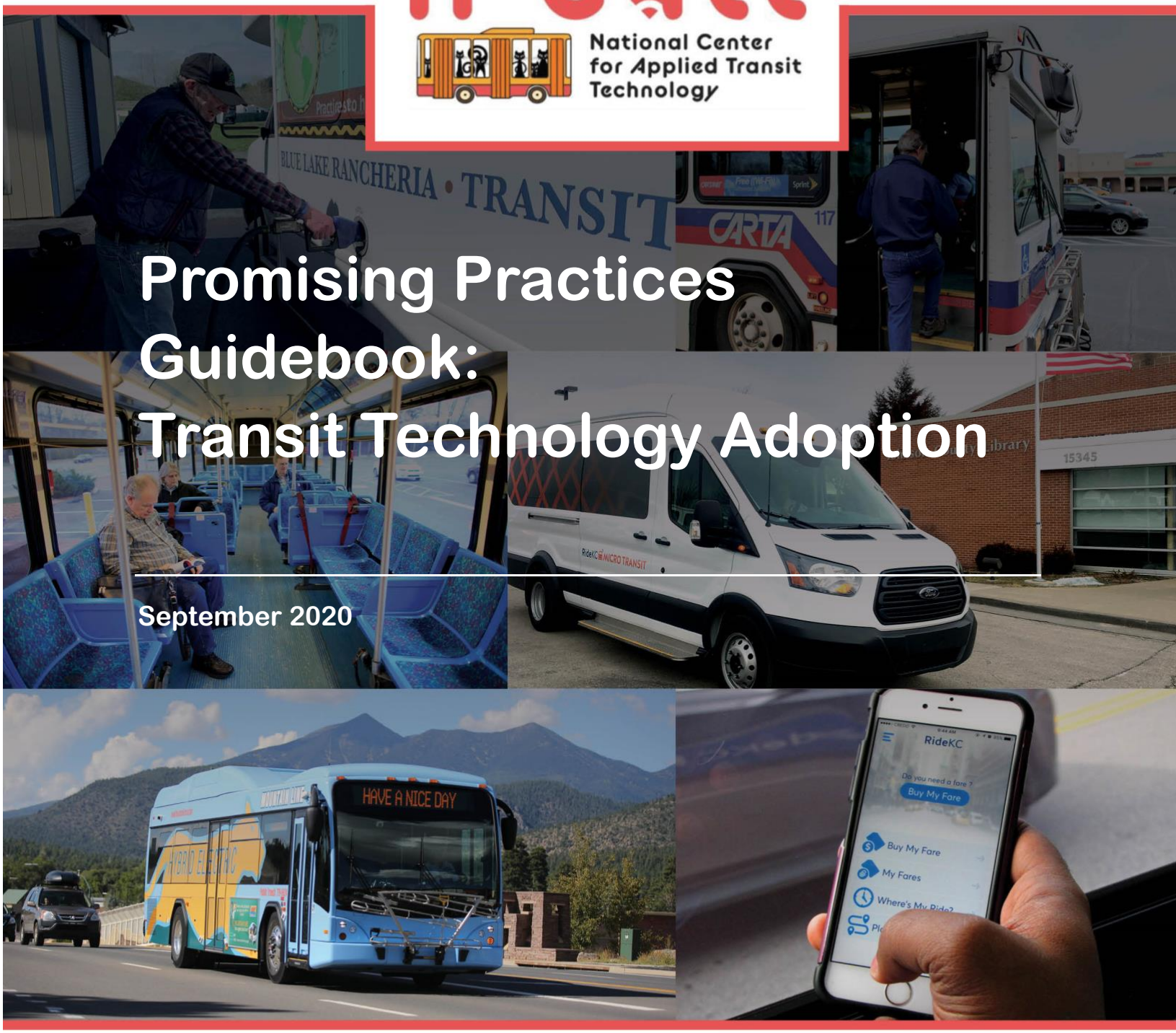
n-catt

National Center for Applied Transit Technology

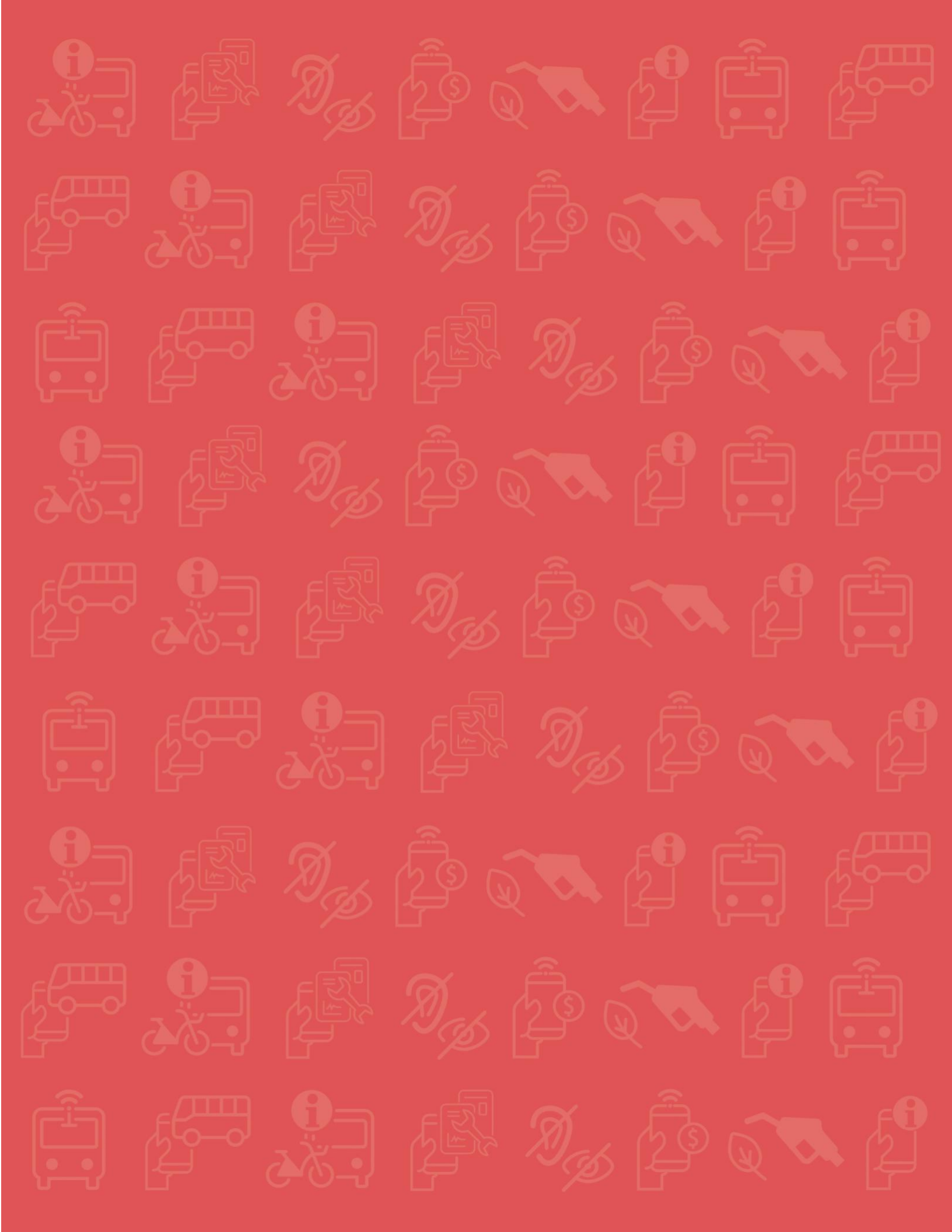


Promising Practices Guidebook: Transit Technology Adoption

September 2020

Prepared by:

FOURSQUARE ITP
INTEGRATED TRANSPORTATION PLANNING



Contents

Executive Summary

The National Center for Applied Transit Technology (N-CATT) is a technical assistance center with a mission to provide small-urban, rural, and tribal transit agencies with practical resources that help them apply technological solutions and innovations. In this setting, the Promising Practices Guidebook: Transit Technology Adoption is intended to be a resource to assist those transit agencies in understanding, selecting, and otherwise planning to incorporate new technology into service. The practices profiled in this Guidebook highlight an array of successful examples where technological approaches are used in creative and innovative ways, and thus show promise for successful adoption or replication among small-urban, rural, and tribal transit providers.

A 'Promising Practice' has worked within at least one organization and shows promise during its early stages for becoming a recommended practice with long-term sustainable impact.

Most practices profiled in this Guidebook are in place at one or more rural, small-urban or tribal transit systems. Nevertheless, many technology-based innovations in transportation have been largely restricted to large-urban systems or dense urban areas. This Guidebook seeks to assist in spreading the benefits of those innovations to smaller transit agencies that may lack the resources and capacities to research, analyze, and test new solutions that could enhance their services. Focusing on technology implementation, this Guidebook is a useful tool for educating system managers and helping them to encourage influential stakeholders to support needed technological advancements.

Promising Practice Identification

The identification and selection of promising practices followed a three-step process. The first step was a desk review to identify practices that may warrant inclusion in the Guidebook. Once a comprehensive list of practices was identified, indicators and a matrix were used to select the promising practices that would be profiled in this Guidebook. A set of eight indicators was used to evaluate each of the initially chosen practices to help determine the qualities that make a practice promising. These indicators were broad enough to assess a wide variety of practices. Once selected, the third and final step in the identification and selection process was to use a matrix to evaluate promising practices based on their performance for each one of the proposed indicators. The results of that analysis guided the selection of the promising practices profiled in this Guidebook.

Innovativeness	Replicability/ Scalability	Cost-Effectiveness	Customer Usability
Operational/ Organizational Efficiency	Impact on Performance Measures	Risk/Barriers	Lifecycle/ Sustainability

After collecting, organizing, and synthesizing available information for the selected practices, in-depth interviews with the staff leading these practices at agencies, organizations, or other partners were conducted to produce a profile of each promising practice. These interviews focused on how promising practices were developed, scaled, and evaluated, and to document lessons learned in the implementation process.

Common Themes Among Promising Practices

While the promising practices profiled in this Guidebook are varied in nature and the types of benefits accrued to transit providers, there were several common themes identified that helped to facilitate practice adoption. The common themes speak to agencies that are resourceful in seeking out not only new practices but in finding ways to fund and implement new practices that are cost-effective and practical for smaller agencies.

Partnerships

A number of the practices profiled were made possible via partnerships that contributed funding, staff hours, and expertise to bring a practice to fruition. Several of these partnerships engaged with organizations outside of the transportation industry.

Vendor Research and Engagement

Many of the practices profiled were the result of or benefited from extensive vendor research and engagement with vendors to communicate small and rural agency needs and constraints.

Stakeholder Involvement

Engagement from key external and internal stakeholders throughout the development and implementation of practice was also common among the practices profiled. Organizations representing key community stakeholders helped to shape the development of several of the promising practices implemented. Similarly, engagement with internal stakeholders helped create practices that met the needs and expectations of all involved internal divisions.

Planning

While all of the practices profiled resulted from careful planning, lessons learned shared by interviewees often related to additional elements of planning or implementation undertaken, or that would have been beneficial in response to the initial deployment.

Promising Practices

This Guidebook includes ten profiles, nine of which profile an individual agency's experience, while one is a composite profile featuring the experience of several agencies. Of the ten profiles, eight practice types were identified: accessibility, alternative fuels, asset management, passenger information, and general transit feed specification (GTFS)/GTFS-Flex, computer-aided dispatch and automatic vehicle location (CAD/AVL), fare payment, microtransit, and mobility hubs. Although these practice types are broad, the practice profiles detail specific examples that are noteworthy in their promise, and sometimes involve new use cases and/or integration of existing technologies.

Accessibility

CARTA's WayFinder SMART Travel System

CARTA, the Tennessee Department of Intellectual and Developmental Disabilities (DIDD), the City of Chattanooga, the non-profit Orange Grove Center, and AbleLink Smart Living Technologies, LLC, formed a public-private partnership to develop an application to help individuals with intellectual disabilities navigate public transit independently.

Michigan Mobility Challenge for Transit Providers to Improve Customer Service for the Visually- and Hearing-Impaired

After receiving a Michigan Mobility Challenge Grant, TheRide selected Feonix – Mobility Rising to develop the Connect app, which helps riders with visual and hearing impairments navigate public transit using What3Words.

Alternative Fuels

Blue Lake Rancheria Transit System Waste Oil to Fuel

Blue Lake Rancheria Transit System constructed a biodiesel conversion apparatus that takes waste cooking oil from the Tribe's hotel and casino kitchens and converts it into biodiesel. Locally-produced biodiesel has been in use by the system since 2015.

Clemson Area Transit - Electric Bus Fleet

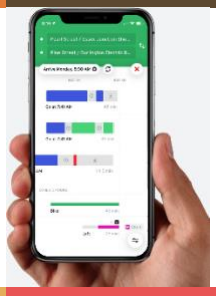
In 2014, CATbus started operating electric buses. By 2017, CATbus electric bus fleet represented half of its entire fleet and allowed for substantial operating savings.

Asset Management

Mountain Line – Asset Management Solution

Mountain Line uses an IoT-enabled Transit Asset Management (TAM) system, ThingTech, to improve the maintenance work order process by reducing manual data entry.

Passenger Information and GTFS Flex



Go Vermont! Trip Planner

In 2018, Go! Vermont launched a trip planner that incorporated both GTFS and GTFS Flex, allowing the trip planner to provide more options than private-sector counterparts. The GTFS Flex function is especially useful in the rural parts of the state, where fixed-route bus services are less common than demand-response services.

