns (Sadik-Khan, 2020).

Amidst the confusion of school and business closures, distancing guidance, and stay-at-home orders, transit agencies across the country have needed to react quickly to the situation and balance the needs of their essential-worker customers and employees with a drastic and sudden drop in ridership. Being an essential resource, public transit continued to provide service during the lockdown, albeit with precautionary adjustments to reduce the likelihood of transmission and to protect both customers and operators. Some of the immediately implemented precautions include:

- ◆ Reducing schedules
- ◆ Shortening hours of operation
- ◆ Reduced capacity on transit vehicles
- ◆ Stringent and more frequent cleaning of vehicles and facilities
- ◆ Implementing rear boarding

- ◆ Eliminating cash payments/payment flexibility
- ◆ Physical barriers to isolate drivers
- ◆ Installing hand sanitizer in vehicles and facilities
- ◆ Mask requirements

THE STATE OF TRANSIT

During the first outbreaks and ensuing economic shutdown, ridership predictably plunged not only nationwide but also drastically in major coastal cities like New York (74% reduction), Boston (83% reduction), and San Francisco (87% reduction) (Sadik-Khan, 2020). It is likely that the majority of remaining riders have been essential workers reliant on public transit to get to work. According to the transportation advocacy organization, Transportation for America, essential workers make up over a third (1/3) of transit riders on an average day under normal circumstances (T4America, 2020). In addition, there has been an increase in the percentage of female transit riders. According to a survey conducted in April by the company behind the Transit app, 56% of riders were female while 40% were male; the numbers are usually around 50/50% (Transit, 2020).

While ridership has gone up since businesses started reopening and shelter-in-place orders were lifted, a combination of having steadily high numbers of new daily COVID-19 cases; a significant proportion of individuals working from/staying at home; high unemployment; and an aversion to enclosed, potentially contaminated spaces has kept it from returning to pre-emergency numbers. There is a fear among transit advocates that ridership will remain low as lingering trepidation about using transit could prevent many from riding. As a result, transit professionals and experts are focusing on how to regain ridership once all restrictions are lifted and travel returns to pre-COVID conditions. A major concern is a loss of confidence in the ability of transit to be a safe option in a time when cleanliness, hygiene, and personal space are highly valued. There are other factors that experts claim could keep ridership numbers down.

For one, Work-From-Home (WFH) initiatives, once considered a potential hinderance to productivity, have been utilized during the crisis wherever possible. In fact, a large proportion of people have continued to work remotely; in May 2020, this was roughly 30% of workers in the United States (Greene, 2020). The necessity of working from home during the COVID-19 shutdowns led to a push for better communications and other technologies. While most workers could likely return to working in person again once they believe it is safe, at this time it is not known how long that will take. Furthermore, it is not known whether public schools and colleges across the country will return to campus for classes for the 2020-2021 school year. If not, this would both directly and indirectly affect transit: more people would attend virtual classes online instead of traveling to school and the lack of available childcare would make it difficult for many parents to return to work in person.

Secondly, there have been increases in other transportation modes that allow users to avoid traveling with others. Bicycle sales and ridership numbers have risen steeply: compared to the same time period last year, urban cycling has increased by 21% across the United States between March and June while the Rails to Trails Conservancy has reported a 110% increase in ridership (Rust, 2020). Cycling offers riders an opportunity to travel and get exercise while safely social distancing. Interest in car ownership has also been on the rise during the COVID-19 crisis, with sales recently beginning to increase, as well (Boston, 2020).

In order to combat these influences, transit agencies have put a number of new directives into place while they determine how to proceed if and when society returns to pre-COVID-19 "normal" travel patterns. Plans for enhancing customer and driver safety and encouraging riders to return to transit are being discussed or carried out.

- ◆ Permanently adopting some of the practices established during the initial outbreak, such as:
 - Reducing vehicle capacity
 - Providing hand sanitizer on vehicles and in facilities

- Providing more space between seating
- Separating drivers from the public
- Enforcing mask requirements during public health events
- Rear-loading passengers
- ◆ Migrating to all-in-one payment and trip planning apps to simplify transit travel and provide contactless payment options
- ◆ Using antimicrobial materials and textiles
- ◆ Revising cleaning procedures and creating transparent methods to convey cleaning efforts to the public
- ◆ Developing pandemic response plans

In addition, some transit agencies are considering adopting bike and scooter-share and other transportation modes into their systems to increase revenue and create better full trip services for customers. While this was something that many agencies were already considering before COVID-19, a desire to maintain relevance and move to a customer-centric business model is more prescient as they look for ways to boost ridership overall. This could be an opportunity for agencies to take the reins by advancing transit, integrating new technology, and working to regain riders and restore customer confidence.

NEW TECHNOLOGIES AND POST-COVID TRANSIT RECOVERY

A major issue for transit agencies dealing with decreased ridership will be to regain public trust (Sadik-Khan, 2020). Articles blaming transit for the spread of COVID-19 coupled with the persistent stigma associated with the safety and cleanliness of transit, make addressing those concerns a top priority now more than ever. On the other hand, even before COVID-19 forced the discussion many agencies were already contemplating how to reinvigorate public transit due to a trend in declining ridership that began around 2014 (Bliss, 2020). If forward-thinking practitioners and leaders are willing to invest in the existing systems, the current

crisis could naturally provide an opportunity to reinvent and reinvigorate existing transit networks and the cities they serve (Sohn, 2020). Many developing technological innovations could effectively work to address the issues of health and safety as well as create more exciting and desirable public transportation networks.

Online and mobile platforms allow for greater dissemination of pertinent information. One way in which transit agencies could enhance public safety is to limit the need for riders to interact with objects like ticketing kiosks and turnstiles. Integrated online or mobile payment apps and the ability to pre-book seating provide a contactless payment system that eliminates the need to use public touch screens (Sohn, 2020). Pre-booking seats and providing capacity information available through smartphones can allow riders to choose less crowded train cars and make other trip choices when vehicles are at capacity (Sohn, 2020). In some countries, riders can be tracked and alerted if they have ridden with someone who is later found to have been ill. While this technology is being developed by Apple and Google, privacy concerns make adoption in the U.S. unlikely (Sohn, 2020). Mobile notifications could provide additional information to help agencies and riders such as when buses were last cleaned and agency cleaning policies.

Another option is to integrate alternative modes into existing transportation systems. Bike and scooter-share could be adopted by agencies with the ability to reposition themselves as mobility managers. This creates a more complete network with additional options while also potentially providing more access for those who will not want to get on public transit, even when its deemed safe and clean. Integrating those options into an agencies' trip planning app will provide an easier way to plan whole trips and eliminate the need for users to juggle different sites or make multiple payments to get from one place to another.

- » Integrated mobile payments for a totally contactless customer experience
- » Real-time data apps that provide both riders and agencies with a variety of

information

- » Ability to provide transparent cleaning information in real time via apps, websites, signage, and social media
- » Integrating multimodal options into transit for those who will not want to ride on mass transit

TRANSPORTATION-RELATED GUIDANCE

Institutes, agencies, researchers, and transit professionals have been continually releasing and updating informational resources regarding the effects of COVID-19 on transit. In an effort to keep up with the ever-changing nature of the crisis and its effects on the transit community, a number of guides, preliminary reports, announcements, articles, webinars and podcasts have been produced. The following list captures some of these resources.

The linked [National Association of City Transportation Officials \(NACTO\) COVID-19 Transportation Response Center](#) site is continually being updated. It contains four sections:

- 1. Tools for Rapid Response** – Emergency response and recovery strategies
- 2. On-the-Ground Updates** - Webinars and discussions from transportation leaders with links to resources regarding community engagement, streets, and staff
- 3. Federal Funding** – Information on federal funding with resource links
- 4. External Resources** – Links to webinars, podcasts, presentations, databases, guides and information centers
 - ◆ [Smart Growth America Complete Streets + COVID-19](#)
 - ◆ [National League of Cities Local Action Tracker](#)
 - ◆ [North American Bikeshare Association COVID-19 Shared Micromobility Status](#)

[Tracker](#)

◆ [The Urban Project COVID-19 Street Rebalancing Guide](#)

STUDIES

As of now, the global scientific community is still sorting out how to collect, share, and analyze data on the pandemic and its short- and long-term impacts. The nature of scientific, peer-reviewed research requires multiple examinations and reviews of subject matter before it can be accepted. At this relatively early date, many new studies are ongoing, but few are at the stage of publication. While most information is coming from preliminary analysis and news reports, which can sometimes be misguided and anecdotal, researchers are working towards a greater understanding of the ways in which the current situation has and will continue to affect society.

For example, there are continuing studies on transmission while using transit, such as the COVID-19 Transit Bus Air Circulation and Virus Mitigation Study being conducted by the Mineta Consortium for Transportation Mobility at San Jose State University. Others, such as the Portland-Nashville Bicycle and E-Scooter Study, a collaboration between the University of Tennessee at Knoxville and Portland State University, focus on upticks in ridership for transportation alternatives. As more reliable and plentiful data becomes available, researchers will continue to examine the effects of COVID-19 and how it might change the way people travel.

B SURVEY RESULTS

Mobility Stakeholder Survey

The study team drafted a 15-question Internet-based survey tool that was circulated to the ATSUN/FPTN network in February of 2020 via Microsoft Forms. The survey was comprised of a mixture of short answer and multiple-choice/ranking questions. A summary of represented agencies who filled out the survey and their accompanying responses are captured below. Please note that the summary of survey responses begins with question two (2) since the first question asked respondents for their name and organization.

Each survey question response summary (aside from those captured as a graphic) includes a topic taken from the survey question, the full question, unedited answers from each individual, and a summary of each topic's responses either in list or paragraph format. Five multiple-choice questions and one ranking question are included in this report as graphics.

Survey Introduction

Emerging technologies, such as autonomous and connected vehicles, and Mobility as a Service (MaaS) are transforming the transportation ecosystem and have significant implications for agencies that plan, fund, and operate transit facilities and services. Public transit service is typically run by cities, counties, and transportation authorities. However, the Florida Department of Transportation (FDOT) and Metropolitan Planning Organizations (MPOs) play important funding, regulatory, planning, and policy roles in advancing transit. Much discussion has occurred around how these transformational changes in mobility will impact the position of transit agencies and how “managers” or “integrators” of mobility services can redefine their roles.

In response to transit agencies continuing to see their roles evolve in the context of a shifting mobility ecosystem, FDOT's Public Transit Office is leading a study to examine the state of transit innovation in Florida; identifying challenges facing transit providers; assessing the relationships between transit agencies, FDOT and MPO's; outlining best

practices; and ultimately recommending strategies and an appropriate framework through which FDOT and MPOs can more effectively support transit agencies.

The following survey is designed to gather insights and information from key stakeholders on current issues, concerns and ongoing efforts surrounding this rapidly changing mobility environment. The survey results will be combined with best practices research, one-on-one interviews and interactive workshops to support study recommendations and policy guidance.

Survey Responses

The first question of the survey asked respondents to identify themselves and the agency which they represent. For privacy reasons, we did not include respondents' names. Below are a list of agencies represented in the survey responses:

- » Hernando/Citrus Metropolitan Planning Organization
- » Jacksonville Transportation Authority
- » Pinellas Suncoast Transit Authority
- » Palm Beach Transportation Planning Agency
- » Downtown Fort Lauderdale Transportation Management Association
- » Broward County Transit
- » MetroPlan Orlando
- » LYNX
- » Gainesville Regional Transit System
- » St. Lucie Transportation Planning Organization
- » StarMetro

2

Topic: New Technologies

Within your organization, what, if any, emphasis has been put on adapting new technologies into your existing service?