CAD/AVL

Portneuf's Smartphone CAD/AVL and Fare Collection System

Portneuf, Quebec, Canada uses an off-the-shelf mobile-phone and tablet-based software to facilitate dispatching, vehicle location and to provide passengers with real-time in formation on vehicle location. The same software suite facilitates on-board fare payment with smartcards.

Fare Payment

Mobile Fare Payment

Transit agencies can choose from a wide variety of fare payment and validation methods, business models, and companies to implement mobile fare payment systems. With mobile fares, riders download the app from a mobile app store, enter payment information or link the app with an existing transit account, board the vehicle, and validate their fares.

Microtransit

Johnson County, Kan. Flex Service Pilot

In 2019, Johnson County, Kansas, located in the Kansas City metropolitan area, implemented a demand-response service to connect residents to fixed-route transit. The service experienced rapid growth, followed by a need to rapidly modify operations in response to COVID-19 in 2020.

Mobility Hubs

City of Minneapolis Mobility Hubs

The Minneapolis Mobility Hubs Pilot increases access to convenient, low, or no carbon transportation options by creating centers where riders can transfer between these modes easily. Implemented in September of 2019, the original pilot covered 12 locations marked by specially designed wayfinding signs in North, Northeast, and South Minneapolis. Mobility hubs include seating, bikeshare docks, transit stops (often on high-frequency routes), and designated parking locations for dockless shared bikes and scooters.

Introduction

The National Center for Applied Transit Technology (N-CATT) is a technical assistance center with a mission to provide small-urban, rural, and tribal transit agencies with practical resources that help them apply technological solutions and innovations. In this setting, the Promising Practices Guidebook: Transit Technology Adoption is intended to be a resource to assist those transit agencies in understanding, selecting, and otherwise planning to incorporate new technology into service. The practices profiled in this Guidebook highlight an array of successful examples where technological approaches are used creative and innovatively that show promise for successful adoption or replication among small-urban, rural, and tribal transit providers.

A 'Promising Practice' has worked within at least one organization and shows promise during its early stages for becoming a recommended practice with long-term sustainable impact.

Most practices profiled in this Guidebook are in place at one or more rural, small-urban or tribal transit systems. Nevertheless, many technology-based innovations in transportation have been largely restricted to large-urban systems or dense urban areas. This Guidebook seeks to assist in spreading the benefits of those innovations to smaller transit agencies that may lack the resources and capacities to research, analyze, and test new solutions that could enhance their services. Focusing on technology implementation, this Guidebook is a useful tool for educating system managers and helping them to encourage influential stakeholders to support needed technological advancements.

Ten promising practices are profiled in this Guidebook, highlighting the context around the practice adoption, the needed resources, and the results lessons learned. A successful technology implementation may require establishing partnerships, building consensus among stakeholders, or cultivating support for innovation. Transportation providers also face barriers in harnessing the benefits of technology-based innovations such as the vast nature of many of the agencies' service areas, the cost of deploying systems, and limited staff, to name a few. The experiences organized in this Guidebook aim to help other providers to learn from them and set them one step ahead when it comes to successfully implementing similar practices.

About N-CATT

The National Center for Applied Transit Technology (N-CATT) is a technical assistance center funded through a cooperative agreement with the United States Department of Transportation's Federal Transit Administration (FTA). Operated by the Community Transportation Association of America (CTAA), the mission of N-CATT is to provide small-urban, rural and tribal transit agencies with practical, replicable resources that help them apply technological solutions and innovations. Among its activities, N-CATT produces a series of white papers, technical reports such as this document, and other resources, all of which can be accessed on-line at https://n-catt.org.

About this Document

This document was prepared for CTAA by Foursquare ITP in September 2020 as part of the N-CATT cooperative agreement between CTAA and FTA. Primary authors were Shana Johnson, Reinaldo Germano, Sofie Rhoads, Sanford Klanfer and Laura Culp of Foursquare ITP. Opinions expressed or implied in this document are those of the authors. Nothing in this document is to be interpreted as position, policy or guidance from the United States Government. Incidental use of companies' names or the names of their products is made solely to facilitate discussion and should not be regarded as recommendations or endorsements.

Methodology for Identifying and Profiling Promising Practices

The identification and selection of promising practices followed a three-step process. The first step was a desk review to identify practices that may warrant inclusion in the Guidebook. This review included recent Transit Cooperative Research Program (TCRP) reports, a review of Federal Transit Administration (FTA) Mobility On Demand grant awards, information on the Institute of Transportation Engineers and Intelligent Transportation Systems America websites, and resources from the Shared-Use Mobility Center, the National Center for Mobility Management, the Rural Health Information Hub, National Rural Transit Assistance Program, and Transport Research International Documentation. An initial list of practices was identified, some already in place in rural, small-urban, or tribal transit agencies, others that show potential to be adopted in these operating contexts.

Once a comprehensive list of practices was identified, indicators and a matrix were used to select the promising practices that would be profiled in this Guidebook. A set of eight indicators was used to evaluate each of the initially chosen practices to help determine the qualities that make a practice promising. These indicators were broad enough to assess a wide variety of practices and are shown in **Figure 1**. The third and final step in the identification and selection process was to use a matrix to evaluate promising practices based on their performance for each one of the proposed indicators. The results of that analysis guided the selection of the promising practices profiled in this Guidebook.

Figure 1: Set of Indicators of "Promising Practices"

After collecting, organizing, and synthesizing available information, in-depth interviews with the staff leading these practices at agencies, organizations, or other partners were conducted to produce a profile of each promising practice (a complete list of interviewees can be found at the end of this document). The goal of the profiles is to describe how promising practices were developed, scaled, and evaluated, and to document lessons learned in the implementation process.

Types of Promising Practices Profiled

This Guidebook includes ten profiles, nine of which profile an individual agency's experience, while one is a composite profile featuring the experience of several agencies. Of the ten profiles, eight practice types were identified: accessibility, alternative fuels, asset management, passenger information and general transit feed specification (GTFS)/GTFS-Flex, computer-aided dispatch and automatic vehicle location (CAD/AVL), fare payment, microtransit, and mobility hubs. Although these practice types are broad, the practice profiles detail specific examples that are noteworthy in their promise, and sometimes involve new use cases and/or integration of existing technologies.

Accessibility

Accessible transit options impact many groups of riders, each with their own unique needs that may necessitate different types of accommodations, and the transit industry can harness technology to improve access, ease of use, and inclusion for these populations. The Americans with Disabilities Act (ADA) defines disability as a "physical or mental impairment that substantially limits one or more major life activities of such individual; a record of such an impairment; or being regarded as having such an impairment." Just over 40 million Americans have a disability, and Census projections indicate an aging American populace in the coming decades.[1] In addition to the disabled and aged communities, veterans with disabilities are another key population that can benefit from improvements in transit accessibility.

There are far-reaching technology solutions to maintain and improve transit accessibility that find support at the federal level. At the United States Department of Transportation (USDOT) Access and Mobility for All Summit in 2019, the Secretary of Transportation announced initiatives to help improve access for people with disabilities (**Table 1**).[2] USDOT is also researching to improve mobility options for all travelers through its collaboration with FHWA, Accessible Transportation Technologies Research Initiative (ATTRI).[3] The six-year program focuses on smart wayfinding and navigation systems, pre-trip concierge and virtualization, robotics and automation, and safe intersection crossings and endeavors to understand the travel needs and barriers of disabled, veteran, and aged populations.[4]

---

[1] U.S. Department of Commerce. U.S. Census Bureau. 2018 5-year American Community Survey estimates, Table S1810: Disability Characteristics; U.S. Department of Commerce. U.S. Census Bureau. Demographic Turning Points for the United States: Population Projections for 2020 to 2060, available at: https://www.census.gov/content/dam/Census/library/publications/2020/demo/p25-1144.pdf, as of August 5, 2020.
[2] U.S. Department of Transportation. Accessibility, available at: https://www.transportation.gov/accessibility, as of August 5, 2020.
[3] U.S. Department of Transportation. Intelligent Transportation Systems Joint Programs Office. Accessible Transportation Technologies Research Initiative (ATTRI), available at: https://www.its.dot.gov/research_archives/attri/index.htm, as of August 5, 2020.
[4] U.S. Department of Transportation. Intelligent Transportation Systems Joint Programs Office. Accessible Transportation Technologies Research Initiative (ATTRI): Factsheets, available at: https://www.its.dot.gov/factsheets/pdf/JPO_ATTRI.pdf, as of August 5, 2020; U.S. Department of Transportation. Intelligent Transportation Systems Joint Programs Office, Accessible Transportation Technologies Research Initiative (ATTRI): User Needs Assessment: Stakeholder Engagement Report Final Report, May 2016, accessible at: https://rosap.ntl.bts.gov/view/dot/31320, as of August 5, 2020.

Table 1: Selected Technology and Innovation Funding

Name	Amount	Summary
Complete Trip – ITS4US Deployment Program	Up to $40 million	Showcases "innovative business partnerships, technologies, and practices that promote independent mobility for all. "Complete Trip" means that a user can get from point A to point B seamlessly, regardless of the number of modes, transfers, and connections."
Inclusive Design Challenge	$5 million	"Cash prizes available to innovators who design solutions that can enable people with physical, sensory, and cognitive disabilities to use AVs to access jobs, healthcare, and other critical destinations."
FY2020 Mobility for All Pilot Program	$3.5 million	"Seeks to improve mobility options and access to community services for older adults, individuals with disabilities, and people with low incomes. The $3.5 million initiative will fund projects that enhance transportation connections to jobs, education, and health services."

At the local level, some agencies are experimenting with partnerships with transportation network companies (TNCs) to provide paratransit services at a lower cost, using a third-party software to improve paratransit booking and routing services, or starting on-demand paratransit services that don't require advanced booking. Programs that improve access by using apps must comply with Section 508 of the Rehabilitation Act, to ensure IT accessibility, and to comply with health information privacy requirements associated with the Health Insurance Portability and Accountability Act to ensure patient privacy. Innovation in-vehicle technologies, such as independent wheelchair securement or wheelchair charging on buses, are other ways technology is improving accessibility.[5]

Accessibility Practices Profiled

CARTA's WayFinder SMARTA Travel System

- Agency: Chattanooga Area Regional Transportation Authority's (CARTA)
- Location: Chattanooga, Tennessee
- Context: Large urban

CARTA serves the City of Chattanooga, Hamilton County, TN, and the surrounding areas with fixed-route bus service, paratransit service, a downtown electric shuttle system, and operates the Lookout Mountain Incline Railway. CARTA, the Tennessee Department of Intellectual and Developmental Disabilities (DIDD), the City of Chattanooga, the non-profit Orange Grove Center, and AbleLink Smart Living Technologies, LLC, formed a public-private partnership to help individuals with intellectual disabilities navigate public transit independently.

Michigan Mobility Challenge for Transit Providers to Improve Customer Service for the Visually- and Hearing-Impaired

- Agencies: Ann Arbor Area Transportation Authority (TheRide); Detroit Department of Transportation; Suburban Mobility Authority for Regional Transportation (SMART)
- Location: United States
- Context: Large urban

TheRide serves the greater Ann Arbor-Ypsilanti region with fixed-route bus service, shared-ride accessible service, vanpools, and express buses. After receiving a Michigan Mobility Challenge Grant, TheRide

[5] Transportation Research Board. Transit Cooperative Research Program (TCRP) Synthesis 50: Use of Rear-Facing Position for Common Wheelchairs on Transit Buses, available at: http://www.trb.org/Publications/Blurbs/153576.aspx, as of August 5, 2020; National Rural Transit Assistance Program. Best Practices Spotlight Article: Wheelchair Charging at Transit Stations and on the Bus, available at: https://nationalrtap.org/News/Best-Practices-Spotlight/Archive-Wheelchair-Charging, as of August 5, 2020.

selected Feonix – Mobility Rising to develop the Connect app, which helps riders with visual and hearing impairments navigate public transit using What3Words.

Alternative Fuels

Most traditional buses operate on diesel fuel, which is burned in a combustion engine. Carbon dioxide emission from transportation is a major contributor to global climate change – approximately 28 percent of all of the United States' carbon emissions come from transportation.[6] Additional issues with diesel fuel include high cost, low energy efficiency, and limited supply. In response to these challenges, interest in alternative fuel options such as electricity, biofuel, hydrogen, and natural gas has risen in recent years. Transit agency adoption of two promising alternative fuel types, electricity and biofuel, are profiled in this Guidebook. For a closer look at particular promising alternative fuels and energy strategies, please visit the N-CATT website, https://n-catt.org.

Although electric buses may look very similar to a traditional bus from the outside, they operate differently. An electric bus contains a battery that is charged before the bus begins its route. Fully charging a battery takes several hours, even with the most high-powered electric chargers. The most efficient electric buses currently on the market have a maximum range of between 150 and 300 miles on a single charge.[7,8,9,10] **Table 2** compares electric buses across several metrics to traditional diesel buses and biodiesel buses. Fuel cost saving is one of the major attractors that drive agencies to adopt electric buses – it is less than half the cost to power an electric bus compared to a traditional diesel bus. Electric buses also require less maintenance due to less moving parts and do not emit tailpipe smog, which improves air quality.

Table 2: Performance Comparison Across Alternative Fuel Vehicles

	Traditional Diesel Bus	Electric Bus	Biodiesel Bus (B20)
Energy Efficiency	3.8 miles per gallon (MPG)	16.5 miles per gallon equivalent (MPGe)	3.8 miles per gallon (MPG)
Fuel Cost*	$2.61 per gasoline gallon equivalent	$1.24 per gasoline gallon equivalent	$2.36 per gasoline gallon equivalent
Environmental Impact	22.38 pounds of carbon dioxide are emitted per gallon of diesel *Additional emissions include particulate matter and nitrous oxide (NOX)*	40% of the total emissions compared to diesel	Reduced carbon dioxide emissions by 15% compared to pure diesel *Comes from a renewable source (organic material such as plants)*

*Based on average fuel costs for April of 2020.[11]

[6] U.S. Environmental Protection Agency. Greenhouse Gas Emissions, available at: https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions#:~:text=The%20primary%20sources%20of%20greenhouse,share%20of%20greenhouse%20gas%20emissions., as of Augsut 5, 2020.
[7] BYD. BYD 35' Eletric Transit Bus, available at: https://en.byd.com/bus/35-electric-transit-bus/, as of August 21, 2020.
[8] Proterra. Catalyst Electric Bus, available at: https://www.proterra.com/vehicles/catalyst-electric-bus/, as of August 5, 2020.
[9] Volvo. New Volvo 7900 Electric offers greater range and flexibility, available at: https://www.volvogroup.com/en-en/news/2017/oct/new-volvo-7900-electric-offers-greater-range.html, as of August 21, 2020.
[10] Mercedes Benz. Mercedes-Benz Citaro with all-electric drive system, available at: https://media.daimler.com/marsMediaSite/en/instance/ko/Mercedes-Benz-Citaro-with-all-electric-drive-system-Locally-emission-free-and-almost-silent-through-the-city.xhtml?oid=33859393, as of August 21, 2020.
[11] U.S. Department of Energy. Alternative Fuels Data Center. Alternative Fuel Price Report, available at: https://afdc.energy.gov/fuels/prices.html, as of August 5, 2020.

Biodiesel is a fuel source that is made from organic matter, typically cooking oil, soybean oil, or animal fat. In general, the biodiesel used in vehicles is a biodiesel blend that contains both the biofuel component and petro-diesel. The most common mixings of biodiesel are B5 and B20, which includes five and 20 percent biofuel, respectively; the remaining fuel in the mixture is petro-diesel. Retrofitting of diesel buses to operate on B20 biodiesel is typically unnecessary. Retrofitting is only necessary if the vehicle is to run on a higher biofuel concentrate such as B100, which is pure biodiesel.

Biodiesel can come from a variety of sources. Commercially produced B5 and B20 biodiesel typically come from soybeans or similarly abundant cash crops. Biodiesel can also be created from waste oil or grease from a commercial kitchen, although this requires cleaning and refining prior to use. B20 biodiesel has nearly the same energy efficiency as traditional diesel fuel but reduces carbon dioxide emissions by about 15 percent. One major limitation with biodiesel is that frigid temperatures can cause fat and oil in the fuel to coagulate, which may obstruct the use of fuel in a vehicle engine.

Alternative Fuels Practices Profiled

Blue Lake Rancheria Transit System Waste Oil to Fuel

- Agency: Blue Lake Rancheria Transit System
- Location: Humboldt County, California
- Context: Federally-recognized Tribe

Blue Lake Rancheria Tribe operates the Blue Lake Rancheria Transit System (BLRTS), which provides a deviated fixed-route bus service in the Mad River Valley Region. In 2014, the Tribe began construction of a biodiesel conversion apparatus that takes waste cooking oil from the Tribe's hotel and casino kitchens and converts it into biodiesel. The Tribe began powering their buses using the biodiesel by 2015.

Clemson Area Transit - Electric Bus Fleet

- Agency Name: Clemson Area Transit (CATbus)
- Location: Seneca, South Carolina
- Context: Small urban

Clemson Area Transit (CATbus) was founded in 1996 and serves the towns of Clemson, Central, Pendleton, and Seneca in northwest South Carolina. CATbus is the largest fare-free bus service in the Carolinas, serving around 2 million passengers per year. In 2017, with the addition of 10 Proterra buses to its electric fleet, CATbus' electric fleet accounted for 50 percent of its total bus fleet.

Asset Management

Public transportation agencies are using asset management software solutions to optimize repair and maintenance operations, aid prioritization of repairs, allow inspectors to input findings through a mobile application, and provide open-source one-stop-shops with a suite of solutions.[12] Emerging Internet-of-Things (IOT) solutions incorporate the use of sensors and predictive analytics to identify assets in need of maintenance and repair and help agencies to prioritize asset management work.[13] At an organizational level, these tools provide large amounts of data that can be

[12] Documoto. LA Metro Implements Integrated Service Solution to Drive Maintenance Efficiency, available at: https://documoto.com/resources/la-metro-case-study/, as of August 5, 2020; BEM Systems. Asset Management, available at: https://bemsys.com/assetmanagement/, as of Augsut 5, 2020; Cambridge Systematics. Asset Performance Management Platform, available at: http://camsys.software/assets/downloads/transam_cs-product-sheet_mar2020.pdf, as of August 5, 2020.

[13] ThingTech. Moving Beyond Transit Asset Management by Leveraging IoT, available at: https://thingtech.com/2019/11/moving-beyond-transit-asset-management-by-leveraging-iot/, as of August 5, 2020.

used across departments at an agency, facilitate data-driven decision-making, and help agencies communicate the status of their assets and their funding needs.

Asset management solutions can help agencies with their Federal Transit Administration (FTA) reporting requirements. In July 2016, the FTA published the Transit Asset Management (TAM) Final Rule.[14] The TAM rule, which applies to "all recipients of Chapter 53 funds that either own, operate, or manage capital assets used in providing public transportation services," requires agencies to develop TAM plans (TAMPs) and report asset conditions to the National Transit Database (NTD).[15] The TAMPs include an inventory of capital assets, including facilities, equipment, rolling stock, and infrastructure, and details how an agency will ensure that its assets will maintain or achieve a "State of Good Repair" (SGR). A recent American Public Transportation Association report provided an overview of asset management software and guidelines for how to select the appropriate solution.[16]

Asset Management Practice Profiled

Mountain Line – Asset Management Solution

- Agency Name: Mountain Line
- Location: Flagstaff, Arizona
- Context: Small urban

Mountain Line serves Flagstaff, Arizona, with fixed-route bus service, paratransit, seasonal service, and coordinates shuttle service with Northern Arizona University to move over 2.5 million riders a year (FY 2019). The system includes 78 bus shelters, ten of which are shared with Northern Arizona University, as well as two connection centers and one maintenance shop. Mountain Line uses an IoT-enabled Transit Asset Management (TAM) system, ThingTech, to improve the maintenance work order process by reducing manual data entry.

Passenger Information and General Transit Feed Specification (GTFS)/GTFS-Flex

Passenger information allows travelers to know not only what transportation services are available near them, but also when, where, and how they can access these services. Today, riders are often looking for passenger information via a number of devices, including computers, mobile devices (using a variety of agency-created and third-party apps), and passenger information screens at bus shelters or transit stations, in addition to traditional bus schedules. General Transit Feed Specification (GTFS) is used as a standard format for making trip planning accessible for public use on interactive web-based applications as well as through third-party websites or mobile applications. Transit information providers rely on GTFS to obtain scheduled trip times and routes, and in instances where real-time vehicle location is made available, they can also provide passengers with real-time information on vehicle location and predicted arrival times. When agencies provide real-time passenger information, uncertainty around wait times is reduced, and people are more likely to choose transit for a given trip. Although most urban and many rural fixed-route transit services use GTFS to make their schedule and route information public,

[14] Federal Register. Transit Asset Management; National Transit Database, A Rule by the Federal Transit Administration on 07/26/2016, available at: https://www.federalregister.gov/documents/2016/07/26/2016-16883/transit-asset-management-national-transit-database, as of August 5, 2020.
[15] U.S. Department of Transportation. Federal Transit Administration. Transit Asset Management: Top 12 Frequently Asked Questions, available at: https://www.transit.dot.gov/TAM/gettingstarted/htmlFAQs, as of August 5, 2020.
[16] American Public Transportation Association. Standards Development Program Recommended Practice: Procuring Software to Support Transit Asset Management, available at: https://www.apta.com/wp-content/uploads/APTA-SUDS-TAM-RP-008-20.pdf, as of August 5, 2020.

GTFS use is now expanding to capture multi-modal and demand-response services as well. For a closer look at GTFS and GTFS Flex, please visit the N-CATT website, https://n-catt.org.

For many rural, small town, and tribal transit providers, which tend to rely heavily on demand-response or other flexible services, GTFS became a much more useful option with the rollout of GTFS-Flex. Before the introduction of GTFS-Flex, GTFS was only useful for fixed-route services that operate on a regular schedule with trips starting and ending at bus stops. GTFS-Flex adapts standard GTFS to account for a variety of flexible services, including demand-response services, deviated fixed-route services, and fixed-route services with flag stops. GTFS-Flex will enable more transit agencies to offer trip planning and transit service information solutions to their riders.[17]

Passenger Information and General Transit Feed Specification (GTFS)/GTFS-Flex Practice Profiled

Go Vermont! Trip Planner

- Agency Name: Vermont Agency of Transportation (VTrans)
- Location: Vermont
- Context: Rural

In 2018, Go! Vermont launched a trip planner that incorporated both GTFS and GTFS Flex, allowing the trip planner to provide more options than private-sector counterparts. The GTFS Flex function is especially useful in the rural parts of the state, where fixed-route bus services are less common than demand-response services.

Computer-Aided Dispatch and Automatic Vehicle Location (CAD/AVL)

CAD/AVL systems connect vehicles to scheduling and dispatching software. These systems collect crucial data used by dispatchers to keep bus drivers on-schedule and communicate breakdowns and emergencies from the field to office staff. AVL also provides bus global position system (GPS) locations that can feed into real-time passenger information applications.

Traditionally these CAD/AVL systems were limited to large agencies that could afford complex, bundled CAD/AVL solutions. However, innovations that reduce the need for capital investments are emerging[18] that are helping to expand their use outside of their more traditional urban contexts. Vehicles equipped with off-the-shelf GPS hardware, such as smartphones or tablets and Software as a Service (SaaS) business models are among these innovations. These new technologies are allowing smaller agencies to take operation advantages of a CAD/AVL and real-time passenger information (RTPI) systems that are cheaper and more adaptable.

Computer-Aided Dispatch and Automatic Vehicle Location (CAD/AVL) Practice Profiled

Portneuf's Smartphone CAD/AVL and Fare Collection System

- Agency Name: Corporation de Transport Régional de Portneuf (CTRP)
- Location: Portneuf Regional County Municipality, Canada
- Context: Small urban, rural

---

[17] Trip Planning Tools for Flexible Transit Services TRB International Conference on Demand Responsive and Innovative Transportation Services. Trip Planning Tools for Flexible Transit Services, Presentation by Paul Sorensen, Cambridge Systematics, April 15, 2019, available at: http://onlinepubs.trb.org/onlinepubs/Conferences/2019/DRT/PaulSorensen.pdf, as of August 5, 2020.

[18] World Resources Institute. Real-Time Transit Data Is Good for People and Cities. What's Holding This Technology Back, available at: https://thecityfix.com/blog/real-time-transit-data-good-people-cities-holding-technology-back-diego-canales/, as of August 5, 2020.

CTRP provides public transportation in the municipalities of the Portneuf Regional County Municipality, a region with a population slightly above 50,000, in Quebec, Canada. CTRP operates two commuter routes to Quebec City, deviated fixed-route service within the Portneuf Regional County Municipality and to Quebec City for older adults, and paratransit service. Advanced reservations via phone are required for the deviated fixed-route and paratransit services, and trip payment can be made with cash or smartcards. For the commuter service, riders can choose to purchase monthly passes online or at over 20 physical stores in 16 cities in the region.

Fare Payment

The use of mobile fare payment apps has grown in the last several years. Transit agencies can choose from a wide variety of payment and validation methods, business models, and companies to implement mobile fare payment systems. With mobile fares, riders download the app from a mobile app store, enter payment information or link the app with an existing transit account, board the vehicle, and validate their fares. Mobile fare payment can improve rider satisfaction since it helps reduce waiting times for ticket purchases, doesn't require riders to carry cash for on-board payment, and is often integrated with real-time location information and trip planning tools.

From a transit agency perspective, wide-scale mobile fare payment use has potential operational and administrative cost benefits. These include reduced driver burdens for cash payments or fare validation and reduced dwell times by eliminating on-board fare payment. Agencies can also select from a few validation methods, such as mobile tickets that can be displayed on a smartphone screen and validated by drivers, or barcodes or Quick Response (QR) codes that riders scan on their own but may require upgraded fareboxes or new scanning devices. Given the number of products and companies offering mobile fare payment systems, agencies can select a system that matches their needs and can scale it accordingly, often with few initial costs.