1. The transit system has recently adopted the Flamingo Fare system used by PSTA, HART, and PCPT.
2. We have our Ultimate Urban Circulator (U2C) program which is the modernization of our elevated monorail system known as the Skyway. The plan is to either have AV that transitions from the elevated structure through ramps into a dedicated lane or into mixed traffic.
3. Various pilot projects with Uber/Lyft; incorporation of hybrid and electric buses into fleet; in-route induction charger; Automated vehicle study/pilot (in planning), smart car/mobile pay; real time.
4. We are currently in the process of our CAV Readiness Study (please contact Eric Hill or Lara Bouck for more information).
5. Autonomous vehicle, pedestrian detection devices, connected vehicle technology, CAD/AVL system upgrades, Wi-Fi on all buses, mobile fare payment, real time passenger information systems at main stations, electric buses, researching potential implementation of MaaS system, and microtransit service.
6. The TPO conducted a study: ACES (Automated/Connected/Electric/Shared-Use) Vehicles for Transit Study that informed the transit provider's Transit Development Plan (TDP) Major Update. Over the next two years, the TPO will be conducting the following studies: Drone Port Study, Micro-Mobility Study, Electric Vehicle Charging Station Plan, Transit Route Optimization Study, and ACES Vehicles for Transit Study Update.
7. Fare payment, passenger counting, safety and alerts, wayfinding, autonomous vehicles.
8. Mobile Ticketing, Microtransit pilot later this CY Transit Signal Priority pilot with FDOT Queue Jump pilot with FDOT.
9. Our Organization is very favorable and welcoming of new technologies that enhance transit and the passenger experience. We are constantly looking forward to the next step or the newest tech, I'd say we are progressively minded. We, however, are fiscally challenged so when it comes to buying new technology, we seem to be a step behind by the time we have the money. We are currently looking at microtransit options, such as a VIA service, better and more interactive signage/maps for passengers at stops and transfer center alike, autonomous vehicles, and the use of electric shuttles. These are all in the talks of happening in near future. We just completed our app, so now passengers can pay with their mobile phone.
10. TBARTA does not currently operate any fixed route service. We are conducting a PD&E Study for what we are calling our Catalyst BRT Project, which will be a 41-mile BRT on I-275 from Wesley Chapel to Saint Petersburg. We will be considering new technologies for this service (e.g. electric buses; the use of ramp meters and technology on the buses that will communicate with the ramp meters to hold traffic at the ramp until the bus passes by).
11. New safety app, fare payment app. Working on Regional route coordination app. U2C AV services.
12. The TPA serves as the MPO for Palm Beach County and does not provide transit service; however we encourage our transit agencies and cities to look into more innovative transportation solutions by sharing information, conducting peer exchanges, educational workshops, performing planning studies and prioritizing funds for transit capital that is fed-aid eligible. The TPA's LRTP 2045 includes a "561 Plan" with a network of desired enhanced transit corridors. The TPA has prioritized funds for our local transit agency to implement fare-interoperability, TSP, electric buses, enhanced transit stops that are envisioned to have off-board ticketing, Wi-Fi, level boarding, solar electricity, bike racks, etc. The TPA has also prioritized funds for transit capital of local trolley/shuttle vehicles and stations for cities and Tri-Rail to provide first-last mile connections. The TPA has encourage its local transit providers to make their general transit feed

03. Have any of the following changes been implemented in your agency?

Change Affected by Technology (Route Optimization, Fare Box, etc.) **28**%

Fleet Changes **23**%

Staff Changes (Procurement, Mobility Coordinator, AI Specialist) **18**%

New Mobility Incorporation **15**%

Communication Channels **8**%

Not Sure **8**%

Other **3**%

New Technologies Represented Agencies are Adopting by Order of Response



specification (GTFS) transit feeds with real-time data public so private developer can integrate into their apps - ex. Transit App.

13. We have had a real-time app for ten years. We would like to incorporate mobile ticketing, but don't think the convenience is worth the trade-off for the costs. We need to implement APCs but have been hesitant to do this in the past due to the inaccuracy APCs have had in the past. The technology has gotten better, but the cost is too high for us. We are considering the implementation of iPads that can receive manually entered data.

14. New technologies have been discussed and/or implemented in the following areas:

- » Passenger information: implementation of MyRide Broward, a real time passenger information app which provides vehicle location, estimated arrival

time, and trip planning.

- » Fare payment: implementation of a mobile ticketing app which allows passengers to pay fares with their cellphones.
- » Microtransit: BMSD
- » Late night on demand

15. Combined trip planning and mobile fare app, APCs, New fare boxes, Electric vehicles/buses, Depot chargers, In-line chargers, Variable sign boards

Summary of New Technologies Being Adapted or Studied (by Agency)

- » Hybrid/Electric Buses & Infrastructure (8)
- » Mobile Fare Payment (7)
- » Autonomous/Connected Vehicles (6)
- » Microtransit Service (4)
- » Real Time Passenger Info (4)
- » Regional Fare System (3)
- » Transit Signal Priority/Ramp Meters for Buses (3)
- » Improved Wayfinding Tech (2)
- » TNC Partnerships/MaaS (2)
- » Automatic Passenger Counting (2)
- » Wi-Fi On Buses (2)
- » Safety Alerts
- » Pedestrian Detection System
- » Drone Port Study
- » Improved Transit Stops (Wi-Fi, ticketing, level boarding, etc.)
- » Late Night On-Demand Service

4

Topic: MPO Involvement

What is the level and nature of involvement between your organization and your MPO?

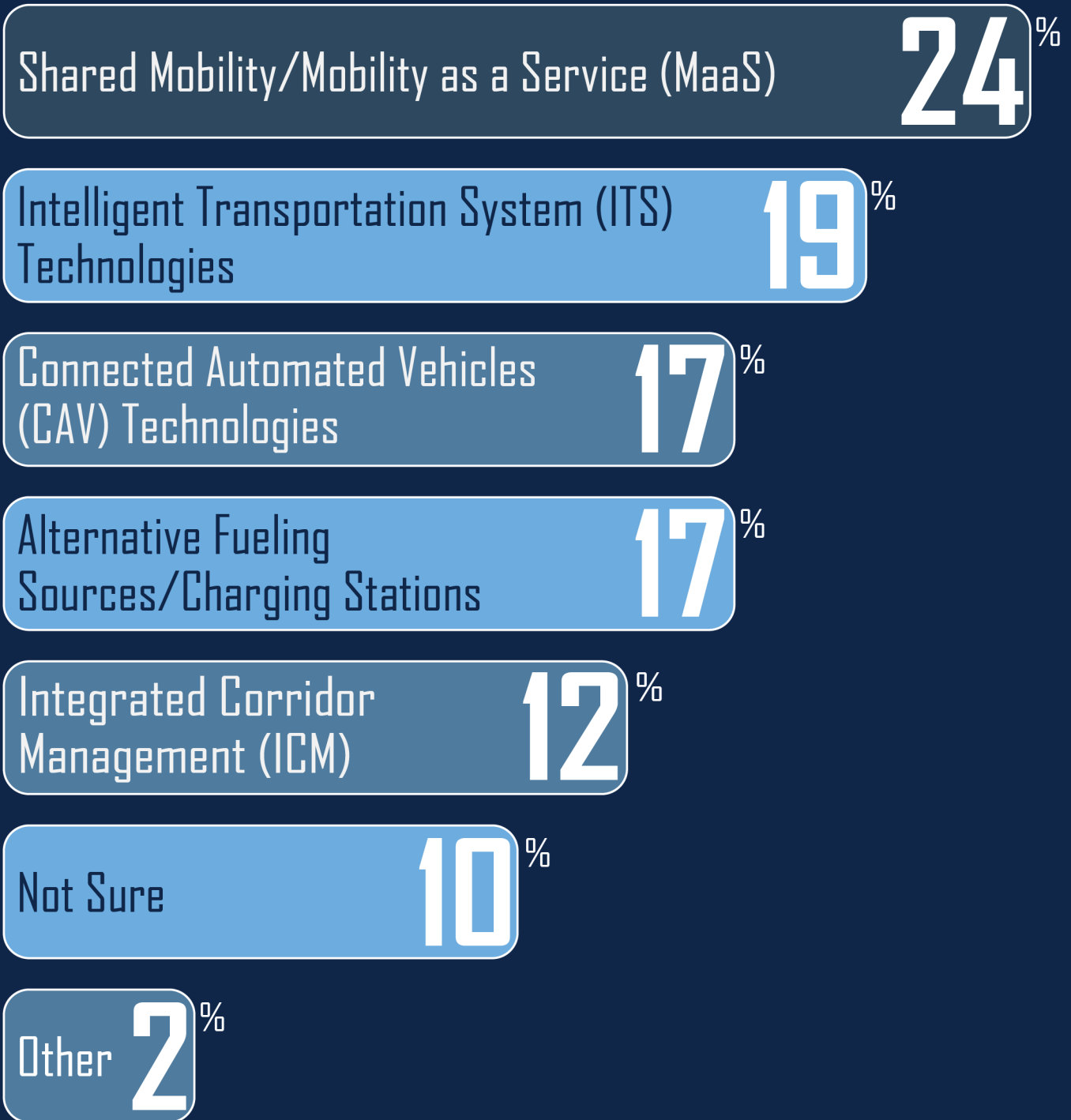
- 1.** The MPO currently pays for and coordinates the TDP for both Hernando and Citrus Counties. As the Planning Agency, we also coordinate the TD program in both counties.

- 2.** There is a high level of collaboration and coordination between the two organizations.
- 3.** Close coordination.
- 4.** We are the MPO. We meet with our transit authority (LYNX) regularly and we are in constant communication, particularly as we plan our 2045 MTP.
- 5.** Coordination of all projects with MPO transit priority list and FDOT STIP.
- 6.** The TPO has a collaborative relationship with the transit provider.
- 7.** Work closely and well together on staff level. Great staff coordination.
- 8.** We coordinate with the MPO on the UPWP, they also evaluate the city projects for the surtax that will be funded.
- 9.** We interact a fair bit and MPO helps financially support some of our studies. I, however, wouldn't say there is heavy involvement in transit from the MPO.
- 10.** TBARTA staff are members of the technical advisory committees of the MPOs within our 5-county service area.
- 11.** Great staff coordination.
- 12.** We are the MPO and have monthly coordination meetings with Palm Tran and quarterly coordination meetings with SFRTA. We also participate on each other's planning and agency advisory committees.
- 13.** MPO Executive Director is our Board Chair. The City of Fort Lauderdale has an Inter Local Agreement with Broward MPO.
- 14.** Not sure, not my area of expertise.
- 15.** We work together, collaborate, as needed.

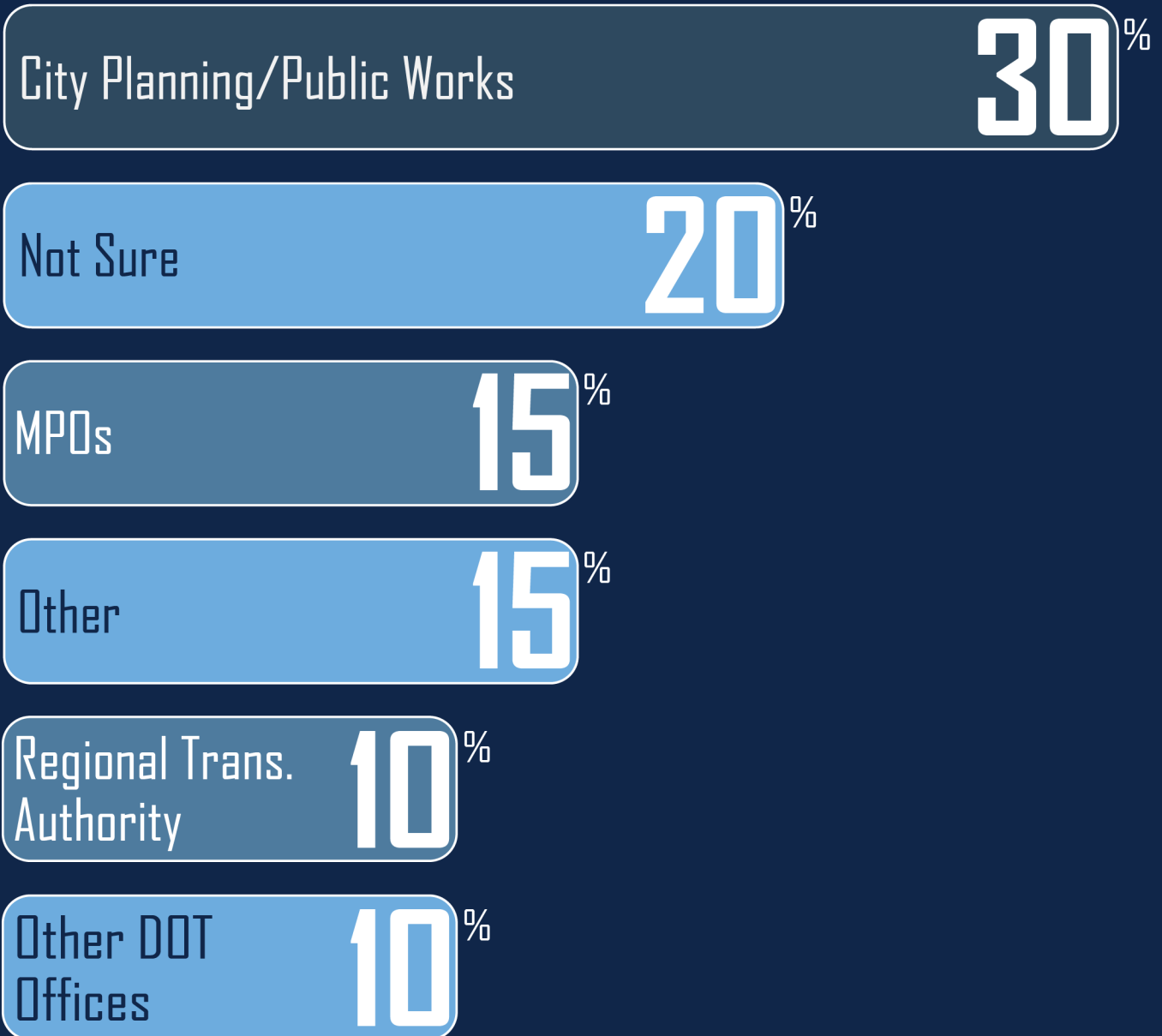
Summary of MPO Involvement

Although each agency and MPO relationship has a unique structure, almost all responses indicated that they work well together.