Mobile Fare Payment Practices Profiled

Mobile Fare Payment Technologies

- Agency/Company Name: Numerous agencies and providers in North America
- Location: North America
- Context: Rural, Small urban, and Large urban

Microtransit

Microtransit is a technology-enabled demand-response service that provides on-demand access to transit via requests from mobile applications, as well as via phone or internet trip requests. Like other types of demand-response service, microtransit is typically operated with smaller vehicles (e.g., cutaways, minivans). However, specialized microtransit software is used to dynamically generate routes that respond to rider requests in real-time with wait times measured in minutes from trip requests. Operational models can include services operated by public agencies, services operated in whole or in part by private vendors, as well as fully private microtransit operations. Microtransit may operate within specific zones and serve any location within a zone, or operate from specific points (e.g., bus stops or transit stations) at one or both ends of a trip. Another hallmark of microtransit service is that it allows for electronic payment (typically via a mobile application) and provides real-time information to passengers on vehicle location and wait times.[19]

Transit agencies across the country, in rural, suburban, and urban communities, have implemented microtransit services to serve a variety of purposes. Microtransit has been used to enhance coverage and

[19] Shared Use Mobility Center. Learning Module, Microtransit, available at: https://learn.sharedusemobilitycenter.org/learning_module/microtransit/, as of August 6, 2020.

service quality in lower-density areas where transit demand is deemed too low to support fixed-route services, it has been used to facilitate access to transit (i.e., connecting areas otherwise unserved by transit to bus stops or train stations to enable access to a transit system), and as an alternative service model in lieu of fixed-route or other types of demand response service on a broad scale (i.e., full or large scale replacement of existing services with microtransit.)[20]

Microtransit Practice Profiled

Johnson County, Kan. Flex Service Pilot

- Agency Name: Johnson County, Kansas
- Location: Metro Kansas City, KS
- Context: Large urban

In 2019, Johnson County, Kansas, located in the Kansas City metropolitan area, implemented a demand-response service to connect residents to fixed-route transit. The service quickly grew, with the number of vehicles needed to provide the service more than doubling in the space of a few months, spurring ridership growth on the county's fixed-route services as well. In 2020, Johnson County has simultaneously had to work to ensure that the program continues to meet demand, while also navigating the constraints of COVID-19 related capacity and budget issues.

Mobility Hubs

As micromobility options such as shared bicycles and scooters have grown in popularity over the past decade, governments and transit agencies have increasingly seen the need to integrate them into broader transportation networks, improving mobility by making it easier to use these options as a first or last-mile connection to other modes of transportation. Mobility Hubs have emerged as a potential solution to this problem, creating "focal points" that not only maximize connectivity between modes but can also serve a placemaking function, turning an ordinary intersection into a community gathering place.[21]

Mobility Hubs are designed to make the most of emerging technologies, taking advantage of the growth in micromobility to expand the reach of traditional transit services. For smaller transit providers, Mobility Hubs may help make the most of limited resources. Additionally, Mobility Hubs can also improve access to social services and commerce for vulnerable communities, with many governments looking at Mobility Hubs as a community gathering spot at which resources can be distributed.[22]

Mobility Hubs Practice Profiled

Minneapolis Mobility Hubs Pilot

- Agency: City of Minneapolis
- Location: Minneapolis, Minnesota
- Context: Large urban

The Minneapolis Mobility Hubs Pilot increases access to convenient, low or no carbon transportation options by creating centers where riders can transfer between these modes easily. Implemented in September of 2019, the original pilot covered 12 locations marked by specially designed wayfinding signs

---

[20] Transportation Research Board. Transportation Research Board. Transit Cooperative Research Program (TCRP) Project H-56: Redesigning Public Transportation Networks for a New Mobility Future. Forthcoming.
[21] Los Angeles Department of City Planning, Urban Design Studio. Mobility Hubs: A Readers Guide, available at: http://www.urbandesignla.com/resources/docs/MobilityHubsReadersGuide/lo/MobilityHubsReadersGuide.pdf, as of August 5, 2020.
[22] Transit Forward Rhode Island. Transit Master Plan, Mobility Hubs: https://transitforwardri.com/pdf/Strategy%20Paper%2018%20Mobility%20Hubs.pdf, as of August 5, 2020.

in North, Northeast, and South Minneapolis. Mobility hubs include seating, bikeshare docks, transit stops (often on high-frequency routes), and designated parking locations for dockless shared bikes and scooters. In this year's pilot, the City expanded the number of locations in their Mobility Hub program and is now pivoting hub usage to respond to the new needs of the community due to COVID-19 and civil unrest. The City will be working with local community partners to identify the evolving needs of the low-income neighborhoods disproportionately impacted and use the Hubs as a neighborhood level distribution point.

Promising Practices Profiles

CARTA's WayFinder SMART Travel System

PROMISING PRACTICE: A CUSTOMIZABLE APP WITH VISUAL CUES AND RECORDED AUDIO DIRECTIONS TO HELP INDIVIDUALS WITH INTELLECTUAL DISABILITIES TRAVEL

Riders participating in this pilot project use a tablet equipped with vendor AbleLink's WayFinder to navigate fixed-route service. WayFinder is a customized navigation system that can be programmed with individual routes. Riders are guided from their origin to their destination with visual cues and recorded audio directions. The Tennessee Department of Intellectual and Developmental Disabilities (DIDD) funds the project through its Enabling Technology program, which helps individuals with disabilities to be as independent as possible with the use of new technologies.

Context

AbleLink worked with DIDD to identify potential test sites for their WayFinder technology in Tennessee and settled on Chattanooga's Orange Grove Center, which is in CARTA's service area. Some individuals with developmental and cognitive disabilities that are enrolled in adult programs at the Orange Grove Center have jobs throughout the Chattanooga area. Although many of these individuals rely on CARTA's paratransit or their families for transportation to and from their job sites, WayFinder and CARTA can help individuals travel independently. Independent travel has multiple benefits: independence for the individual; decreased responsibility on behalf of family members to meet transportation needs; and shifting the agency's riders from paratransit services to more cost-effective fixed-route service, which could decrease operating costs.

> The Orange Grove Center has worked with individuals with intellectual or developmental disabilities since 1953. TN DIDD worked with the Center and its clients to test WayFinder.

Alana Shores is CARTA's travel trainer, and her main responsibility is to teach people how to use public transportation. In this pilot project, she is responsible for setting up rider routes in WayFinder and training riders to use the application. To perform the setup, Ms. Shores needed to ride the bus just like a WayFinder user would; create GPS waypoints along the route; take pictures to make visual cues; record verbal cues that were synced with visual cues and GPS location data, and conduct quality control of the routes. Because each rider has a different worksite, each route setup in WayFinder is unique, with different origins, destinations, and itineraries. It took approximately four months from initiation for CARTA staff to receive WayFinder training, set up the routes, secure tablets from the Orange Grove Center that could run the app, and begin their initial training with a rider from the Orange Grove Center. The agency plans to work with more riders once it is safe to do so as expansion plans were put on hold during the COVID-19 pandemic.

Before riders could be selected for the program, robust approval, testing, and safety procedures were established. The Orange Grove Center worked with individuals and their families to explain the goals of the program, receive their consent, and gather feedback from the individuals' Direct Support Professionals at the Orange Grove Center. Potential riders needed to pass an assessment that tested their ability to identify road signs and choose the safest walking routes from a series of pictures before they could participate in the program.

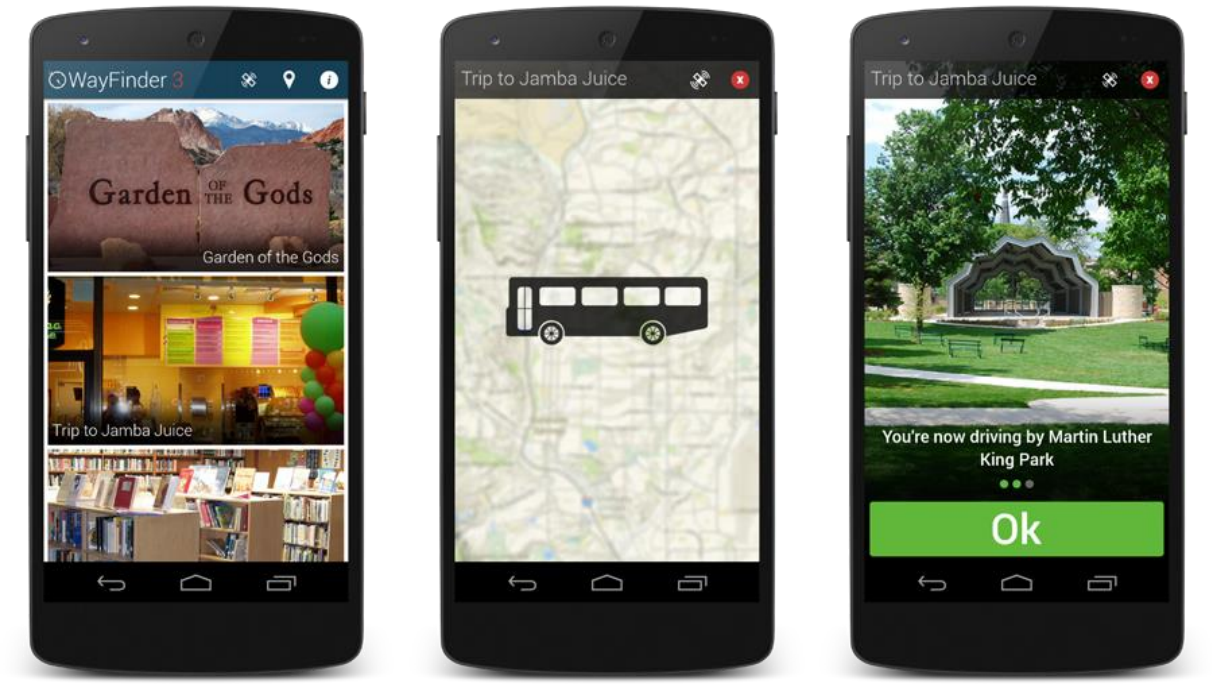
Resources

Because DIDD funds the pilot, CARTA did not need to provide any direct funding. However, the agency contributes significant staff time and human resources. Ms. Shores spent two months learning the software and developing the first route, and CARTA staff will be responsible for route setup and rider training and for each new route and rider in the future.

Long-term, widespread WayFinder use could move riders from paratransit to fixed-route service, which would decrease operating costs. At an agency level, CARTA has a dedicated travel training program that was established in 2002 and has helped hundreds of riders navigate the fixed-route bus system independently, providing riders with additional mobility options. The training process for riders in the pilot project is more involved than the general travel training that CARTA conducts. These riders may be new to transit, or elderly, or have a development or physical disabilities that may otherwise necessitate their use of paratransit. According to TCRP Report 168, *Travel Training for Older Adults*, reducing paratransit trips or shifting riders from paratransit to fixed-route service can result in substantial cost savings for transit agencies.

Riders participating in the program are given a tablet with all the route information that CARTA has programmed. The first tablets CARTA received from DDID for riders were unable to run the navigation app smoothly due to poor GPS functionality on the older tablets, and it took time to receive new tablets that could run the app without a problem. WayFinder is also available to the general public to use on tablets and smartphones, in which instance users would need to download the app and create their customized routes on their own.

Figure 2: AbleLink WayFinder interface



Source: https://www.ablelinktech.com/

Lessons Learned

Aside from the need to learn and use new technology, CARTA faced some obstacles in implementing WayFinder. Developing the routes was challenging from a technical perspective. For example, the audio and visual cues that riders receive through the app must match their bus's location, but sometimes GPS connectivity was poor when the routes were being created in the system, and it caused the bus's actual location to be out of sync with what the recorded GPS data reflected. In the long-term, there is some uncertainty about how to grow the use of the app and what future licensing or service options may look like. The AbleLink WayFinder application is currently priced at $349.99 for individual users in locations where the full WayFinder ecosystem services are not offered through a local transit agency. However, AbleLink also offers the WayFinder services to transit agencies, which allows the WayFinder app itself to be made available to its customers at no cost to the traveler.

Rider safety is a major component of the pilot project. By the time their training is complete, riders will not only use transit independently, but they will also navigate the last steps from transit to their destination safely on their own. Each commute is unique. Whereas one rider works at a school with an on-site crossing guard, another rider needs to walk three blocks on their own from the bus stop to their worksite. In these last few blocks, the rider needs to push signal buttons, wait for signals, and cross intersections of varying complexity. The program needed to consider these factors and the complexity of each route to ensure the safety of each rider through proper training. In the long-term, the program's training component will have multiple phases which have not yet been rolled out due to COVID, and will include:

1. An initial phase when CARTA sets up the route and trains the rider directly.
2. Then, the Orange Grove Center provides additional training to the rider, focusing on the route to the bus and from the bus to the final destination.
3. Finally, CARTA's travel trainer and/or Orange Grove Center staff will follow the rider on their route without their knowledge to observe how well they follow the procedures they learned during their training and the extent to which they are able to complete the trip independently and safely.

Results

The pilot project is still in the early phase, but there are some initial takeaways. The project has moved forward thanks to solid stakeholder relationships, which have proved essential. Although the end goal is to have individuals traveling independently and safely, it has also made the organizations involved think critically about how much individuals with cognitive and developmental disabilities can achieve if they have the training and, more importantly, an opportunity to show what they can do. Ms. Shores stressed that any agency that works with people with disabilities should consider developing a similar program, especially if they serve individuals who live near fixed-route service. Since the pilot was launched, one agency has contacted CARTA to request a tour to learn more, and several other transit agencies have reached out to the agency for more information.

Key Takeaways

1. Partnerships were critical to development and implementation of WayFinder, including funding from the Tennessee Department of Intellectual and Developmental Disabilities (DIDD) and the participation of the Orange Grove Center and their clients.
2. Long-term, widespread WayFinder use could move riders from paratransit to fixed-route service, which would decrease operating costs. In the short-term CARTA invested significant staff time in developing the routes in WayFinder and conducting travel training with pilot participants was a significant investment of staff time.

For More Information

- Expert's contact details: Alana Shores, Travel Trainer, CARTA, alanashores@gocarta.org
- Video with Kenny, CARTA's first rider under this project: https://www.youtube.com/embed/7rbwuIZBwg4
- AbleLink WayFinder: https://www.ablelinktech.com/index.php?id=33
- Orange Grove Center: https://www.orangegrovecenter.org/www
- TN DIDD's Enabling Technology Program: https://www.tn.gov/didd/for-consumers/enabling-technology.html
- Chattanooga Times Free Press article on CARTA's travel training: https://www.timesfreepress.com/news/news/story/2012/jun/08/with-help-disabled-have-freedom-to-travel/79840/
- TCRP Report 168, *Travel Training for Older Adults*: http://www.trb.org/Main/Blurbs/171323.aspx

Improving the Paratransit On-Demand Booking Experience, with an Emphasis on the Visually- and Hearing-Impaired

PROMISING PRACTICE: WEB-BASED BOOKING AND TRIP MANAGEMENT PLATFORM TO CREATE A "ONE-CLICK" EXPERIENCE FOR USERS OF THE THREE PUBLIC TRANSPORTATION SYSTEMS THAT INCORPORATES TECHNOLOGY TO MAKE IT EASY FOR THE VISUALLY- AND HEARING-IMPAIRED PEOPLE TO ACCESS SERVICES.

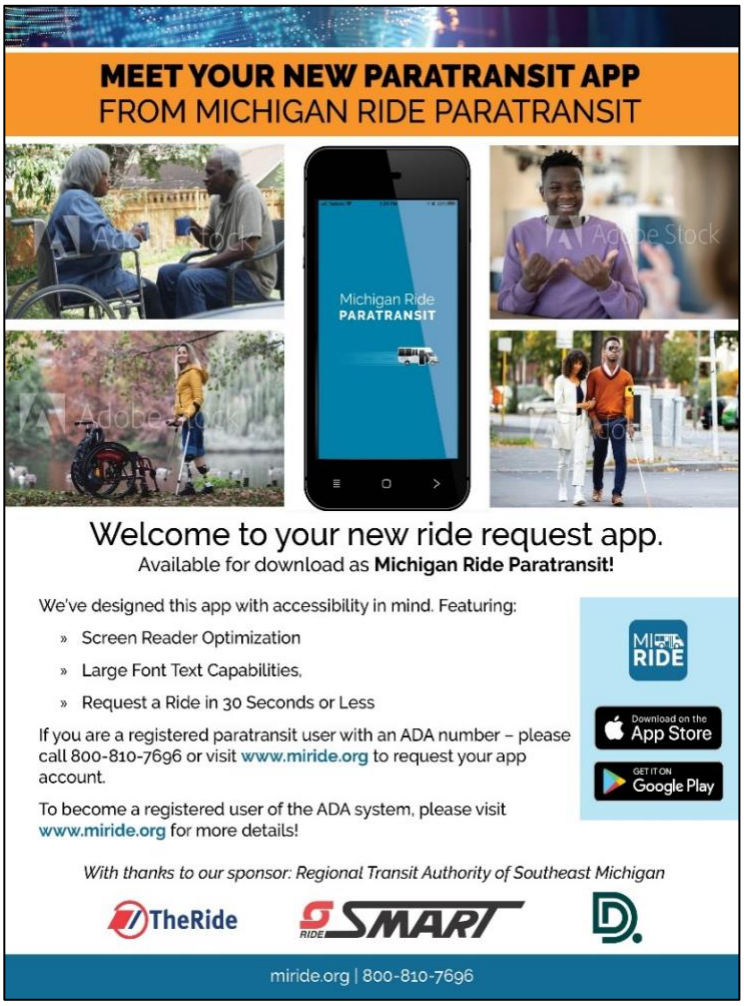
Southeast Michigan is a vast region – home to 4.2 million residents, spanning 2,600 square miles, and home to three major transit systems – including TheRide, DDOT, and SMART. In addition, SMART and DDOT have riders who utilize both paratransit systems each day, increasing the critical need for coordination in supporting riders. The RTA received a $1.05 million Michigan Mobility Challenge grant from Michigan Department of Transportation/PlanetM to create an integrated online booking and trip management platform to create a "one-click" experience for users of the three systems that could also be scaled to accommodate future growth. As part of this new "Michigan Ride Paratransit" app, Feonix – Mobility Rising (hereafter refered to as Feonix) will integrate What3Words technology into the app, which was employed under a previous project with TheRide. What3Words is an addressing convention that divides the earth into squares of three by three meters and assigns each square a unique, three-word code, assuring that riders and drivers will easily be able to find pickup and drop-off locations. Paratransit passengers who live in areas that Google Maps does not provide an exact address, such as an apartment complex, can enter their three-word address in the app.

Context

The idea for the Michigan Mobility Challenge project began in 2018 when representatives from the Michigan Division on Deaf, DeafBlind and Hard of Hearing; Area Agency on Aging; Veterans Administration; and transit agencies; social workers; and other advocacy leaders gathered at a governor's summit to discuss the challenges their populations face. Individuals with disabilities, veterans, and other target audiences led sessions to share their experiences. The resulting Michigan Mobility Challenge aims to "address core mobility gaps for seniors, persons with disabilities, and veterans across the state and encourages public-private partnerships. In response, Feonix proposed the development of the Michigan Ride Paratransit app to address problems these populations experienced with transit – two of the most significant being arduous trip booking experiences and location confusion between pickup and drop-offs.

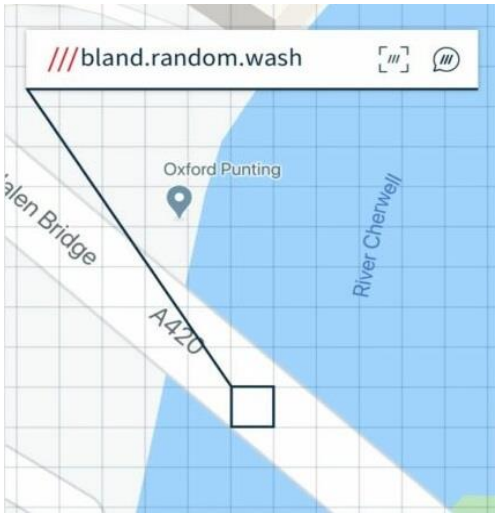
The Michigan Ride Paratransit app addresses problems identified by riders and transit agencies. It will help paratransit riders easily book their rides, especially in instances of cross-agency coordination, and communicate their pickup location to help drivers navigate to the correct location, with What3Words integration in Fall 2020. The What3Words addressing system will help make the process easy in facilities such as VA hospitals, which often have multiple pickup and drop-off zones, or large shopping centers. What3Words technology is also important for rural locations that might not be included in mainstream mapping apps.

Figure 3: Marketing Materials



Source: Feonix

Figure 4: Location in What3Words



Source: What3Words

The final version of the Michigan Ride Paratransit app will not require many resources from the transit agency side, other than the to intake and dispatch the rides. Within the scope of the Michigan Mobility Grant, Feonix will finish the app and support the app's large-scale rollout in Fall 2020. Rollout support includes overseeing dispatch and assisting the agencies that are training new staff while rolling out the new technology. In addition, maintenance will be provided on the technology through September 2021.

Stakeholders provided critical input throughout the development of the technology. In the initial planning period, three focus groups of agency leaders, disability advocates, transit agencies, and community leaders were engaged. In addition, Menlo Innovations was brought into to provide High-Tech Anthropology, a proprietary method of gathering feedback for software design in which they conducted a wide variety of interviews with transit agency staff and riders.

Moving forward, Feonix is working with partner agencies to establish baseline metrics and metrics of progress for the deployment. These metrics include: ride booking time; app complaints; the number of users booking rides; app downloads; number rides per month; the percentage of overall rides per month

booked via the app; multi-agency rides, the percentage of multi-agency rides, the number of riders that book a second ride after the first one; and app satisfaction.

Challenges

Developing a technology-based solution for three separate transit agencies comes with challenges. Each agency has a different service design, service areas, and different trip booking policies. Some agencies allow riders to book paratransit services two days in advance, but for preferred ride times or on weekends, even more advanced notice might be needed to ensure there is capacity on the system. Each agency also uses a different booking software.

The booking technology is currently supporting the booking experience. In the full vision, the driver will know exactly where the passenger is at the pick-up location in real-time, using What3Words to complement any challenges where the passenger and driver are trying to find each other. This advanced locational functionality will require integration with the transit agency providers and their dispatching platforms that are not currently planned. The first priority is addressing dispatch and pick-up locational needs now, and once that process has been streamlined and business case proven, the agencies will explore options for enhancing the product.

Early Takeaways

Although the Michigan Ride Paratransit has recently launched with beta users, the pilot project has benefited from frequent and clear communication between stakeholders and the High-Tech Anthropology process with Menlo Innovations. Their extensive research on agency and customer preferences laid an incredible foundation for the future lines of communication to move the project forward. Feonix recommends that any agency that is working with tech startups or pilots consider how a pilot project will change over the course of development and implementation and that a frequent and well thought out internal and external communication plan helps assure that projects move forward successfully.

Key Takeaways

1. The Michigan Mobility Challenge Summit provided the forum for the identification of needs through input from a variety of agencies serving persons with disabilities and veterans, as well as from community members directly, that led to the scoping of the Michigan Ride Paratransit application.
2. Frequent and clear communication between the three participating agencies and vendors enabled issues associated with creating a solution that works across three systems and service areas.

For More Information

- Valerie Lefler, Executive Director, Feonix – Mobility Rising, valerie.lefler@feonixmobilityrising.org
- https://feonixmobilityrising.org/
- Finnish mobility company and vendor partner Kytti: https://www.kyyti.com/
- Menlo Innovations: https://menloinnovations.com/services/high-tech-anthropology

Blue Lake Rancheria Transit System Waste Oil to Fuel

PROMISING PRACTICE: CONVERSION OF ON-SITE WASTE OIL TO FUEL PROGRAM DEVELOPED THROUGH UNIVERSITY PARTNERSHIP

In 2014, Blue Lake Rancheria Tribe began construction of a biodiesel conversion apparatus that takes waste cooking oil from the Tribe's hotel and casino kitchens and converts it into biodiesel. Blue Lake Rancheria Transit System (BLRTS) began powering their buses using the biodiesel by 2015. The entirety of the Tribe's sustainability program, which includes a solar-powered microgrid and electric vehicle infrastructure in addition to their waste oil to biofuel program, is spearheaded by the Director of Sustainability and Government Affairs, Jana Ganion. Ms. Ganion has been with the Tribe for more than 15 years and has dedicated her career to reducing the Tribe's carbon and overall environmental footprint. In 2014, the Tribe was federally recognized as a Climate Action Champion.

Context

Blue Lake Rancheria began operating its deviated fixed-route bus service in 2000. In 2014, Blue Lake Rancheria partnered with Humboldt State University and Schatz Research Center to work on making their transit system more sustainable and reduce costs. The resulting program is a waste oil to biodiesel conversion system, which takes the waste oil from commercial kitchens at the Rancheria and converts it into fuel for buses. Biodiesel made from cooking oil resulted in an 86 percent reduction in greenhouse gas emissions compared to traditional petro-diesel. Their biodiesel is converted on-site and mixed at a rate of 20 percent biodiesel and 80 percent petro-diesel, which yields a B20 biofuel blend.[23] The fuel can be used in commercial buses without requiring any vehicular retrofitting.

This practice started as a student engineering project at Humboldt State University, which provided Blue Lake Rancheria with the costs and benefits of switching to biodiesel. While the primary motivation behind the biodiesel program implementation is the Tribe's goal of reaching carbon net neutrality by 2030, the switch has also reduced operating costs.

State of the Practice and Trends

BLRTS currently operates between two and four buses at any given time, and a B20 biodiesel blend powers the entire fleet, while the conversion of waste oil into fuel and mixing are done on-site by the Tribe. According to Ms. Ganion, the B20 blend is the highest concentration of biodiesel that the vehicles can run on without any alterations to the existing buses. A B40 (40 percent biofuel) or B100 (pure biofuel) blend would require adaptations and negate the bus warranties.

Ms. Ganion stated that they had considered the possibility of expanding their program to produce more biofuel – the Tribe currently makes a few hundred gallons of fuel each month. The expansion would involve both upgrading the apparatus as well as expanding the supply of waste oil. Now, the agency receives all of the waste oil used in the biofuel process from the Tribe's commercial kitchens, and the program is paid for as part of the Tribe's general fund. To expand this practice, BLRTS would need to secure an additional source of waste oil, and there are two major concerns with this. The first is that waste oil is a commodity, so the Tribe would have to an expensive purchase of waste oil from other commercial kitchens. The second is that the Tribe has a level of control regarding the quality of the waste oil that comes from their own kitchens. They know what contaminants are potentially mixed in and can regulate the types of oils used. The same is not true if the oil was to be purchased from an outside source. Any

[23] U.S. Department of Energy. Alternative Fuels Data Center. Biodiesel Blends, available at: https://afdc.energy.gov/fuels/biodiesel_blends.html, as of August 5, 2020.

additional contaminants or varying properties can make the waste fuel to biofuel process more difficult and impact the quality of the resulting biofuel.

Resources

The Tribe relied on grants from the FTA to purchase their biodiesel conversion apparatus and on technical expertise from Humboldt State University, Schatz Research Center, and the Office of Indian Energy. The Tribe has a strong relationship with their biodiesel equipment provider, Tennessee Diesel, which provides technical advice in addition to parts. Ongoing maintenance is handled and funded internally by the BLRTS.