05. What, if any, innovative technological mobility solutions have your MPO/FDOT District planned for or begun to deploy?



06. Are there other government agencies implementing mobility services that need to be integrated with your transit service? If yes, which ones?



7

Topic: External Technology Integration

Are there other government agencies implementing mobility services that need to be integrated with your transit service?

1. Regional Transportation Authority. TBARTA and its Van Pool Service.
2. City Planning/Public Works; MPOs; Other DOT Offices. The JTA, the North Florida TPO, the City of Jacksonville, FDOT, JEA, and a bevy of other stakeholders in the community are collaborating to develop a smart corridor that will incorporating automation and smart technologies.
3. N/A or Not Sure.
4. MPOs; Regional Transportation Authority. No additional information provided.
5. City Planning/Public Works. No additional information provided.
6. City Planning/Public Works; MPOs. The City of Fort Pierce operates the local bike-share and e-scooter programs.
7. JTA has integrated very well with FDOT and TPO.
8. City Planning/Public Works. City of Hollywood, offering Circuit and City of Fort Lauderdale, I think they operate Circuit or another pilot.
9. N/A or Not Sure.
10. N/A or Not Sure.
11. City Planning/Public Works; Other DOT Offices. No additional information provided.
12. City Planning/Public Works. City of West Palm Beach has trolleys, bikeshare, scooters, etc. that connect with Palm Tran and Tri-Rail. City of Delray Beach has local shuttles that connect with Tri-Rail.
13. These are all already integrated with the TMA.
14. Municipalities. Microtransit, City of Fort Lauderdale (Circuit) and City of Hollywood (Sun Shuttle).

15. N/A or Not Sure.

Summary of External Agencies Implementing Services Needing Integration

- » MPOs – 3
- » City Planning/Public Works – 6
- » Other DOT Offices – 2
- » Regional Transportation Authority – 2
- » Municipalities – 1
- » None or Not Sure - 6

8

Topic: Public-Private Partnership Agreements

Has your agency considered/entered into any public-private partnership (P3) arrangements to integrate mobility solutions?

1. No.
2. Yes, the JTA currently contracts with the private sector to operate our microtransit services known as ReditRide.
3. No, just service partnerships but no funding.
4. No.
5. Yes, but conflict funding priorities and some existing regulations (e.g. to contract TNC).
6. Not the TPO, but the transit agency partners with Transloc to provide a 'public Uber' service.
7. The U2C autonomous transit project has private partners anticipated.
8. No.

- 9. Yes, we are considering various shared-ride service companies and their microtransit services. We are also looking into public-private partnerships for park and ride lots.
- 10. No.
- 11. Planning for P3s.
- 12. TPA has been a funding partner for Brightline /Virgin Trains USA Quiet Zones. TPA has encouraged Palm Tran and Tri-Rail to pursue partnerships with TNCs. TPA participated on City of West Palm Beach's RFP Selection Committee for Bikeshare/Scooters.
- 13. Yes, for micro-transit providers, such as FreeBee, Circuit, Via, etc.
- 14. Not sure, not my area of expertise.
- 15. The city is looking into what P3s for C.K. Steele redevelopment might look like.

- 2. I see it as an opportunity to expand our footprint in terms of connecting our customers with a first-mile/ last-mile transportation solution. It also for the most efficient use of limited resources.
- 3. Opportunity - demand response - better service, first/ last mile - more efficient connections.
- 4. We hope to play an important in data acquisition and management in the future. We see this as an opportunity that is not without its challenges.
- 5. AV, Microtransit, On-demand services, TNC, etc. present challenges and opportunities that are affecting and will continue to affect future transit services.
- 6. New technologies and emerging mobility solutions, if they are customer-centric, could be opportunities.
- 7. Both. Opportunity to offer improved transit services. Challenge to some customers not computer literate. Challenge to work force planning. Great opportunity.
- 8. Both. It is an opportunity because we transit can provide longer haul trips and the emerging mobility solutions can provide the first/last mile connections. However, it is a challenge to overcome the somewhat negative perception of transit and encourage more people to ride.
- 9. As previously mentioned, CAT is progressive in the mindset to new technologies. We identify these as opportunities. We believe that these are just another tool in our toolbox that will help us remain relevant in an ever-changing world.
- 10. Hard to tell at this point since we do not yet operate any fixed route service.
- 11. Great opportunity.
- 12. New technologies present an opportunity to provide first last mile connections, increase transit service efficiency, and improve the user experience; however, the challenge is getting past federal funding timing, federal-state-local policies and regulations to implement new technologies, services and private-public partnerships.
- 13. No answer provided.
- 14. I believe that these new technologies and emerging mobility solutions are an opportunity. On the

Summary of P3 Arrangements

- » Yes (Existing or Planned) – 9
- » No – 5
- » Not Sure – 1

Topic: Impact of New Technologies

9

What potential impact do you see new technologies and emerging mobility solutions, such as AV, demand responsive service models, etc., having on your organization? Is this identified as an opportunity or a challenge?

- 1. While the jury is still out on what type of impact, the consensus is that there WILL be an impact. It is both an opportunity to embrace these new technologies and a challenge to adapt.

10. What obstacles associated with integrating new technologies do you or your organization foresee?



technology side, it will allow our organization to make data driven decisions to employ our resources more effectively. Some of the emerging mobility solutions represent an opportunity for our organization to fill gaps within our existing service in a cost-effective manner.

15. Big impacts. Both opportunity and challenge.

Summary of Impact of New Technologies

Of those that provided a response, all cited new technologies as opportunities to better serve their customers. However, many also mentioned that there will be challenges with funding, procurement, workforce planning, and the equitable distribution of new technology. Overall, the respondents sounded positive about the impacts of new technology on their systems/regions.

11

Topic: Effects of New Technology on the Workforce

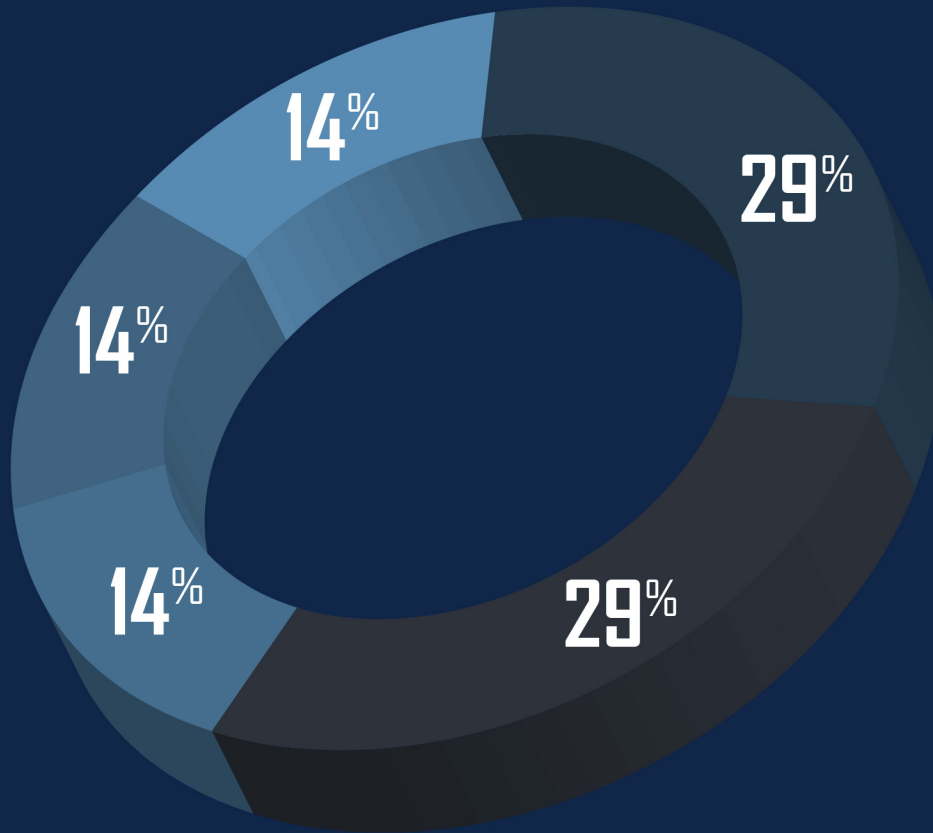
How do you see technology affecting the transit workforce? What are some of the challenges with preparing the associated transit workforce for transit technological innovations?

- 1.** Autonomous buses and vans will replace drivers. On-demand rides will affect both the transit system and the TD program to a great extent.
- 2.** The shifting landscape of transit with the emergence and integration of smart technology and automation may have a negative impact on the current transit workforce who may not be able to adapt to those changes.
- 3.** Training operators; IT staff staying current.

- 4.** Our region relies on transit for our service industry workers. If transit improves, then this can greatly improve the lives of our workers. Our concern is that transit technology will not be distributed equitably and may be concentrated in tourist corridors that do not connect to the neighborhoods where our workers live.
- 5.** Work displacing/shift of job duties need for training workforce.
- 6.** Hiring qualified transit staff has always been a challenge and tech innovations might contribute to the challenge.
- 7.** Operator Unions concerns about automation.
- 8.** Trying to attract and retain younger generations into transit. The transit force is aging and not being replaced quickly enough. So many agencies are poaching staff from one another.
- 9.** It is a shift in an industry, some people may lose their positions but maybe not their jobs. The needs will shift into different areas within the industry. It will be a shuffle of jobs and the creation of others.
- 10.** I see TNCs siphoning off more transit riders as time goes on.
- 11.** JTA has started JTA University to begin training for changes.
- 12.** New technologies may eliminate some jobs by making things more efficient and streamline. It may be challenging to get all transit agency employees up to speed with new technologies and changing the way of doing things - from administrative to operations staff.
- 13.** They need ongoing training by someone who is available locally and readily.
- 14.** These new technologies create an incredible amount of data, which is in turn allowing organizations to make data-driven decisions. As such, I believe that one of the main challenges for organizations will be attracting, training, and retaining a workforce able to harness, analyze, and interpret the data generated by the different technologies that they employ.
- 15.** Change. Change.

12.

Is there a type of data or technology that is not currently being collected or utilized at your agency that could improve analytics and mobility integration?



Passenger Counting Systems



Automatic Vehicle Location System



Not Sure



Other



Fare Collection Automation

Summary of Anticipated Effects on the Workforce

The most frequent answer given was a need for training – not just for operators but also for administrative and IT staff. There were concerns about the ability of staff to adapt to new technologies in an industry where attracting and maintaining employees is already difficult. One person suggested that implementing new technology will be a hinderance to hiring qualified workers while another suggested that new technologies will actually attract in-demand workers to the agencies that adopt them. Some mentioned that with increased automation and movement of riders to on-demand transportation over transit, jobs will be eliminated.

However, others believe that this is an industry shift that will result in both elimination of some current positions and the creation of new ones. One respondent noted that because of the plethora of data that agencies will soon be able to collect, there will be a sharp increase in the need for data analysis and management. One respondent said their top concern is equitable distribution of the technology, not for the transit workers themselves but for service industry workers, who rely on transit, being able to access the new/improved services. In areas of Florida where tourism is a major industry, the effects on those workers need to be considered.