Ms. Ganion emphasized that the most important resource to ensure a successful implementation of a similar biofuel program is a steady, consistent stream of waste fuel. This could either be in the form of a consistent source of waste oil that is then converted on-site or a consistent source of already created biofuel. Getting all the biofuel from the same source ensures consistent quality biofuel. Also, it is not recommended that engines change types of diesel – once the bus starts to run on B20 biofuel, it should continue to run on B20 biofuel. There must always be a source of consistent, high-quality biofuel to prevent mechanical issues with the vehicles.

The advantage of mixing biofuel on-site is cost savings. When purchased in its final state, biodiesel can be as expensive as traditional petro-diesel or, depending on the biofuel source, slightly more economical. BLRTS has enjoyed greater cost savings from their biofuel program because they get free waste oil from their own kitchens. Even with the cost to purchase a conversion apparatus and convert the fuel on-site, the Tribe still saves money on fuel.

Figure 5: On-site biodiesel conversion apparatus

Source: Blue Lake Rancheria

Figure 6: Driver fueling a BLRTS bus

Source: Blue Lake Rancheria

Barriers and Challenges

When Blue Lake Rancheria was conducting initial research into the implementation of waste oil to biofuel process, there were very few existing systems to research as case studies. They relied heavily on engineering students to conduct the initial research into costs and benefits for different types of conversion systems. Despite the difficulty with finding comparable case studies, Ms. Ganion stated that the actual process of converting waste oil into biodiesel has been very smooth.

One challenge Blue Lake Rancheria noted was related to biofuel storage. According to Ms. Ganion, biofuel can be stored for a few months only, which means it is imperative to have a steady supply of biofuel balanced with the amount that is used. Biofuel can degrade and coagulate when sitting for extended periods. In addition to the limited shelf life, biodiesel also does not work as well in cold climates due to the properties of the waste oil. When it gets too cold, the fat in the oil starts to coagulate and can clog an

engine. These characteristics are important to be considered when evaluating a waste oil biofuel application.

Results

Since the practice was adopted, Blue Lake Rancheria has been able to reduce its annual fuel costs by approximately $5,000 and its greenhouse gas emissions by 20,000 pounds per year. The biodiesel adoption allowed the Tribe to decrease transit operating costs and further its goal of carbon net neutrality by 2030, which will likely be achieved five years ahead of schedule.[24] Among all of the Tribe's sustainability programs, they have managed to reduce their energy costs by $200,000 per year and have reduced their emissions by 40 percent since 2014. The Tribe has received multiple awards for its sustainability efforts, including recognition as a Climate Action Champion in 2016 and the EPA's Green Power Leadership Awards in 2019.

Key Takeaways

1. External assistance was critical to the development of this practice; the concept began as a student engineering project at Humboldt State University, which provided Blue Lake Rancheria with the costs and benefits of switching to biodiesel. Technical expertise from Humboldt State University, Schatz Research Center and the Office of Indian Energy aided implementation.
2. While the primary motivation behind the biodiesel program implementation is the Tribe's goal of reaching carbon net neutrality by 2030, the switch has also reduced operating costs.

For more information

- Contact Jana Ganion, Director of Sustainability and Government Affairs at Blue Lake Rancheria jana.ganion@bluelakerancheria-nsn.gov
- Blue Lake Rancheria:
  - https://bluelakerancheria-nsn.gov/initiatives/transportation/
  - https://bluelakerancheria-nsn.gov/initiatives/sustainabilityandresilience/

[24] Times-standard.com. 2020. Blue Lake Rancheria Receives EPA Award For Green Energy Leadership – Times-Standard. [online] Available at: <https://www.times-standard.com/2019/09/06/blue-lake-rancheria-receives-epa-award-for-green-energy-leadership/> [Accessed 5 August 2020].

Clemson Area Transit - Electric Bus Fleet

PROMISING PRACTICE: CATBUS ELECTRIC BUS FLEET REPRESENTS HALF OF ITS ENTIRE FLEET SHOWING SUBSTANTIAL OPERATING SAVINGS

Clemson Area Transit (CATbus) was founded in 1996 and serves the towns of Clemson, Central, Pendleton, and Seneca in northwest South Carolina. CATbus is the largest fare-free bus service in the Carolinas, serving around 2 million passengers per year. In 2014, CATbus started operating electric buses, in 2017, with the addition of 10 Proterra buses to its electric fleet, its electric fleet accounted for 50 percent of its total bus fleet.

Context

The electric bus program at CATbus was introduced in 2010 as part of a larger program to reduce energy consumption and increase energy efficiency. Electric buses were included in this program in response to poor air quality and a desire to cut operational costs at this fare-free system. The program was facilitated by a partnership between CATbus, the City of Seneca, the Center for Transportation and the Environment, and SCDOT. CATbus also formed a strong relationship with South Carolina-based Proterra, one of the largest electric bus manufacturers in the United States.

Figure 7: CATbus at Charging Station

Source: http://www.transitmos.com/

The implementation of emerging technology can be challenging as the first few generations of vehicles are perfected. The first set of buses that CATbus purchased in 2014 had a few technical issues that required resolution. However, the technology has matured vastly in the last six years, and the issues experienced in 2014 did not recur when the second order of buses arrived in 2017. The original CATbus electric bus program included electric buses and two chargers, a primary and a secondary. These fast chargers do not require the buses to be plugged in; instead, the driver simply drives underneath the suspended charger. The back-up second charger was located at a hospital so that the charger would have emergency power in the event of a disaster.

Resources

The first phase of the process was completing an electric bus study to determine the applicability of the electric bus program. Four years later, the original four buses were purchased using a 4.1 million-dollar TIGGER grant (Transit Investments for Greenhouse Gas Reductions) and a 1.8 million-dollar Bus Livability Program grant.[25] In addition to buses, this grant also purchased two fast-charging stations. In 2017, CATbus purchased an additional ten buses with a 3.9 million-dollar Low or No Emissions grant from the FTA.

[25] City of Seneca, SC. “Electric CATbus” available at: http://www.seneca.sc.us/AboutSeneca/PublicTransit/ElectricCatBus.aspx, as of August 31, 2020.

Results

The program is considered to be an absolute success by CATbus. The buses have surpassed their original expectations in function and efficiency. Fuel costs were cut in half, and maintenance costs have reduced by two thirds with the implementation of electric buses. The buses get 16.8 miles per gallon equivalent and cost $0.28 per mile to operate. The bus batteries have lasted longer than anticipated, and the vehicles are cheaper and easier to maintain compared to diesel buses.

Since the implementation of the program, the electric buses have reduced diesel consumption by approximately 40,000 gallons per year. Thanks to those electric buses, 2.7 million pounds of net CO_2 were not emitted. CATbus plans to go fully electric by 2025.

Lessons Learned

The keys to the success of the all-electric model, according to CATbus, are:[26]

1. Ensure adequate funding to start the conversion to electric service.
2. Get information from agencies that are using the technology – CATbus was invited by Doran Barns to visit Foothill Transit to see electric buses on route and talk to the staff.
3. Determine the electric rate structure and use rate modeling in the planning.
4. Study the route modeling data to determine the type of bus for the route, i.e., Quick Charge or Extended Range buses, and consider:
    a. Round trip mileage of the route
    b. Daily total mileage
    c. Topography
    d. Route schedule, timing
    e. Possible location of charging stations
5. Shadow the diesel buses with different vendor's vehicles to see if the model works before going out for bid.
6. Make the bid include the needs that have come out of the route study.

Key Takeaways

1. CATBus electric buses began as part of a larger program to reduce energy consumption and increase energy efficiency. Electric buses were included in this program in response to poor air quality and a desire to cut operational costs at this fare-free system.
2. Relationships were key to this practice's successful implementation; the program is facilitated by a partnership between the CATBus, the City of Seneca, the Center for Transportation and the Environment, and SCDOT. CATBus also formed a strong relationship with South Carolina-based Proterra, one of the largest electric bus manufacturers in the United States.

[26] Moody, K. (2019). Save $, Save Energy, Save the Planet [Conference presentation]. Sustainable Fleet Technology Conference and Expo 2019 https://static1.squarespace.com/static/584598d4d1758ec839a47bab/t/5d66d9592d18f0000123aae5/1567021410821/3C_MoodyKeith_ClemsonTransit.pdf

For more information

- Contact Sammy Grant, General Manager, Clemson Area Transit, sgrant@cityofclemson.org
- TCRP Report 219: Guidebook for Deploying Zero-Emission Transit Buses: http://www.trb.org/Publications/Blurbs/180811.aspx
- Financial Analysis Of Battery Electric Transit Buses, NREL: https://afdc.energy.gov/files/u/publication/financial_analysis_be_transit_buses.pdf

Mountain Line – Transit Asset Solution

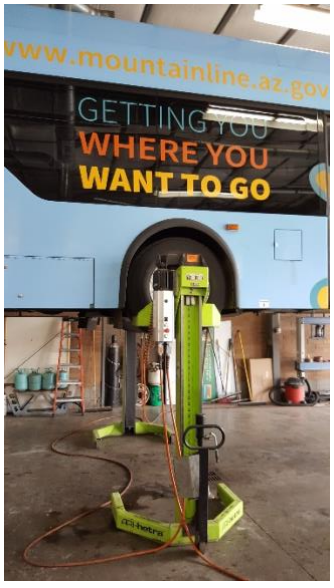
PROMISING PRACTICE: SHIFTING WORK ORDERS FROM A PAPER-BASED TO A SMARTPHONE APPLICATION AND CLOUD-BASED SYSTEM THAT FACILITATES TRANSIT ASSET MANAGEMENT DECISION-MAKING

Mountain Line uses an IoT-enabled Transit Asset Management (TAM) system, ThingTech, to improve the maintenance work order process by reducing manual data entry. In the second implementation phase, which will begin in Summer 2020, ThingTech will be implemented across Mountain Line's divisions as a singular solution for asset management and help Mountain Line with the FTA's State of Good Repair reporting requirements.

Context

Mountain Line implemented ThingTech to make the work order process easier and more efficient. Before ThingTech, Mountain Line's Facilities Division tracked work orders manually on paper and entered them into a spreadsheet. Wade Forrest, Mountain Line's former Facilities Manager, was involved in the previous manual entry process and ThingTech's initial implementation. The Facilities Division was interested in an asset management solution that would: eliminate manual data entry on the 10,000 work orders they process annually; support capital improvement and grants, handle fleet work orders, parts inventory, and facilities information; and track IT assets. When a new 25,000 square foot storage and maintenance building was completed in 2015, Mountain Line used a capital grant to fund an initial three-year subscription to ThingTech to support the building's onboarding. In this initial implementation phase, Mountain Line deployed the solution in a limited fashion only for the Facilities Division's work order and asset tracking tasks.[27] ThingTech's full features will be expanded and used to unify asset management throughout the agency in the forthcoming second phase.

Figure 8: Mountain Line's New Storage and Maintenance Facility



Source: Northern Arizona Intergovernmental Public Transportation Authority

[27] Mountain Line does not currently use ThingTech for any IoT-related tracking.

Resources

Mountain Line relies on human and financial resources for its ThingTech implementation and expansion. Members, from the Business Manager to staff in the Facilities and Fleet Divisions, joined the Implementation Team to provide detailed feedback during the initial development process and to ensure that ThingTech would meet their needs and expectations. This early and continued involvement helped improve staff buy-in when ThingTech was rolled out.

After roll-out, the staff needed to learn how to use the solution. Mr. Forrest reviewed early information that the team captured in the system and identified data entry errors, particularly those related to time. In response, he scheduled weekly meetings with each member to review the data, improve entry, and reduce and correct errors. Finally, in terms of financial resources, a capital grant funded the initial phase, and Mountain Line finances its continued use of ThingTech as part of its operating budget, spending $30,000 annually.

Barriers

The nature of a large systematic change was one barrier Mountain Line faced. Individual staff members needed to learn a new way of managing work orders and a new workflow after years of the manual process. Although change is sometimes painful, most staff saw the benefit of the new system and how it could serve them and the organization. Continuous stakeholder engagement and support from senior leadership were essential to the implementation.

Results

Mountain Line has observed some early positive results after the completion of phase one. Approximately 95 percent of the Facility Team's total work orders are being tracked in ThingTech. That number includes all work orders related to preventative maintenance (approximately 10,000 work orders annually, the bulk of which are bus stops, and 300-400 work orders related to facilities) and corrective maintenance. Tracking work orders has helped Mr. Forrest see where the team's time and energy are spent and strategically allocate staff and resources, which simultaneously gives the team time to focus on other tasks and helps them understand when more staff may be required. Finally, ThingTech has helped Mountain Line develop transparency across divisions and, with the implementation of phase two, will help the agency take a unified approach in applying for funding and prioritizing repair and replacement of capital infrastructure in the future.

Figure 9: Bus Stops

Source: Northern Arizona Intergovernmental Public Transportation Authority

In the second implementation phase, the fleet and IT inventory will be added into the system, and ThingTech will also be used to track Fleet Division work orders. The phase two implementation should also yield results that can be used for FTA reporting requirements and data mining for strategic decision-making across the agency. Mountain Line will use ThingTech to track asset conditions according to the TERM-Lite scale and add financial and grant tracking information into the system, which will support planning and accounting processes.

Lessons Learned

Mountain Line has several recommendations for other agencies interested in implementing a similar solution. Management had the same learning curve as staff but also needed to understand the administrative side of the solution. This included the need to develop Standard Operating Procedures for data governance to ensure that data was entered accurately by the individuals responsible for its collection and entry. Managers at the agency also needed to learn best practices for adding new transit routes and their accompanying assets into the system and assuring the data was entered correctly. Strong project management skills were required to implement a system of that size in addition to a clear, defined, and unchanging scope that guided the implementation.