13

Topic: Desired Resources for Changing Technologies

In an ideal world, what resources would be available to fully prepare for the technological shifts facing transit agencies?

1. As FDOT has done with the ACES program, perhaps extending this to transit and all that entails.
2. The infrastructure to support these new technologies and systems needs to be readily available. There needs to be more collaboration and less working in silos by all stakeholders.
3. Standard API integration agreements; an app that could fully integrate TNCs, real time trip planning across modes, and purchase of fixed route and other mobility services.
4. Better funding.
5. Dedicated funding and training.
6. Training for students at the high school level to ensure work readiness.
7. FDOT could help test some equipment as they do for emerging traffic signal technologies. FDOT could approve equipment on state contract. State research support and funding.
8. Funding, Staff (utilization and need more).
9. IT is going to play a huge role in transit in upcoming years as well as Planners analyzing that data created from various technologies. Industry specific training workshops, less “how to fill out” form workshops for data collection. Create a smarter industry. Work with Industries and Universities together, help bridge that gap and get the students entering the transit working world ready.
10. Don't know.
11. State research support and funding (repeat answer)
12. More flexibility for private-public partnerships; Open Data; Faster funding & implementation.
13. Money.

14. N/A

15. Funding, funding, funding.

Summary of Desired Resources

Almost all respondents gave multiple answers and while funding was the most frequent answer (6), each response was unique. Some framed their answers specifically for FDOT and others were thinking on an industry-wide level.

Suggestions for FDOT included:

- » Expansion of the ACES program to transit.
- » Help with testing new equipment.
- » Approve equipment for state contracts.
- » State research support.

General needs included:

- » P3 flexibility.
- » More collaboration between various stakeholders.
- » API integration agreements.
- » Fully integrated apps across platforms including TNCs and real-time trip planning.
- » Purchase of fixed route and other mobility services.
- » Open data arrangements.
- » Training:

- At the high school level, to prepare students to enter the workforce.
- Industry-specific for IT and planning staff to navigate new technologies and big data management.

1. A forum like this would be useful, along with continued webinars and workshops.

15

Topic: Missing Topics and Overall Comments

Are there any topics or comments not covered by this survey that you would like to include?

2. Maybe sustainability and resilience as it relates to transit and infrastructure.

3. No.

4. This survey was very heavily directed toward transit agencies, therefore some of the questions were not applicable or just difficult to answer as an MPO. But during the webinar we were all encouraged to complete the survey, so I wanted to do that.

5. Agencies need dedicated funds for technology; otherwise, funds will be shifted to operational necessities or deal with safety concerns.

6. Our transit agency established the bike share program but later transferred the program to the City of Fort Pierce.

7. TPO is pursuing Integrated Data Exchange for region to handle transportation data.

8. No.

9. In my opinion, the MPO seems to be more worried about checking off the "State's" mandated "boxes" rather than helping come up innovative technological solutions. The quick band-aid is easier than really fixing the issues.

10. No.

11. No.

14. Rank the following in terms of highest to lowest priority issue areas for your agency as you face emerging technologies and new mobility solutions:

1 PROCUREMENT OF INNOVATIVE TECHNOLOGIES

CREATING SEAMLESS CONNECTIONS 2

3 DATA COLLECTION, MANAGEMENT, & QUALITY

WORKFORCE CAPACITY 4

5 MANAGING RISK

OTHER 6

12. Technology Integration for Complete Trip

- » Transit agencies should let the private sector develop apps that the public can choose for user friendliness and that integrate across all mobility options - example: Transit App
- » Transit agencies could partner with these apps so the users can select their complete trip and purchase their trip from start to end - across modes and transit providers via their smart device.
- » It doesn't make a lot of sense for transit agencies to spend a lot of money creating an app that is solely for their service and becomes outdated shortly.
- » Also, Transit agencies should partner more with first-last mile connection providers in public-private partnerships - such as Bikeshare and TNCs. (ex. LA Metro partners with bikeshare where transit riders can use the same transit card for bikeshare and the bikeshare is branded the same as the Transit, even though it is provided by a private company).

13. None. Looking forward to the results.

14. N/A

15. No.

This page intentionally left blank.

C SCENARIO EXERCISE

Purpose

In response to transit agencies continuing to see their roles evolve in the context of a shifting mobility ecosystem, FDOT's Public Transit Office is leading a study to examine the state of transit innovation in Florida; identifying challenges facing transit providers; assessing the relationships between transit agencies, FDOT and MPOs; outlining best practices; and ultimately recommending strategies and an appropriate framework through which FDOT and MPOs can more effectively support transit agencies.

The purpose of this exercise is to understand how participants would think through and approach the scenario prompt and associated organizational roles when addressing one or more issues pertaining to technological innovation in transit, including planning and policy, agency coordination, operations, procurement, and labor and workforce development. The idea is to foster greater understanding for the regulatory framework within which transit agencies must navigate to adapt to and adopt new transit and mobility solutions. Examples of these include, but are not limited to, data collection and management, mobile fare payments, mobility integration, Mobility as a Service (MaaS), automatic passenger counters, and/or micromobility/microtransit programs. Facilitating group member discussion of the various institutional and organizational roles involved in addressing each scenario prompt's issue will allow the study team to better understand and analyze opportunities for enhanced flexibility and support surrounding transit agencies and technological transformation.

Instructions

NOTE: Don't forget to HAVE FUN! The "sky is the limit" when it comes to this exercise - try to approach these scenarios with as much flexibility as possible and an openness to modifying existing regulatory frameworks that often act as barriers to innovation.

Attendees will be separated out into several virtual "rooms" to discuss one of three possible scenarios. This exercise should last approximately 30 minutes, after which all

participants will be brought back together into the same "room" for a de-brief before the workshop ends.

Once in your virtual "room" (or ahead of time, if you'd prefer), please read through the scenario prompt and roles. Take a few minutes to think about the day-to-day duties associated with these various roles and how these organizations would or could respond to the issue(s) at hand.

Think through your answers to the questions below, then discuss them together with your group:

1. Who are the key players likely to be involved in addressing these issues?
2. What, if any, part does each role play in addressing these issues?
3. What role is the MPO or DOT likely to play in addressing these issues?
4. What are the obstacles to adopting innovative mobility solutions and creating seamless connections in your scenario?
5. What opportunities are created by technology in the scenario?
6. From the perspective of each role, what could the MPO or DOT do to support technological innovation in a technical, institutional, and funding capacity to address these issues?

Scenario A: Smaller Rural Community

Smallville is a rural, landlocked town with a population of 15,000. Many of its residents are older and retired. The neighborhoods of single-family housing, mobile parks, and some mid-density apartment complexes are all spread apart with scattered strip malls providing commercial and retail access for the community.

The Town of Smallville's transit agency, Small Tran, a department of county government, has a paratransit service that it is looking to expand. To do so, Small Tran

must leverage the county's procurement process, the driving force of which is risk management. Some members of Smallville's Town Council are interested in offering additional services to improve mobility around the town center where a new apartment complex is being built. The town center is a historical Main Street with more walkable, urban characteristics than anywhere else in town. Smallville's Town Council is looking for ways to redevelop Main Street and the town center area to attract more people to support the local businesses there.

Additionally, Smallville's Regional Planning Council is working with staff from the Department of Transportation (DOT) District as well as the MPO in Middletown to fund a transit option, potentially run by Small Tran, that could improve connections between the two regions. Middletown, with a population of roughly 185,000, is a mid-size "town and gown" municipality with urban areas that coalesce around a large university and public state college.

Issues for Discussion

- Smallville wants to expand paratransit service and improve mobility options around the town center area where Main Street is being redeveloped.
- The Regional Planning Council is working with the DOT District and Middletown's MPO to determine funding sources for a regional transit option.

Roles

- 1. Transit Manager for Small Tran.** Your top priority is expanding the transit options within Smallville, but your biggest concern is funding. The Town Council recently asked that you and your staff investigate private sector options to improve not only the paratransit service, but also mobility options around Main Street. You have heard that Middletown is using micromobility options like bikeshare and scootershare to provide alternative transportation options, but are skeptical and do not know where to begin looking for answers to the request.
- 2. Director of the Regional Planning Council.** You

are trying to encourage Smallville's Town Council and Small Tran's Transit Manager to introduce more dynamic solutions to solving mobility issues.

- 3. Transit Unit Manager for the Smallville DOT District.** The bulk of your time is spent securing grant funding, ensuring compliance, and handling contracts, which greatly limits your ability to focus on planning and innovation.
- 4. Mayor of Smallville.** Your role is to focus on economic development. Many of your constituents are local business owners who have complained that the town's big box store has stolen all of their customers. As head of the Town Council, you are pushing for redevelopment on Main Street.
- 5. Smallville Finance Director.** You are in charge of procurement, budget, Human Resources, and generally wear many hats.
- 6. Smallville Town Planner.** You returned to Smallville after attending university in Middletown to encourage innovative transportation solutions that improve mobility options in your hometown. You have been trying to convince the Town Council to consider technology-based mobility services on Main Street.

Scenario B: Mid-Size "Town and Gown" Community

Middletown is a mid-size town with a population of roughly 185,000. The urban parts of Middletown are confined around a public state college and a large university, known as Middletown University. Middletown's development pattern ranges from rural to suburban with a central, urbanized area. Most density is centered around a small downtown, the university campus, and surrounding student housing complexes.

Middletown's transit agency, Middletown Regional Transit (MRT), falls under a department of city government. Between its bus and paratransit service, MRT generates almost 9.2 million unlinked passenger trips each year. MRT additionally provides transit service to Middletown University through a multi-year cost-share agreement

paid for by a per credit student transportation fee. Due to the university presence, the number of people who walk, bike, and take transit (especially amongst the 18% student population) to and around campus is significant. Therefore, Middletown is trying to find ways to improve alternative transportation options by experimenting with a first-mile/last-mile micromobility pilot. The town's central, urbanized area has welcomed a private vendor, Sublime, to test their dockless bikes and scooters over a three (3) month period.

To keep the pilot going past the initial 3-month period, Middletown has applied for grant funding from the DOT District as well as the Middletown MPO. MRT does not have the budget or capacity to manage and operate micromobility, but the Planning Director of Middletown believes that MPO support in the form of data management and training could empower MRT to create a viable program. The Planning Director would also like to see transit, paratransit, and micromobility services and fare payments combined into one smartphone app.

Issues for Discussion

- Middletown local government is working with the university and MRT to find ways to improve alternative transportation options for students.
- Middletown local government is submitting a grants application to the DOT District to perpetuate its micromobility pilot program and is also interested in meeting with the university to discuss funding opportunities.
- Middletown local government is seeking MPO support in facilitating data management and training for MRT staff to manage the new micromobility pilot program.

Roles

- 1. Transit Manager for Middletown Regional Transit.** The planning department is managing a micromobility pilot to address first-mile/last-mile transportation options for students and wants you and your staff to take it over.
- 2. Planning Director for Middletown.** You originally went to the Transit Manager for Middletown Regional

Transit for help with addressing first-mile/last-mile connectivity issues in your city, but were told the transit agency did not have the capacity to manage micromobility, so you decided to try it in-house.

- 3. Director of the Middletown MPO.** You support innovation, especially when it comes to data collection and analysis that could improve the upcoming Long-Range Transportation Plan update.
- 4. Vice President of the Department of Student Affairs at Middletown University.** While you are excited about the opportunities the micromobility pilot program offers, you are also concerned about student safety on and around campus.
- 5. Mayor of Middletown.** You are focused on finding the right mobility solutions for the student population and want to push for a way students could access, track, and pay for all public transportation services in a single app.
- 6. Transit Unit Manager for one of Middletown's DOT Districts.** The bulk of your time is spent securing grant funding, ensuring compliance, and handling contracts, which greatly limits your ability to focus on planning and innovation.
- 7. Sublime Government Affairs Liaison working with Middletown.** Your main concern is ensuring that the micromobility pilot program is extended and expanded.

Scenario C: Large Metro Area

Urbanville is one of many cities spread across a four-county region. With a population of roughly 450,000, Urbanville prioritizes making a variety of public transportation options available to its residents and is focusing on transit-oriented development.