As part of the project management process, Mountain Line conducted stakeholder interviews within the organization to develop a scope statement that was then used to guide the work with ThingTech in the development of the TAM solution.

Agencies also need to choose between cloud-based or in-house storage solutions, both of which carry their costs. In Mountain Line's case, the cloud-based solution, despite the annual storage and maintenance costs, was a better fit than in-house storage, which requires servers, as well as other infrastructure and dedicated IT staff. Although some agencies may be concerned about the cost of a solution like ThingTech, Mr. Forrest believes that these types of tools can not only help agencies with FTA reporting requirements but also be considered best practices for asset management that help make smart, data-driven decisions. Mountain Line has had strong support from senior leadership that understands the importance of continued funding for a solution that helps maintain over $30 million in assets and considers the subscription part of the cost of doing business.

Key Takeaways

1. Continuous stakeholder engagement and support from senior leadership were essential for successfully making a significant systematic change.
2. Tracking work orders has helped Mountian Line understand how staff spend their time and strategically allocate resources accordingly. This gives their team time to focus on other tasks and helps them understand when more staff may be required.

For more information

- Contact Jon Matthies, IT Manager, Mountain Line, jmatthies@mountainline.az.gov
- https://mountainline.az.gov/
- https://thingtech.com/

Go Vermont! Trip Planner

PROMISING PRACTICE: IMPROVING ACCESS TO TRANSIT INFORMATION TO INCLUDE DEMAND-RESPONSE AND VOLUNTEER-RUN SERVICES

Go! Vermont is VTrans' program to promote alternatives to drive-alone trips, administering a carpool ride-matching service in addition to providing information about transportation options in the state, including the state's volunteer driver program. In 2018, they launched a trip planner that incorporated both GTFS and GTFS Flex, allowing the trip planner to provide more options than private-sector counterparts. The GTFS Flex function is especially useful in the rural parts of the state, where fixed-route bus services are less common than demand-response services. In 2020, the agency upgraded the trip planner to include more modes, which allows users to plan both peak and off-peak trips.

Context

As a rural state, fixed-route transit service is challenging to provide in many areas, which leads to challenges accessing essential services for many Vermonters, especially those who are older or disabled, without access to private vehicles. The state makes heavy use of demand-response and volunteer driver services to meet these transportation needs. Still, existing trip planning services omitted those services, meaning that many Vermonters were unaware of the options available to them.

Trillium, a data-focused transportation consulting firm, helped VTrans create GTFS-Flex data for its demand-response services, and then helped to create an initial trip planning application for Go! Vermont. In 2020, upgraded the trip planner with the help of vendor AgileMile to include additional transportation options. As AgileMile was already providing a trip-tracking app to Go! Vermont, this upgrade also integrated the trip planning and trip tracking apps, providing both functions in a single app for the first time in Vermont.

Organizations representing elderly and disabled Vermonters, such as the Vermont Association of the Blind and Visually Impaired and the Vermont Center for Independent Living, were heavily involved in the process of developing and marketing the application. These organizations and their constituencies are considered key target audiences for the trip planner app. Beyond the development phase, these organizations continue to submit feedback to VTrans with suggestions for app updates and improvements.

State of the Practice and Trends

While VTrans was the first state transportation agency to implement a trip planning tool with GTFS-Flex capabilities, such practices are now more and more common. In the Washington, DC metropolitan area, the IncenTrip[28] app is being used to both plan and track trips for transportation demand management (TDM) purposes. Some trip planning tools, such as the EZFare system launched by a consortium of Ohio and Kentucky transit agencies called NEORide,[29] now also include fare payment capabilities as well. Go! Vermont itself has assisted in driving the state of the practice forward, making the code that powers its trip planner app open source and available to any agency that wants to use it through the GTFS-Flex Github repository.

Resources

Initial funding for the trip planner was provided by a United States Department of Transportation (USDOT) Federal Transit Administration (FTA) Mobility on Demand Sandbox grant. VTrans complemented FTA's

[28] https://www.incentrip.org/
[29] https://www.neoride.org/

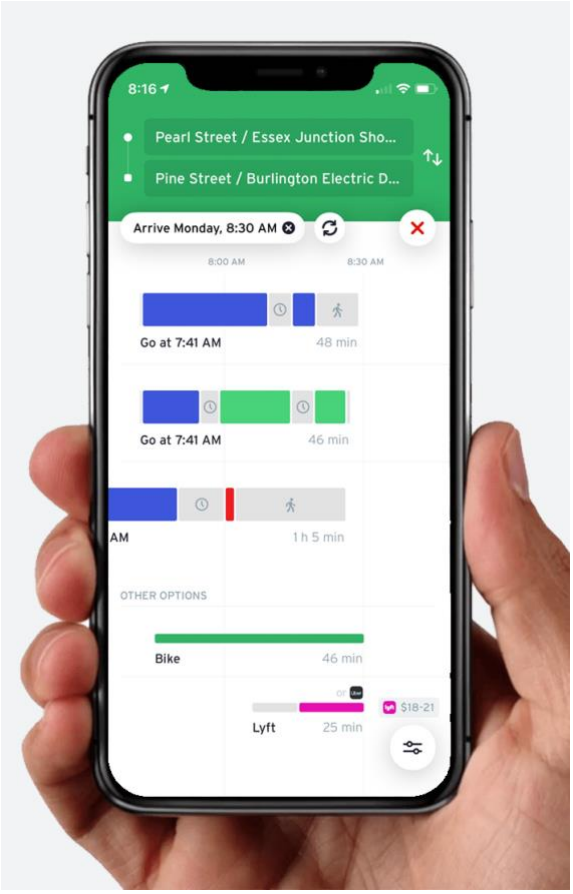
$480,000-grant for the development of the tool with an additional $120,000. The state also pays about $30,000 per year to transportation consulting firm Cambridge Systematics to maintain the trip planner, which comes out of Go! Vermont's roughly $800,000 annual budget.

Go! Vermont Program Manager Dan Currier noted several other resources Go! Vermont drew on to help create the trip planner tool. One of these was the program's existing strong partnership with employers and Transportation Management Associations (TMAs) throughout the state. Another was the availability of reliable data on both fixed-route and flexible services in the state. Trillium's help in developing GTFS-Flex data for demand-response services in Vermont was a key building block in making the trip planner a reality, but developing that GTFS-Flex data can be a resource-intensive process.

Barriers

For Go! Vermont, developing and deploying this trip planner was just one piece of a broader effort to encourage more people to use alternatives to driving alone. While the trip planner does help people learn about their transportation options, it has yet to fuel significant change in mode choice in the state. Go! Vermont representatives reported that a critical barrier to the increased use of non-car options is a common mindset that everyone drives everywhere, so people don't often consider alternatives to driving unless they have no other choice. For Go! Vermont, this mindset is a key barrier they need to overcome, and they see the trip planner as one tool to help them do that.

Figure 10: Transit App Screen



Go! Vermont has also struggled to get members of the public to use the app. When they originally launched the app in 2018, they promoted it via several different media channels, including radio, television, social media, and an online community news service local to Vermont called Front Porch Forum. These initial outreach efforts were marginally successful. Because Go! Vermont did not roll out the new version of its trip planner until after the COVID-19 pandemic, and related stay-at-home orders, had already reached Vermont. They chose to take a "light touch" with promoting the new version of the tool, focusing on AgileMile's trip tracking tools and the ability to earn rewards by teleworking. The agency has seen some success with this and hopes to promote the tool more aggressively once conditions no longer necessitate travel restrictions.

Results

Go! Vermont is still in the process of determining how to evaluate the success of the trip planner app. While the tool has not seen as much use as VTrans had hoped, and has had only small successes in changing travel behavior, the project has been a key step forward in developing the knowledge and technology to allow trip planning tools to incorporate flexible transit services, and many other agencies have built on this to provide similar tools with additional features.

Lessons Learned

Mr. Currier pointed to several lessons learned that might help other agencies trying to implement a similar tool. They noted missed opportunities in the initial planning phases, such as the lack of established measures of success, which made program evaluation difficult later on, as well as insufficient knowledge about why their desired end-users make the transportation choices they do, which made it more difficult to leverage the tool to change travel behavior. In terms of Go! Vermont's successes, one crucial element that enabled the project to be undertaken in the first place was building a strong commitment to TDM among state transportation officials and lawmakers. VTrans spent a decade building this support, and they reported that the trip planner tool could not have happened if this groundwork had not been laid.

Key Takeaways

1. State transportation officials and lawmakers support for transportation demand management and transportation options, built over a decade of engagement, was crucial to garnering necessary support and resources to implement the project.
2. Organizations representing elderly and disabled Vermonters, such as the Vermont Association of the Blind and Visually Impaired and the Vermont Center for Independent Living, were heavily involved in the process of developing and marketing the application, ensuring it can meet the needs of these populations.

For more information

- Contact Dan Currier at VTrans: Dan.j.currier@vermont.gov.
- See N-Catt's GTFS webinar recording, slides, transcript, and fact sheet: https://n-catt.org/tech-university/webinar-gtfs-flex/
- The Shared-Use Mobility Center's writeup of this practice can be found at https://learn.sharedusemobilitycenter.org/casestudy/vermont-flexible-trip-planner-bringing-fixed-and-flexible-transit-together-on-a-single-platform/.
- The Shared-Use Mobility Center's writeup of the NeoRIDE platform can be found at https://learn.sharedusemobilitycenter.org/overview/trip-planning-ticketing-app-launched-for-10-transit-agencies-oh-2019/.

Portneuf's Smartphone CAD/AVL and Fare Collection System

PROMISING PRACTICE: USING A SMARTPHONE TO GEOLOCATE VEHICLES, A CAD/AVL MODULE INTEGRATED WITH A FARE COLLECTION SOLUTION ALLOWS A PROVIDER TO SEE FROM ONE WEBPAGE OPERATIONAL AND RIDERSHIP DATA IN REAL-TIME.

Context

The search for an alternative to paper-based monthly passes was the impetus behind the adoption of the smartphone, cloud-based CAD/AVL, and fare collection systems. CTRP started offering monthly passes for its commuter route riders even before selling passes online and installing electronic fare collection equipment to its vehicles. Due to its large service area and numerous cities served, the process of distributing passes for sale was very labor-intensive to the agency, requiring monthly visits to each one of the over 20 selling locations.

A year-long, unsuccessful search for a local electronic fare payment vendor in Quebec preceded the current solution adoption. CTRP was looking for fare payment solutions that would allow riders to register and recharge smartcards online, but all solutions offered by Canadian vendors ended up being too complex, designed for large transit agencies, or unaffordable. A year into the search, the General Director at CRTP, Maryse Perron, watched a presentation by vendor Ubitransport and was attracted by the simplicity of their solution. Based in France, Ubitransport develops integrated cloud and smartphone intelligent transportation solutions for public passenger transportation systems, and among its solutions is a CAD/AVL module that integrates with an account-based fare collection system.

> Equipped with an off-the-shelf smartphone or tablet, each vehicle is geolocated, while the power of CAD/AVL gives access to operational data feeds in real-time.

Ubitransport's CAD/AVL module integrates natively with the fare collection solution. These two modules combined make real-time data available back in the office from one webpage that includes the vehicle's load factor, the number of boardings at each stop point, and the ability to cross-check fares of those who pay cash, to name a few capabilities. While in the vehicles, drivers can follow early or late indicators, remaining distance on the route, correct stop points, information on riders, and more. If there are unplanned events on the route, they can also send messages to back-office administrators.

Resources

CTRP purchased all CAD/AVL and fare payment equipment and maintains the service with agency operating funds surplus. Canadian transit systems, in general, rely much more heavily on fare revenue to fund operational and capital expenses as compared to American providers. There are no dedicated public funding sources for transit technological improvements in Quebec. Capital investment decisions regarding the purchase of a new vehicle, for example, limit their capacity to invest in technology. In this context, a light, affordable solution to fare collection technology was imperative, and all the equipment necessary for the solution chosen is an off-the-shelf smartphone, a small printer, and a smartcard reader.

Figure 11: Vehicle Equipment

Source: Ubitransport[30]

To take full advantage of the CAD/AVL capabilities, CRTP would ideally have a staff member dedicated to controlling the operations in the office. However, with a team of three staff, the agency doesn't currently have the resources to dedicate making to real-time operational adjustments from the office. Currently, CRTP only processes part of the information available to them through the CAD/AVL and fare payment systems. Ms. Perron noted that data analysis could be a time-consuming task for their team, yet CRTP makes use of several standard statistics reports offered by the system.

Results

The solution made operations easier and pleased the riders. Among younger riders, online smartcard recharges and real-time bus tracking via the mobile app are exceptionally successful, according to Ms. Perron. While CRTP believed that the overwhelming majority of the riders would be using smartcards by the second year after adopting the technology, this did not happen. With transit services designed for older adults (who are the majority of CRTP riders), 80 percent of those riders still pay fares with cash, despite CRTP offering smartcard recharges via phone using credit cards in addition to the numerous stores in the region. Regardless, the solution decreased dwell times with drivers receiving fewer cash payments and made the monthly visits to physical stores a twice-a-year activity for CRTP staff.

The electronic fare payment technology with the vehicle geolocation has provided CRTP the means for service optimization. Beyond a route-level on-time performance measure or passenger counts, the technology allows CRTP to easily access information such as an underused stop or stops where the bus is frequently late or ahead of schedule. A better performance monitoring system informed CRTP to optimize route itineraries and consolidate stops. AVL alone is also key for providing real-time passenger information

[30] https://www.ubitransport.com/wp-content/uploads/2018/09/ubitransport-quipe-la-ca-privas.jpg

and tracking operations, allowing staff to track in real-time eventual reroutes due to roadwork or accident, for example.