The regional transit operator, the Urban Transportation Authority (UTA), generates roughly 100 million annual passenger trips spread across several modes: light rail/streetcar (only in Urbanville), bus and paratransit, as well as regional commuter bus and commuter rail. UTA is moving towards mobility integration and has an arrangement

with the City of Urbanville, which runs the bikeshare/scootershare service using annual funding for operations provided by UTA. UTA operates within three counties, but has coordination issues with the transit provider that solely operates within the fourth, Outlier County. Outlier Area Transit (OAT) must leverage the county's procurement process, the driving force of which is risk management.

UTA is in the process of integrating all of its mobility services into one, convenient platform through which users can determine the best multimodal route to their destination of choice and easily pay one fare for the entire trip. UTA is working closely with Urbanville's regional metropolitan planning organization (MPO) to determine the best route forward for handling the data exchange and management associated with becoming a mobility integrator. It is vital to establish a framework for data standardization across agencies. However, the UTA is having issues getting an open data agreement from the ride-sourcing transportation network company (TNC) that provides subsidized rides to late-shift workers in the City of Urbanville, Goober.

Issues for Discussion

- The Urban Transportation Authority is shifting towards mobility integration and wants to integrate all of its services into one smartphone application that can allow users to plan and pay for their entire trip in the same place. To do so, the UTA must work with other local and regional agencies to determine a framework and protocol for standardizing data collection, exchange, and management.
- The ride-sourcing TNC partnering with the City of Urbanville is unwilling to provide a public version of its application program interface (API). The TNC does not want to risk the privacy of its riders' data, which means the UTA cannot fully integrate all available modes, as planned. Additionally, there is a fear that outsourcing the late-night service would negatively impact bus operators.

Roles

- 1. Executive Director of the UTA.** You believe the best way to improve mobility options and transportation access is by managing and integrating a regional,

multimodal network housed conveniently within a single app. You and the Planning Director for Urbanville are working on an agreement with Goober to establish open data exchange for mobility integration.

- 2. Transit Manager for Outlier Area Transit.** You are focused on converting your vehicle fleet to electric buses.
- 3. Director of the MPO.** While there is limited funding for innovative mobility options in Urbanville, you support the micromobility pilot to be able to analyze additional data inputs for the next Long-Range Transportation Plan update.
- 4. Transit Unit Manager for the Urbanland DOT District.** The bulk of your time is spent securing grant funding, ensuring compliance, and handling contracts, which greatly limits your ability to focus on planning and innovation.
- 5. Planning Director for the City of Urbanville.** Your staff manages the ride-sourcing subsidy program for late-shift workers in collaboration with Goober. You and the UTA Executive Director are working on an agreement with Goober to establish open data exchange for mobility integration.
- 6. Goober Government Affairs Liaison working with the City of Urbanville.** Your main concern is avoiding giving up the data associated with your ridership base, but may be willing to come to an agreement. The subsidy program, and the TNC's relationship with the City of Urbanville, has increased Goober's exposure to new users.
- 7. Bus Operator and Union Representative for the Urbanville Transportation Authority.** You are concerned about the impacts the outsourced late-night service might impact your job security. You want to make sure the Transit Manager is considering the need for additional training opportunities for you and your fellow operators.

This page intentionally left blank.

D AGENCY RESEARCH

Common Agency Types

This appendix contains research on a variety of common agencies (many of which have been involved with this study) and seeks to provide further insight into defining and understanding the role each has to play in supporting innovative transit planning. These (Florida-specific) agency types include:

- » Metropolitan Planning Organization
- » Transit Agency v.s. Transit Authority
- » Regional Planning Councils
- » Non-Profit Organizations
- » Florida Department of Transportation

Metropolitan Planning Organization

WHAT IS AN MPO?

A metropolitan planning organization (MPO) is the policy board of an organization created and designated to carry out the metropolitan transportation planning process. MPOs are required to represent localities in all urbanized areas (UZAs) with populations over 50,000, as determined by the U.S. Census. MPOs are designated by agreement between the governor and local governments that together represent at least 75 percent of the affected population or in accordance with procedures established by applicable state or local law. When submitting a transportation improvement program to the state for inclusion in the statewide program, MPOs self-certify that they have met all federal requirements.

An urbanized area with a population over 200,000 is called a Transportation Management Area (TMA). In recognition of the greater complexity of transportation issues in large urban areas, an MPO in a TMA has a stronger voice in setting priorities for implementing projects listed in the transportation improvement program and are responsible for additional planning products. The planning processes

in MPOs in TMAs also must be certified by the Secretary of DOT as in compliance with federal requirements.

The MPO...

- » Must meet regional transportation needs while being responsive to community interests and local by-laws and policies
- » Is the required “forum for cooperative transportation decision-making for the metropolitan area”
- » Is the engine driving regional collaboration and coordination:
 - Sharing of data
 - Assistance with technical analyses
 - Sound fiscal projections
 - Coordinated public involvement outreach
 - System synergy and connectivity
 - Optimal planning outcomes

THE ROLE OF THE MPO

Fundamentally, MPOs, also known as transportation planning agencies or organizations (TPAs/TPOs) exist to play a role in allocating billions in transportation spending. Making the most of that role, however, requires navigating a thicket of programs, rules, and relationships. The most important of those relationships, arguably, is that with the state Department of Transportation, through which federal dollars flow. MPOs also must coordinate with other recipients of federal funds, such as regional transit authorities, to ensure that the projects receiving funds are consistent with the region’s vision and plans.

Most federal funds are authorized for different categories,

such as public transit, national highways and transportation alternatives. These pots of funding are then distributed to states or transit agencies through Congressionally mandated formulas. A portion of each state's funds is targeted directly to metropolitan areas through a process called "sub-allocation." Although the share of dollars exclusively within an MPO's purview is small, there are two key avenues for shaping how money gets spent in your region: 1) by making the most of the flexibility available in federal dollars, and 2) by using MPO authority to set criteria for prioritizing projects.

Federal dollars in the highway account can be "flexed" to support transit, just as transit dollars can be used to support safe pedestrian and bicycle access to public transportation. Funds transferred from the highway account to the transit account are treated as transit funds so that the eligible uses, reporting requirements and approvals also transfer to the Federal Transit Administration. Further, transit funds can support development at or adjacent to a transit stop, creating additional opportunities for MPOs to shape growth and development while increasing ridership and revenue to support the transit system. Determining whether to flex funds, how much and for what purposes requires the active engagement and approval of the full MPO Policy Board, the state DOT, local transit agencies and the FHWA and FTA.

Fast Facts on Florida MPOs:

- » Florida has **27** MPOs
 - Smallest serves a population of about 110,000 (2011)
 - Largest serves a population of just over 2.5 million (2011)
- » **3** MPOs function on a regional scale
 - Capital Area Regional Transportation Planning Agency

- North Florida Transportation Planning Organization
- Heartland Regional Transportation Planning Organization

Transit Agency v.s. Transit Authority

WHAT IS A TRANSIT AGENCY?

A transit agency (also called transit system) is an entity (public or private) responsible for administering and managing transit activities and services. Transit agencies can directly operate transit service or contract out for all or part of the total transit service provided. When responsibility is with a public entity, it is a public transit agency. When more than one mode of service is operated, it is a multimodal transit agency. Transit agencies can fall under city or county jurisdiction, depending on the geographic area within which they are supplying public transportation service. When purchasing equipment or procuring services, the agency must be mindful of federal, state, and local governmental regulations.

WHAT IS A TRANSIT DISTRICT OR AUTHORITY?

In the United States, a transit district (or transit authority), organized either as a corporation chartered by statute or as a government agency, is created to give it the power of the government in solving problems related to transit issues. This includes the powers of eminent domain to obtain space for rights-of-way (e.g. for railways or busways); the ability to impose excise, income, property, and/or sales taxes to fund subsidies of operating costs of local transportation; and the ability to operate independently of the cities and counties within which the transit district operates. A district is usually contained within one state, but in rare circumstances may cover two or more states. A transit district may also have its own transit police force, although in some areas the local police provide a special bureau for this purpose. Typically, western states create a "transit district" and eastern states create a "transit authority" (also known as a transportation authority) but the type of agency is generally the same.

Fast Facts on Florida Transit Agencies and Authorities:

- » **76** transit agencies report to the National Transit Database
- » **6** transit agencies provide over 10 million annual unlinked passenger trips
 - Miami-Dade Transit generates the most trips, at roughly 89.5 million in 2017
- » There are **6** transit authorities:
 - Pinellas Suncoast Transit Authority (PSTA)
 - Jacksonville Transportation Authority (JTA)
 - Hillsborough Area Regional Transit Authority (HART)
 - South Florida Regional Transportation Authority (SFRTA, Tri-Rail)
 - Central Florida Regional Transportation Authority (LYNX)
 - Tampa Bay Area Regional Transportation Agency (TBARTA)

Regional Planning Councils (Florida Specific)

WHAT IS A REGIONAL PLANNING COUNCIL?

Regional Planning Councils (RPCs) are quasi-governmental organizations that are designated by Florida law (Ch. 186,

Florida Statutes) to address problems and plan solutions that are of greater-than-local concern or scope, and are to be recognized by local governments as one of the means to provide input into state policy development. With regard to transportation-related issues, RPCs are empowered to provide technical assistance to local governments on growth management matters; coordinate land development and transportation policies in a manner that fosters region-wide transportation systems; review local government comprehensive plan amendments, evaluation/appraisal reports, and Developments of Regional Impacts for consistency with state and regional plans; and, review the plans of independent transportation authorities and metropolitan planning organizations to identify inconsistencies between those plans and applicable local government plans. RPCs are a type of regional planning organization, specific to the state of Florida.

RPCs are primarily responsible for producing the Strategic Regional Policy Plan (SRPP), which identifies key regional resources and facilities, examines current and forecast conditions and trends (including expected growth patterns), and establishes regional goals and policies that guide a program of actions to address identified problems and needs. RPCs may also be involved in a variety of other programs other than growth management, such as emergency preparedness programs planning, GIS services, statistical analysis, small business development and public health projects. RPCs provide an effective mechanism in assisting the State in articulating its policies/programs at the regional and local levels.

Each RPC's Board May Be Composed of the Following Members:

- » Local elected officials (city and county commissioners)
- » Officials appointed by the Governor, including an elected school board member to be nominated by the Florida School Board Association

- » Ex officio non-voting members appointed by the Governor

Examples of Florida Regional Planning Councils:

- » North Central Florida Regional Planning Council
- » Apalachee Regional Planning Council
- » Tampa Bay Regional Planning Council
- » South Florida Regional Planning Council

Non-Profit Organizations

Non-profit organizations (NPOs) are usually private foundations engaged in social or public benefit activities and registered as such with the Internal Revenue Service (IRS). Often, these organizations assume government's role in providing social services when government is absent or has not yet addressed the issue (private organizations can often act or react with greater speed than government). Over time, agreements – such as Memorandums of Understanding or Cost-Share Agreements – may develop between NPOs and government agencies, often defining the former as a service provider and the latter as a source of funding. Councils on Aging are good examples of such public-private arrangements.

COUNCILS ON AGING (FLORIDA SPECIFIC)

In Florida's St. Lucie County, the Council on Aging of St. Lucie, Inc. (COASL) began as a volunteer organization in 1973 to provide a daily hot meal to seniors. Over the years, it grew in scope and size to provide a number of senior social services that reflect the agency's mission to delay the premature placement of seniors into long term care facilities. Today, Community Transit, a division of COASL, provides transportation for seniors within St. Lucie County for various senior programs. Through contract with the Board of County Commissioners, Community Transit is also

the public transportation provider for St. Lucie County.

COASL is the designated Lead Agency for St. Lucie County for Community Care for the Elderly (CCE) state funded programs. COASL contracts with the Florida Department of Elder Affairs (DOEA) through the Treasure Coast Area Agency on Aging (AAA), to provide senior services within the county.

Florida Department of Transportation

The Florida Department of Transportation (FDOT) is an executive agency, which means it reports directly to the Governor. FDOT's primary statutory responsibility is to coordinate the planning and development of a safe, viable, and balanced state transportation system serving all regions of the state, and to assure the compatibility of all components, including multimodal facilities. A multimodal transportation system combines two or more modes of movement of people or goods. Florida's transportation system includes roadway, air, rail, sea, spaceports, bus transit, and bicycle and pedestrian facilities.

FDOT is a decentralized agency. The Central Office establishes departmental policies, rules, procedures, and standards and ensures uniform compliance and quality performance by the districts and central office units that implement transportation programs. In order to provide for efficient operations and to expedite the decision making process, the operations of the Department are organized into seven (7) districts, each headed by a district secretary, and a turnpike enterprise, headed by an executive director. The District Secretaries and the Executive Director of Turnpike Enterprise are appointed by the Secretary and serve at the pleasure of the Secretary.

FLORIDA DEPARTMENT OF TRANSPORTATION DISTRICTS

The Florida Department of Transportation is decentralized in accordance with legislative mandates. Each district is managed by a District Secretary. They vary in organizational structure, but in general each has major divisions for

Administration, Planning, Production, and Operations. Also, each district has a Public Information Office that reports to the District Secretary and a District Chief Counsel who reports to the DOT General Counsel in Tallahassee.

Examples of What FDOT Districts Do:

- » Provide capital grant funds to airports
- » Provide funding to assist transit authorities within their district
- » Monitor major transportation infrastructure within their district, including airports, deep-water ports, and railroads
- » Collect and manage data needed to comply with annual performance measures associated with multimodal transportation network within their district

E FUNDING RESEARCH

Funding Research

The study team conducted research into state and federal funding opportunities for transit and innovative mobility solutions. The research is split between federal funding and state funding opportunities. Federal funding research includes Federal Transit Administration (FTA) competitive grant programs and as well as recent infrastructure bills that have passed onto the U.S. Senate from the House of Representatives. State level funding opportunities are also addressed, but pertain to grant programs that encourage innovation and were created by an act of Florida legislature.

This appendix is meant to be a quick and easy way to understand the funds transit agencies have available to them at the state and federal level when seeking to adopt innovative mobility solutions to expand public transit service and increase ridership. Please note that the information below is focused on funding specifically for transit and alternative mobility solutions.

Federal Infrastructure Bills

H.R. 2: THE MOVING FORWARD ACT

- ◆ Extensive investment plan, with big impacts on transportation, for roads, bridges, transit, water, broadband, workforce, and financing for U.S. infrastructure needs
- ◆ Major component: Investing in a New Vision for the Environment and Surface Transportation (or INVEST) in America Act (passed the U.S. House Transportation and Infrastructure Committee in June of 2020)
- ◆ Over \$1 billion in new local transportation grants, including \$250 million per year to non-State applicants for transit and rail projects that reduce greenhouse gas emissions and the same amount for reducing urban congestion in large metro areas
- ◆ Transportation Alternatives Program funded at \$6 billion over four years, double current levels

- ◆ \$105 billion for transit programs (over 5 years): boosting funding for (zero emission) buses; creating incentives to increase transit frequency and ridership; allowing transit agencies to use up to 10% of federal funds for operations
- ◆ New mechanisms to begin exploring and innovating in the Mobility on Demand and Mobility as a Service spaces and to start addressing data sharing practices among partners

More information available [here](#).

Federal Grant Programs

REAL-TIME TRANSIT INFRASTRUCTURE AND ROLLING STOCK CONDITION ASSESSMENT DEMONSTRATION PROGRAM

- ◆ Research demonstration program (not a capital procurement program) with \$1.25 million available for awards that funds innovative approaches to eliminate or mitigate infrastructure deficiencies in public transportation using innovative technologies and designs
- ◆ Proposals must include a research/synthesis phase, development phase and a demonstration phase, and applicants must identify partnerships with at least one transit agency

More information available [here](#).

LOW OR NO EMISSION VEHICLE PROGRAM

- ◆ Provides funding to state and local governmental authorities for the purchase or lease of zero-emission and low-emission transit buses as well as acquisition, construction, and leasing of required supporting facilities
- ◆ Eligible projects include: purchasing or leasing low- or no-emission buses; acquiring low- or no-emission buses with a leased power source;

constructing or leasing facilities and related equipment (including intelligent technology and software) for low- or no-emission buses; constructing new public transportation facilities to accommodate low- or no-emission buses; and/or rehabilitating or improving existing public transportation facilities to accommodate low- or no-emission buses

More information available [here](#).

NEW STARTS, SMALL STARTS AND CORE CAPACITY IMPROVEMENTS PROGRAM

- ◆ Discretionary & competitive grant program with roughly \$2.3 billion appropriated each year that funds light rail, heavy rail, commuter rail, streetcar, and bus rapid transit (BRT) projects
- ◆ BRT projects must offer short headway times but can be both corridor-based (separated ROW not required for entirety) and fixed guideway (majority of ROW must be separated for public transit use only)
- ◆ Multi-year, multi-step process projects must follow to receive funds including multiple points of evaluation and applied ratings by the FTA using strict evaluation criteria ranging from low to high on a five-point scale as well as an Annual Report to Congress with project ratings and FTA funding recommendations

INNOVATIVE MOBILITY GRANTS

Figure 12 provides information on the Federal Transit Administration's innovative mobility grant programs, which began in FY 2016 with the Mobility on Demand (MOD) Sandbox Program. Florida's Pinellas Suncoast Transit Authority was a recipient of the MOD Sandbox Demonstration grant program for the agency's innovative Public-Private-Partnership for Paratransit Mobility on Demand (P4MOD) program.

State Grant Programs

PUBLIC TRANSIT SERVICE DEVELOPMENT PROGRAM

This program was enacted by the Florida Legislature to fund special projects that use a new or innovative technique to improve or expand public transit services. Service Development Projects are funded as pilots that must be completed within three years; if successful, projects must be continued by the public transit provider without additional Public Transit Service Development Program funds. Projects must be justified in the recipient's Transit Development Plan.

PUBLIC TRANSIT BLOCK GRANT PROGRAM

This program was enacted by the Florida Legislature to provide a stable source of funding for public transit. Public Transit Block Grants may be used to cover eligible capital and operating costs of providing public transit service, and may also be used for transit service development and transit corridor projects. Projects must be consistent with local government comprehensive plans.

TRANSIT CORRIDOR PROGRAM

This program was authorized by the Florida Legislature to provide funding to Community Transportation Coordinators or transit agencies to support new services within specific corridors designed and expected to help reduce or alleviate congestion or other mobility issues. Funds, which can be up to 100 percent of the project cost, are discretionary and distributed based on documented need. Projects must be identified in a Transit Development Plan, Congestion Management System Plan, or other formal study undertaken by a public agency.

More information on state grant programs is available [here](#).

Figure 12: Federal Transit Administration innovative mobility grants

Federal Transit Administration Innovative Mobility Grant Programs

Federal Transit Administration (FTA) competitive grant programs offer transit agencies the opportunity to win federal dollars to offset project costs. More recent programs have highlighted the FTA's commitment to support and advance innovation in the transit industry, especially for projects that will improve the coordination of transportation services and non-emergency medical services for transportation disadvantaged communities. Innovative mobility grant opportunities, three of which are summarized below, have encouraged a national trend towards incorporating new approaches to improve the rider experience and reconsidering the service models through which transit providers can develop equitable mobility solutions.

It is important to note that not all transit agencies have the means to even successfully apply for an FTA grant. Applications must meet a variety of strict requirements and can be incredibly time-consuming for an agency to assemble (in terms of staff hours and degree of coordination required). For these reasons, submitting a grant application may be beyond the organizational and technical capacity of many smaller transit agencies.

Accelerating Innovative Mobility (AIM) Program FY 2020

A new program to drive innovation by promoting forward-thinking approaches to improve financing, system design, and service, the Accelerating Innovative Mobility program was announced by the FTA in January 2020 during the Transportation Research Board Annual Meeting.

Totaling \$11 million, AIM challenge grants can help transit agencies explore new service models that provide more efficient and frequent service, which will help retain riders. The AIM initiative will establish a national network of transit agencies that will test and share project results and use FTA's technical assistance centers to promote promising innovations.

Integrated Mobility Innovation (IMI) Program FY 2019

In March 2020, the FTA announced approximately \$20.3 million in grant selections made through the Integrated Mobility Innovation program, issued in the summer of 2019. IMI supports projects that use innovative technologies, partnerships, and processes to improve access to public transportation, increase public transportation efficiency, and enhance the overall rider experience. Twenty-five projects will receive funding under the program.

Example: The Central Ohio Transit Authority will receive \$1.7 million to develop a platform that combines traffic and transit management data and uses AI to improve safety, efficiency, and the rider experience.

Mobility on Demand (MOD) Sandbox Program FY 2016

In 2016, the FTA developed the Mobility on Demand Sandbox Demonstration program to envision a multimodal, integrated, automated, accessible, and connected transportation system in which personalized mobility is a key feature. The initiative set aside roughly \$8 million in grants for agencies implementing demand-responsive mobility solutions.

Winning projects focused on integrating shared and micromobility platforms into transit trip planning apps; connecting regional services to improve transit use and access; and developing a mobility on demand paratransit partnership to improve service and reduce costs.

F REFERENCES

- Akers, M. (2019). Las Vegas Trip to Strip ride-hailing service stops after 6 months. Las Vegas Review-Journal. Retrieved from: <https://www.reviewjournal.com/traffic/las-vegas-trip-to-strip-ride-hailing-service-stops-after-6-months-1921064/>.
- American Public Transit Association (APTA). (2020). 2020 Public Transportation Fact Book. American Public Transportation Association. Public Retrieved from: <https://www.apta.com/wp-content/uploads/APTA-2020-Fact-Book.pdf>.
- American Public Transit Association (APTA). (2016). Pinellas Suncoast Transit Authority | Uber, United Taxi and Care Ride. APTA Webpage. Retrieved from <https://www.apta.com/research-technical-resources/mobility-innovation-hub/transit-and-tnc-partnerships/>.
- American Public Transportation Association (APTA) (Producer). (2020). Transit as a Micromobility Manager: The Dayton RTA Experience. APTA Mobility Innovation Pilot of the Month (Webinar). Retrieved from: <https://www.apta.com/dayton-rta-experience/>.
- Anderson, L.V. (2020). Coronavirus has caused a bicycling boom in New York City. Grist. Retrieved from: <https://grist.org/climate/coronavirus-has-caused-a-bicycling-boom-in-new-york-city/>.
- Ann Arbor Area Transportation Authority (AAATA). (2020). New Mobility. Retrieved from: <https://www.theride.org/AboutUs/Initiatives/New-Mobility>.
- Bakule, J. (2020). The Gig Economy Lemonade Stand. Medium. Retrieved from: <https://medium.com/@jjbakule/the-gig-economy-lemonade-stand-50dabbbfcb3f>.
- Bartinique, I. and Hassol, J. (2019). Mobility Payment Integration: State-of-the-Practice Scan. U.S. Department of Transportation: Federal Transit Administration Research. Retrieved from: https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/research-innovation/134056/mobility-payment-integration-state-practice-scan-fta-report-no0143_1.pdf.
- Beal, V. (2020). API - application program interface. Webopedia. Retrieved from: <https://www.webopedia.com/TERM/A/API.html>.
- Boston, W. and Colais, M. (2020). Coronavirus Bolsters Car Ownership as Consumers Rethink Shared Rides. The Wall Street Journal. Retrieved from <https://www.wsj.com/articles/coronavirus-bolsters-car-ownership-as-consumers-rethink-shared-rides-11589564566>.
- Boswell, M. R. and Riggs, W. (2017). Could Autonomous Vehicles Save Lives in Disasters? Planetizen. Retrieved from: <https://www.planetizen.com/features/95813-could-autonomous-vehicles-save-lives-disasters>.
- Brooks, R. (2020). How high-tech tools can help improve transit access and accessibility. Metro-Magazine, Transit Dispatches. Retrieved from: <https://www.metro-magazine.com/10111876/how-high-tech-tools-can-help-improve-transit-access-and-accessibility>.
- Bureau of Transit, Local Roads, Railroads and Harbors. (2015). Mobility Management Practices in Wisconsin. Wisconsin Department of Transportation. Retrieved from: <https://wisconsin.gov/Documents/doing-bus/local-gov/astnce-pgms/transit/mob-prac.pdf>.
- Centers for Disease Control and Prevention (A). (2020). Evidence for Limited Early Spread of COVID-19 Within the United States, January – February 2020. CDC Morbidity and Mortality Weekly Report (MMWR). Retrieved from: <https://www.cdc.gov/mmwr/volumes/69/wr/mm6922e1.htm>.
- Centers for Disease Control and Prevention (B). (2020). Protect Yourself When Using Transportation. CDC Coronavirus Disease 2019 (COVID-19). Retrieved from: <https://www.cdc.gov/coronavirus/2019-ncov/daily-life-coping/using-transportation.html>.
- Cohen, A. & Shaheen, S. (2016). Planning for Shared Mobility. American Planning Associates, Planning Advisory Service (PAS) Report 583. Retrieved from <https://escholarship.org/uc/item/0dk3h89p>.
- Coleman, J. (2020). Uber sues Los Angeles over data collection. The Hill. Retrieved from: <https://thehill.com/policy/technology/technology/489428-uber-sues-la-over-data-collection>.
- Craighead, C. (2020). King County Metro and Sound Transit temporarily suspend fare enforcement amid COVID-19 outbreak. Seattle Pi. Retrieved from: <https://www.seattlepi.com>.

com/local/seattlenews/article/Metro-suspends-fare-enforcement-coronavirus-15129329.php.

Dalton, D. (2018). Expanding Access to Our Communities: A Guide to Successful Mobility Management Practices in Small Urban and Rural Areas. American Association of State Highway and Transportation Officials (AASHTO). Retrieved from: [http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP20-65\(68\)_FR.pdf](http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP20-65(68)_FR.pdf).

Department of Rail and Public Transportation (DRPT). (2019). DRPT Statewide Integrated Mobility Initiative. Virginia Department of Rail and Public Transportation. Retrieved from: <http://www.drpt.virginia.gov/media/2789/drpt-statewide-integrated-mobility-initiative-finalreport-2019-05-16-1.pdf>.

Dickens, M. (2018). Public Transit is Key Strategy in Advancing Vision Zero, Eliminating Traffic Fatalities. American Public Transportation Association (APTA), Policy Development and Research. Retrieved from: <https://www.apta.com/wp-content/uploads/Resources/resources/hottopics/Documents/APTA%20VZN%20Transit%20Safety%20Brief%208.2018.pdf>.

Dickens, M. and Hughes-Cromwick, M. (2019). Leveraging Big Data in the Public Transportation Industry. American Public Transportation Association (APTA), Policy Brief. Retrieved from: <https://www.apta.com/wp-content/uploads/Big-Data-Policy-Brief.pdf>.

Dickens, M. and Hughes-Cromwick, M. (2019). Public Transit Increases Exposure to Automated Vehicle Technology. American Public Transportation Association (APTA), Policy Brief. Retrieved from: https://www.apta.com/wp-content/uploads/Policy-Brief_AVFinal.pdf.

Diehl, P. (2019). Oceanside wants more of a Hoot ride-share program. San Diego Union-Tribune. Retrieved from: <https://www.sandiegouniontribune.com/communities/north-county/oceanside/story/2019-12-25/oceanside-wants-more-of-hoot-ride-share-program>.

Duncan, C., Schroeckenthaler, K., and Blair, A. (2018). The Economic Cost of Failing to Modernize Public Transportation. American Public Transportation Association (APTA). Retrieved from: <https://www.apta.com/wp-content/uploads/Resources/resources/reportsandpublications/>

Documents/APTA-Economic-Cost-Failing-to-Modernize.pdf.

Ellis, E. (2009). Mobility Management. AARP Public Policy Institute. Retrieved from: https://assets.aarp.org/rgcenter/ppi/liv-com/roundtable_091013_mobility.pdf.

Farr, D. (2008). Sustainable Urbanism: Urban Design with Nature. Hoboken, New Jersey: John Wiley & Sons, Inc.

Federal Transit Administration (FTA). (2018). Effective Practices in Bus Transit Safety: Emergency Response. U.S. Department of Transportation: Federal Transit Administration. Retrieved from: <https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/regulations-and-guidance/safety/117621/effective-practices-bus-transit-safety-emergency-response.pdf>.

Federal Transit Administration (FTA). (2018). Strategic Transit Automation Research Plan. U.S. Department of Transportation: Federal Transit Administration Research. Retrieved from: https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/research-innovation/114661/strategic-transit-automation-research-report-no-0116_0.pdf.

Federal Transit Administration (FTA). (2019). Considerations for Evaluating Automated Transit Bus Programs. U.S. Department of Transportation: Federal Transit Administration. Retrieved from: <https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/research-innovation/146801/considerations-evaluating-automated-transit-bus-programs-fta-repor-no0149.pdf>.

Federal Transit Administration (FTA). (2019). Transit Bus Automation Market Assessment. U.S. Department of Transportation: Federal Transit Administration Research. Retrieved from: <https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/research-innovation/134451/transit-bus-automation-market-assessment-fta-report-no0144.pdf>.

Florida Department of Transportation (FDOT). (2013). Quality/Level of Service Handbook. Retrieved from https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/content/planning/systems/programs/sm/los/pdfs/2013_qlos_handbook.pdf?sfvrsn=22690bd2_0.

Fonseca, R. (2020). How LA Metro and Other Public Transit Agencies are Adapting to Our New Coronavirus Reality. LA-ist. Retrieved from: <https://laist.com/2020/03/18/>

coronavirus_la_county_public_transit.php.

Fonseca, R. (2019). You Can Now Pay for Your LA Metro Trip with a Flick of the Wrist. LA-ist. Retrieved from: https://laist.com/2019/08/05/la_metro_tap_flex_wristbands.php.

Freemark, Y. (2019). The perverse incentives produced by institutional division. The Transport Politic. Retrieved from: <https://www.thetransportpolitic.com/2019/09/19/the-perverse-incentives-produced-by-institutional-division/>.

Friedman, J. (2016). Microsoft helping Miami-Dade County achieve mobility for one, mobility for all. Microsoft Industry Blogs. Retrieved from: <https://cloudblogs.microsoft.com/industry-blog/government/2016/12/13/microsoft-helping-miami-dade-county-achieve-mobility/>.

Gardner, K. (2019). Pick up your smartphone for a free ride if you live in southwest Port St. Lucie. TC Palm. Retrieved from: <https://www.tcpalm.com/story/news/local/shaping-our-future/roads/2019/12/09/st-lucie-unveils-free-uber-like-program-port-st-lucie/4377700002/>.

Gettman, D., Lott, J. S., Goodwin, G., and Harrington, T. (2017). Impacts of Laws and Regulations on CV and AV Technology Introduction in Transit Operations. National Highway Cooperative Research Program (NCHRP). Retrieved from: [http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP20-102\(02\)_WP5_Government_Laws_and_Regulations.pdf](http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP20-102(02)_WP5_Government_Laws_and_Regulations.pdf).

GitHub. (2020). MobilityData Specification. GitHub. Retrieved from: <https://github.com/openmobilityfoundation/mobility-data-specification>.

Greene, D. (2020). COVID-19 Forces More People to Work from Home: How's IT Going? National Public Radio Morning Addition. Retrieved from: <https://www.npr.org/2020/05/08/852527736/covid-19-forces-more-people-to-work-from-home-hows-it-going>.

Grisby, D.C., Smith, Z., Weaver, R., Williams, M., Dickens, M., Hughes-Cromwick, M., and Villalobos, F. (2018). The Transformation of the American Commuter. American Public Transportation Association (APTA). Retrieved from: <https://www.apta.com/wp-content/uploads/Resources/resources/reportsandpublications/Documents/APTA-Transformation-of-the-American-Commuter.pdf>.

GTFS. (2020). GTFS: Making Public Transit Data Universally Accessible. GTFS. Retrieved from: <http://gtfs.org/>.

Guzman, A. (2020). Coronavirus in CNY: Syracuse bike share offers wheels to help with restaurants deliveries. Syracuse: Advanced Media NY. Retrieved from: <https://www.syracuse.com/coronavirus/2020/03/coronavirus-in-cny-syracuse-bike-share-offers-wheels-to-help-with-restaurants-deliveries.html>.

Halais, F. (2020). Cities Struggles to Boost Ridership with 'Uber for Transit' Schemes. Wired. Retrieved from: <https://www.wired.com/story/cities-on-demand-transit-buses/>.

Halfon, J. (2019). The Right Way to Regulate Electric Scooters. CityLab Perspective. Retrieved from <https://www.citylab.com/perspective/2019/04/how-safe-are-e-scooters-liability-accident-bird-lime-lyft/588319/>.

Harris, J. (2020). The Subways Seeded the Massive Coronavirus Epidemic in New York City. Massachusetts Institute of Technology. Retrieved from: https://web.mit.edu/jeffrey/harris/HarrisJE_WP2_COVID19_NYC_24-Apr-2020.pdf.

Hawkins, A. (2020). NYC is offering to hire out-of-work Uber and Lyft drivers. The Verge. Retrieved from: <https://www.theverge.com/2020/3/24/21192258/nyc-tlc-uber-lyft-drivers-hire-work-delivery-pay>.

Jacksonville Transportation Authority (JTA). (2020). JTA, Beep & Navya Autonomous Shuttles Help Mayo Clinic Transport COVID-19 Tests. JTA Press Releases. Retrieved from: <https://www.jtafla.com/media-center/press-releases/jta-beep-navya-autonomous-shuttles-help-mayo-clinic-transport-covid-19-tests/>.

Janis, M. (2019). Let's Electrify Public Buses Without Throwing Workers Under the Bus. Forbes. Retrieved: <https://www.forbes.com/sites/madelinejanis/2019/07/30/lets-electrify-public-buses-without-throwing-workers-under-the-bus/#61268cfa1124>.

Kim, J. (2017). What's a mechanic to do when electric cars bring less work?. Marketplace. Retrieved from: <https://www.marketplace.org/2017/08/30/whats-mechanic-do-when-electric-cars-bring-less-work/>.

Linton, J. (2019). Metro Launches 'Mobility on Demand' First/ Last Mile Pilot. LA Streets Blog. Retrieved from: <https://la.streetsblog.org/2019/01/28/metro-launches-mobility-on-demand-firstlast-mile-pilot/>.

Lopez, E.T. (2009). Transit Innovations: Regional Coordination. Metropolitan Planning Council. Retrieved from: <https://www.metroplanning.org/news/3556/Transit-Innovations-Regional-Coordination>.

Miller, K. (2020). Self-Driving Mass Transit Arrives on American Streets. Bloomberg News. Retrieved from: <https://www.bloomberg.com/news/articles/2020-02-05/self-driving-mass-transit-arrives-on-american-streets?srd=hyperdrive>.

Murphy, C., Karner, K., and Accuardi, Z. (2019). When Uber Replaces the Bus: Learning from the Pinellas Suncoast Transit Authority's "Direct Connect" Pilot. Shared-Use Mobility Center: a First-Last Mile Case Study. Retrieved from: https://learn.sharedusemobilitycenter.org/wp-content/uploads/SUMC_CaseStudy_Final3_06.21.19-1.pdf.

Naka, M. (2020). COVID-19 Reveals How Micromobility Can Build Resilient Cities. Next City. Retrieved from: <https://nextcity.org/daily/entry/covid-19-reveals-how-micromobility-can-build-resilient-cities>.

Nasser, A., Brewer, J., Najm, W., and Cregger, J. (2018). Transit Bus Automation Project: Transferability of Automation Technologies. U.S. Department of Transportation Federal Transit Administration (FTA) Research, Report No. 0125. Retrieved from: <https://orfe.princeton.edu/~alaink/SmartDrivingCars/PDFs/transit-bus-automation-project-transferability-automation-technologies-final-report-fta-Oct2018.pdf>.

National Academies of Sciences, Engineering, and Medicine. (2012). Uses of Social Media in Public Transportation. Washington, DC: The National Academies Press. Retrieved from: <https://doi.org/10.17226/14666>.

National Academies of Sciences, Engineering, and Medicine. (2018). Legal Considerations in Relationships Between Transit Agencies and Ridesourcing Service Providers. Washington, DC: The National Academies Press. Retrieved from: <https://doi.org/10.17226/25109>.

National Academies of Sciences, Engineering, and Medicine. (2020a). Attracting, Retaining, and Advancing Women in Transit. Washington, DC: The National Academies Press. <https://doi.org/10.17226/25741>.

National Academies of Sciences, Engineering, and Medicine. (2020b). Business Models for Mobile Fare Apps. Washington, DC: The National Academies Press. <https://doi.org/10.17226/25798>.

National Academies of Sciences, Engineering, and Medicine. (2020c). Multimodal Fare Payment Integration. Washington, DC: The National Academies Press. <https://doi.org/10.17226/25734>.

National Association of City Transportation Officials (NACTO). (2017). Better Boarding, Better Buses: Streamlining Boarding & Fares. NACTO TransitCenter Practitioner's Paper #1. Retrieved from: https://nacto.org/wp-content/uploads/2017/02/NACTO_Better-Buses_Boarding.pdf.

National Center for Mobility Management (NCMM). (2020). Glossary of Key Terms. Retrieved from: <https://nationalcenterformobilitymanagement.org/ncmm-products/glossary-of-key-terms/>.

National Center for Mobility Management (NCMM). (2018). Mobility as a Service: Concept and Practice. Retrieved from: https://nationalcenterformobilitymanagement.org/wp-content/uploads/2018/03/2018_03_MaaS_Final.pdf.

National Center for Mobility Management (NCMM). (2020). What is Mobility Management? Retrieved from: <https://nationalcenterformobilitymanagement.org/ncmm-products/glossary-of-key-terms/>.

Open Mobility Foundation (OMF). (2019). About the Open Mobility Foundation: A Pioneering Partnership. Open Mobility Foundation Website. Retrieved from: <https://www.openmobilityfoundation.org/about/>.

Perk, V. and Antonov, V. (2019). Public Transit and Women's Safety – Real and Perceived Concerns: A Look at the U.S. and Florida. Center for Urban Transportation Research (CUTR).

Perry, M. (2018). Some of Florida's biggest counties

transitioning to electric buses. Florida Phoenix. Retrieved from: <https://www.floridaphoenix.com/blog/some-of-floridas-biggest-counties-transitioning-to-electric-buses/>.

Phelan, D. (2020). Coronavirus and Living Cash Free. How to Set Up Apple Pay, Express Transit & Other Phone Payments. Forbes. Retrieved from: <https://www.forbes.com/sites/davidphelan/2020/03/28/coronavirus-and-living-cash-free-how-to-set-up-apple-pay-express-transit--other-phone-payments/#2bfd0626cde7>.

Reeb, T. (2019). Webinar: Empowering the New Mobility Workforce. Center for International Trade and Transportation. Retrieved from: <https://its.ucdavis.edu/wp-content/uploads/Empowering-the-New-Mobility-Workforce.pdf>.

Roberts, A. (2019). Driving? The Kids Are So Over It. Wall Street Journal. Retrieved from: <https://www.wsj.com/articles/driving-the-kids-are-so-over-it-11555732810>.

Robertson, L. (2019). The waiting game at Miami bus stops could soon be a headache of the past. Miami Herald. Retrieved from: <https://www.miamiherald.com/news/local/community/miami-dade/article231326538.html>.

Runnerstrom, N. (2018). Micromobility 101: What Is It? Transit Screen. Retrieved from <http://blog.transitscreen.com/micromobility-101-what-is-it>.

Rust, S. (2020). Bicycles have enjoyed a boom during the pandemic. Will it last as car traffic resumes? Los Angeles Times. Retrieved from: <https://www.latimes.com/california/story/2020-06-25/bicycle-business-is-exploding-during-covid-19-will-it-last>.

Ryus, P., Danaher, A., Walker, M., Nichols, F., Carter, B., Ellis, E., Cherrington, L., & Bruzzone, A. (2013). Transit Capacity and Quality of Service Manual, 3rd ed. Retrieved from: http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_165ch-04.pdf.

Sadik-Khan, J. and Solomonow, S. (2020). Fear of Public Transit Got Ahead of the Evidence. The Atlantic. Retrieved from: <https://www.theatlantic.com/ideas/archive/2020/06/fear-transit-bad-cities/612979/>.

Schneider, E. (2020). Mayo Clinic using JTA

autonomous vehicles to transport COVID-19 tests. The Business Journals. Retrieved from: https://www.bizjournals.com/jacksonville/news/2020/04/02/mayo-clinic-using-jta-autonomous-vehicles-to.html?ana=e_ae_set1&j=90502630&t=Afternoon&mkt_UzRtRDJZQ1F0VVVOb3pDTmREZkxFWGFtSk9JMVIsIn0%3D.

Schorsch, P. (2017). Uber teams up with 5 Central Florida cities to offer discount fares. Florida Politics. Retrieved from: <https://floridapolitics.com/archives/243428-uber-teams-5-central-florida-cities-offer-discount-fares>.

Shaheen, S., Cohen, A., & Zohdy, I. (2016). Shared Mobility: Current Practices and Guiding Principles. Report No. FHWA-HOP-16-022, US Department of Transportation. Retrieved from www.ops.fhwa.dot.gov/publications/fhwahop16022/index.htm.

Shared-Use Mobility Center (SUMC). (2016). Shared Mobility and the Transformation of Public Transit. American Public Transportation Association (APTA) Research Analysis. Retrieved from: <https://www.apta.com/wp-content/uploads/Resources/resources/reportsandpublications/Documents/APTA-Shared-Mobility.pdf>.

Shared-Use Mobility Center. (2019). What is Shared-Use Mobility? Shared-Used Mobility Center. Retrieved from <https://sharedusemobilitycenter.org/what-is-shared-mobility-old/>.

Sheet Metal, Air, Rail and Transportation (SMART). (2019). Transportation Labor Announces Eight Key Policies to Promote Safety, Protect Transit Jobs in Era of Automation. Retrieved from: <https://smart-union.org/news/transportation-labor-announces-eight-key-policies-to-promote-safety-protect-transit-jobs-in-era-of-automation>.

Short, A. (2019). Are Uber and Lyft the Future of Transit? Not So Fast. StreetsBlog USA. Retrieved from: <https://usa.streetsblog.org/2019/07/22/is-on-demand-transit-the-future-not-so-fast/>.

SmartCitiesWorld. (2019). App-based ride service launches for Columbus community. SmartCitiesWorld. Retrieved from: <https://www.smartcitiesworld.net/news/news/app-based-ride-service-launches-for-columbus-community-4390>.

Smart Growth America. (2019). *Dangerous By Design*. National Complete Streets Coalition. Retrieved from <https://smartgrowthamerica.org/app/uploads/2019/01/Dangerous-by-Design-2019-FINAL.pdf>.

Smith, B. (2019). *TheRide: Improving Inclusion and Access for All*. Passenger Transport. Retrieved from: <https://www.theride.org/Portals/0/Images/5AboutUs/Initiatives/NewMobility/APTA%20Passenger%20Transport%20-%20TheRide%20Improving%20Inclusion%20and%20Access%20for%20All%2001-14-2019%20v3.pdf?ver=2019-02-28-112744-387>.

Smith, C. (2017). *A Canadian Town Wanted a Transit System. It Hired Uber*. The New York Times. Retrieved from: <https://www.nytimes.com/2017/05/16/world/canada/a-canadian-town-wanted-a-transit-system-it-hired-uber.html>.

Smyth, S. (2018). *Announcing Coord: The integration platform for mobility providers, navigation tools, and urban infrastructure*. Sidewalk Labs. Retrieved from: <https://www.sidewalklabs.com/blog/announcing-coord-the-integration-platform-for-mobility-providers-navigation-tools-and-urban-infrastructure/>.

Sohn, E. (2020) *Your daily commute won't ever be the same: Coronavirus will upend—but perhaps make healthier—the ways we use trains, buses, and bike lanes in our post-pandemic future*. National Geographic. Retrieved from: <https://www.nationalgeographic.com/science/2020/05/coronavirus-your-daily-commute-will-never-be-the-same-cvd/>.

Stanley, C. (2019). *For Struggling Legacy Transit Systems, New Mobility Options Present Challenges and Opportunities*. Forbes. Retrieved from: <https://www.forbes.com/sites/debtwire/2019/08/07/for-struggling-legacy-transit-systems-new-mobility-options-present-challenges-and-opportunities/#5298649638b9>.

Tawfik, A. (2020). *COVID-19 Transit Bus Air Circulation and Virus Mitigation Study*. Mineta Consortium for Transportation Mobility. Retrieved from: <https://transweb.sjsu.edu/mctm/research/utc/COVID-19-Transit-Bus-Air-Circulation-and-Virus-Mitigation-Study>.

Teale, C. (2020). *Lyft, Uber suspend pool services due to coronavirus fears*. Smart Cities Dive. Retrieved

from: <https://www.smartcitiesdive.com/news/uber-suspends-uberpool-coronavirus-fears-driver-paid-sick-leave/574308/>.

Thornton, R. (2020). *Capital Metro proposes incorporating Austin B-cycle as extension of public transit network*. The Austin Monitor. Retrieved from: <https://www.austinmonitor.com/stories/2020/05/capital-metro-proposes-incorporating-austin-b-cycle-as-extension-of-public-transit-network/>.

Transit. (2019). *One app to pay for all mobility in any city*. Medium. Retrieved from: <https://medium.com/transit-app/one-app-to-pay-for-all-mobility-in-any-city-f083608f3177>.

Transit. (2020). *Who's left riding public transit? Hint: it's not white people*. Medium. Retrieved from: <https://medium.com/transit-app/whos-left-riding-public-transit-hint-it-s-not-white-people-d43695b3974a>.

Transit Cooperative Research Program (TCRP). (N/A). *Metra Invests in a Sustainable Workforce with Targeted Training, Capacity-Building*. Transportation Research Board, Research in Action: A Case Study. Retrieved from: https://www.apta.com/wp-content/uploads/TCRP_images/Case_Studies/TCRP_Newsletter_Report162_v4b-002.pdf.

Transit Cooperative Research Program (TCRP). (2011). *Practices to Protect Bus Operators from Passenger Assault: A Synthesis of Transit Practice*. Transportation Research Board. Retrieved from: <https://www.cuttr.usf.edu/wp-content/uploads/2012/10/TCRP-Synthesis-93-Report.pdf>.

Transportation for America. (2020). *2.8 Million Essential Workers Use Transit to Get to Their Jobs*. Transportation for America. Retrieved from: <http://t4america.org/2020/03/27/2-8-million-essential-workers-use-transit-to-get-to-their-jobs/>.

Transportation Security Administration (TSA). (N/A). *Motorcoach Security – Best Practices*. TSA Office of Security Policy and Industry Engagement, Surface Division. Retrieved from: <https://www.fmcsa.dot.gov/sites/fmcsa.dot.gov/files/docs/TSA-Motorcoach-Best-Practices.pdf>.

U.S. Department of the Treasury. (2020). *The CARES Act Works for All Americans*. U.S. Department of the Treasury Policy Issues. Retrieved from: <https://home.treasury.gov/>

policy-issues/cares.

Veeder, C. (2019). Transforming Transit, Realizing Opportunity: How battery-electric buses can benefit the environment, the economy, and public transit. Jobs to Move America. Retrieved from: <https://jobstomoveamerica.org/resource/transforming-transit-realizing-opportunity/>.

Volpe National Transportation Systems Center (VNTSC). (2018). Low-Speed Automated Shuttles: State of the Practice. U.S. Department of Transportation. Retrieved from: https://rosap.nhtl.gov/view/dot/37060/dot_37060_DS1.pdf.

Wanek-Libman, M. (2020). Survey: North American commuters are switching habits as result of novel coronavirus. Mass Transit. Retrieved from: <https://www.masstransitmag.com/safety-security/article/21129378/survey-north-american-commuters-are-switching-commuting-habits-as-result-of-novel-coronavirus>.

Whitaker, B. (2017). The Case for Outcome-Based Procurement in Transit. Metro-Magazine. Retrieved from: <https://www.metro-magazine.com/blogpost/724230/the-case-for-outcome-based-procurement-in-transit>.

World Bank Group. (2020). What are Public Private Partnerships? World Bank Group Public-Private-Partnership Legal Resource Center. Retrieved from: <https://ppp.worldbank.org/public-private-partnership/overview/what-are-public-private-partnerships>.

Wright, S. (2020). Access Denied. American Planning Association Planning Magazine, March 2020. Retrieved from: <https://www.planning.org/planning/2020/mar/access-denied/>.

Wray, S. (2020). Bogotá expands bike lanes to curb coronavirus speed. Smart Cities World. Retrieved from: <https://www.smartcitiesworld.net/news/news/bogota-expands-bike-lanes-overnight-to-curb-coronavirus-spread-5127>.

WTVC. (2020). App aims to help Chattanoogaans with cognitive disabilities ride CARTA system independently. News 9 Channel. Retrieved from: <https://newschannel9.com/news/local/app-aims-to-help-chattanoogaans-with-cognitive-disabilities-ride-carta-system-independently>.

Zalewski, A., Byala, L., Weiland, J., Germano, R., Viggiano, C., Stein, N., Irvine, B., Blair, A., and Landau, S. (2019). Supporting Late-Shift Workers: Their Transportation Needs and the Economy. American Public Transportation Association (APTA). Retrieved from: https://www.apta.com/wp-content/uploads/APTA_Late-Shift_Report.pdf.