Lessons Learned

The implementation process was twice as long as the technology vendor anticipated. Ubitransport suggested a three-month implementation period when staff from France would be based in Canada setting up the system and able to respond to any unexpected event without a six-hour time zone difference. One of the reasons for an extended implementation period was adjustments to the product-set up need to account for differences in how transit is structured in France and North America. However, a six-month implementation period proved necessary, and CRTP staff needed another six months to gain confidence in using the system.

Ubitransport's technology is widely adopted in rural France while emerging in Canada with CRTP and the city of Saint-Jean-Sur-Richelieu as the two first agencies to adopt the complete CAD/AVL, electronic fare collection, and RTPI solutions in North America.[31]

The implementation period is particularly critical for training drivers to navigate the smartphone system. Ms. Perron stressed the importance of engaging drivers since the early stages of the practice adoption, saying that drivers need to be on board with the changes as they play a critical role in operating the system. Drivers are the ones logging the trip information, starting and ending a trip, and manually entering cash payments in the smartphone system. Therefore, high-quality statistics are closely associated with the proper navigation of the smartphone system by the driver.

The product offered in Europe required small changes for the North American application. A printer on the vehicle is useful in rural France where a printed proof of payment is common practice for time-based fare charging or transfers between modes. However, in North America, the printer is hardly ever used since riders decline printed receipts and time-based fare charging is rare. Another adaption was needed regarding passenger information, with Ubitransport and Zenbus partnering to offer an RTPI application better suited for the North American public.[32]

Key Takeaways

1. CRTP persisted through a year-long, international search for a vendor that was could provide an off-the-shelf CAD/AVL and fare collection solution that met their needs and was affordable for a smaller agency.
2. Engaging drivers in the early stages of the practice adoption is crucial as they play a critical role in operating the system and need to be comfortable using the system.

[31]Ubitransport, Saint-Jean-Sur-Richelieu, the first city in Canada to deploy our solution, available at: https://www.ubitransport.com/saint-jean-sur-richelieu-the-first-city-in-quebec-to-deploy-our-solution/?lang=en, as of August 31, 2020.

[32] Ubitrasport, Ubitransport et Zenbus rapprochent leurs savoir-faire au service de la mobilité des territoires, available at: https://www.ubitransport.com/ubitransport-et-zenbus-rapprochent-leurs-savoir-faire/, as of August 31, 2020.

For more information

- Contact Isabelle Cloutier, Ubitransport's Canada and United States representative, at i.cloutier@ubitransport.com
- Ubitransport's website: https://www.ubitransport.com/
- CRTP's website: http://www.transportportneuf.com/

Mobile Fare Payment Technologies

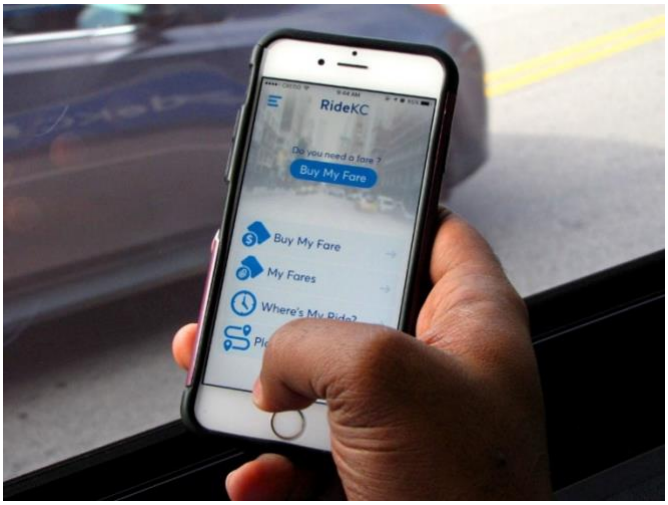
PROMISING PRACTICE: ENABLING MOBILE FARE PAYMENT FOR SMALL AND RURAL PUBLIC TRANSPORTATION SYSTEMSSYSTEMS

Mobile fare payment allows riders to purchase transit rides via a smartphone app linked to a credit card or user account (often called an "account-based system") and provides a digital ticket or other scannable code to validate proof of purchase. Mobile payment makes transit use easier for riders, especially for regional travel if multiple agencies share the same platform; reduces cash payments and the exchange of cash; and is easily validated by transit operators by sight. Although the first mobile fare payment system in the US was established in 2011, most agencies where mobile fare payment options are in use have released their apps since 2015.[33] The rise of the subscription-based or Pay-as-You-Go models provide agencies of all sizes the opportunity to use a cloud-based subscription service to manage fare payment as opposed to customized systems.[34] In the long-term, transit agencies might progressively integrate other public and private transportation modes, such as micromobility and TNCs, into one platform that users could book and pay for through the app. Additionally, other third-parties, such as health and human service agencies, may also be integrated into a mobile fare system to coordinate fare payment for benefit recipients.[35]

Context

Mobile fare payments can improve the fare payment experience for the rider and fare management experience for the transit agency. Riders can easily download a fare payment app to their devices, and, generally, these payment apps also include real-time travel information and trip-planning tools for riders in one convenient location. Depending on the app's setup, riders might even be able to access any special fares available to them, such as student or senior rates. An agency may also elect to add a fare capping capability into an app, which means that once riders have paid enough regular fares equivalent to the cost of a monthly pass, for example, they wouldn't pay any additional fees for the remaining calendar month. Furthermore, mobile fare payment systems may facilitate regional collaboration and scale according to need. EZfare, a cashless mobile ticketing app created by vendor Masabi and launched

Figure 12: RideKC Mobile App



Source: RideKC Facebook

[33] Transportation Research Board. Transit Cooperative Research Program (TCRP) Synthesis 148: Business Models for Mobile Fare Applications, available at: https://www.nap.edu/download/25798#, as of August 5, 2020.
[34] Gooch, J. (2020, February 5). How a new fare payment delivery model is enabling MaaS. Mass Transit Magazine. Retrieved August 31, 2020, from https://www.masstransitmag.com/technology/fare-collection/article/21124088/masabi-us-ltd-how-a-new-fare-payment-delivery-model-is-enabling-maas
[35] Shared Use Mobility Center. Panel: Making MOD Happen through Payment Integration, available at: https://sharedusemobilitycenter.org/panel-making-mod-happen-through-payment-integration/, as of August 5, 2020.

for seven Ohio transit agencies, launched in 2019.[36] Using one app, riders could purchase transit fares for any of the participating agencies. EZfare expanded to cover thirteen agencies in Ohio and Kentucky in late 2019[37] before another expansion covering fifteen systems and integration with the Uber app in 2020.[38]

Mobile fare payments address operational concerns for transit agencies, as they can speed up the boarding process and reduce dwell times. Drivers do not have to wait for riders to insert the correct cash into a farebox or provide paper tickets. Agencies can produce fewer or no physical media for payments such as tickets or stored value cards, which reduces costs.[39] Additionally, the COVID-19 pandemic has shown the importance of contactless payment. LANta, which serves Pennsylvania's Lehigh and Northampton counties, was originally interested in how the switch to mobile fare payment would expedite boarding. However, during initial COVID-19 contingency planning, the agency recognized how the technology could reduce the exchange of cash – and potentially germs – between drivers and riders.[40] Lastly, mobile fare payment systems provide agencies with the flexibility to set up and change fares, loyalty or rewards programs, or other special fare programs easily and have minimal up-front costs depending on the chosen fare validation method.

Transit agencies need mechanisms to validate fare products purchased through the mobile fare payment app. According to a survey with over 60 transit providers in the US and Canada, the vast majority of mobile fare validation is conducted by drivers that see a mobile ticket displayed on a smartphone screen. Quick response (QR) codes or barcodes that riders scan are other validation methods.[40] TouchPass, a Fare Collection-as-a-Service digital platform, for example, provides a QR code that can be scanned upon entry, requires no contact, and is linked to a user account that includes payment information.[41] Those systems can also collect validation information across payment methods, such as smartphones, student IDs, smart cards, and paper QR codes. More than two dozen U.S. transit agencies currently use TouchPass, including recent implementation in the City of

Agencies should consider how mobile fare payments may impact riders:

- **Apps should integrate accessible features such as high-contrast text, large text, and connectivity to hearing aids.**
- **Since mobile fare payment will collect riders' personal, trip data, and payment information, systems will need to be secure.**

[36] Masabi. NEORide and Masabi Launch EZfare, available at: https://www.masabi.com/2019/06/25/neoride-and-masabi-launch-ezfare-an-innovative-multi-agency-cashless-mobile-ticketing-app-making-riding-public-transit-easier-than-ever-before/, as of August 21, 2020.
[37] Masabi. NEORide, Masabi, and Transit Get People Moving with Multi-Agency Mobile Ticketing app, available at:, as of August 21, 2020.
[38] Masabi. EZfare Ticketing Launching with Journey Planning in Uber App for Riders Across Ohio and Kentucky, available at: https://www.masabi.com/2020/07/15/15654/, as of August 21, 2020.
[39] Transportation Research Board. Transit Cooperative Research Program (TCRP) Report 177: Preliminary Strategic Analysis of Next Generation FarePayment Systems for Public Transportation, available at: https://www.nap.edu/download/22158#, as of August 5, 2020.
[40] The Morning Call. LANTA readies contingency plans as more coronavirus cases appear in Pennsylvania, available at https://www.mcall.com/coronavirus/mc-biz-lanta-coronavirus-ticket-app-20200309-ch4wy355gng3xjp6m5pacp7s4y-story.html, as of August 21, 2020.
[41] Cubic. Touch Pass Brochure, available at: https://www.cubic.com/sites/default/files/20-CTS-Cubic%20TouchPass-brochure%20-%20v1%20-%20FINAL.pdf, as of August 5, 2020.

Billings, Montana, where the COVID-19 pandemic and brought to the fore the need for contactless and quick fare collection.[42]

State of the Practice and Trends

Mobile fare payment companies are working with agencies of all sizes across the world. Token Transit works with 94 agencies across the United States and Canada and Masabi's Justride with over 80 agencies in 11 countries. [43, 44] Ubitransport has a light account-based fare collection system widely adopted in rural France and a couple of small systems in Canada.[45] Other companies are operating in this space for which public-facing client information was not readily available. However, many vendors strive to provide solutions that are easy to use and provide detailed rider data with low or no upfront costs and scalability that can meet agency needs.

Resources

Agencies implementing mobile fare payment systems rely on human, financial, and technological resources. The agency would need to understand their needs and select an appropriate payment solution, which may be limited based on available levels of funding. There are several business models and contract types for mobile fare payment. Still, vendors tend to handle mobile app development, payment processing, and compliance requirements and are paid based on a percentage of sales.[33] Transit agencies tend to address customer service and marketing the fare option.[33] Agencies can also choose from an off-the-shelf app with fewer customizations that might be used by several agencies, or a so-called "white label" app which is designed to look like it was made by the agency, albeit at a higher cost. Since most mobile fare payment systems are cloud-based, agencies do not need additional physical, in-house IT infrastructure. Drivers and riders must be trained to learn how to use mobile fare payment systems. If other validation methods than visual checks are to be used, agencies may also have to consider capital expenditures to update existing fareboxes or install new fare readers on vehicles.

Key Findings

Scholarly research on mobile fare payment is limited, as is transit agency data that quantify its impact. A study[46] among bus riders in Florida found that riders spent less time buying tickets and experienced reduced boarding times. In the same study, drivers spent less time validating fares and also noted reduced boarding times. In a pilot project in Florida, riders downloaded an app to purchase tickets. Upon the pilot's conclusion, 75 percent of riders indicated that they were "very satisfied" with the app, although some experienced difficulties with internet connectivity.[47] From an agency perspective*, TCRP Synthesis 148: Business Models for Mobile Fare Apps* asked agencies about the challenges they faced in deploying mobile fare payment. Write-in responses included, "(1) training of frontline staff, (2) customer education and awareness, and (3) a lack of integration either regionally or with their existing fare payment system.[33]

---

[42] Cubic. (2020, August 28). Cubic expands TouchPass Solution to Montana's MET Transit system. Mass Transit Magazine. Retrieved August 31, 2020, from https://www.masstransitmag.com/technology/fare-collection/fare-collection-equipment/press-release/21152201/cubic-transportation-systems-cubic-expands-touchpass-solution-to-montanas-met-transit-system

[43] Token Transit. Bus Passes on Your Phone, available at: https://tokentransit.com/, as of August 5, 2020.

[44] Masabi. Justride Mobile Ticketing, available at: https://www.masabi.com/justride-mobile-ticketing, as of August 5, 2020.

[45] Ubitransport. What We Do: Fare Collection, available at: https://www.ubitransport.com/what-we-do-fare-collection/?lang=en, as of August 5, 2020.

[46]Brakewood, C., Ziedan, A., Hendricks, S. J., Barbeau, S. J., & Joslin, A. (2020). An evaluation of the benefits of mobile fare payment technology from the user and operator perspectives. Transport Policy, 93, 54-66. https://www.sciencedirect.com/science/article/pii/S0967070X19304056.

[47] Ibid.

Key Takeaways

1. While there are several business models and contract types for mobile fare payment, vendors tend to handle mobile app development, payment processing, and compliance requirements and are paid based on a percentage of sales.
2. The rise of the subscription-based or Pay-as-You-Go models provide agencies of all sizes the opportunity to use a cloud-based subscription service to manage fare payment as opposed to customized systems.

For more information

- Many small-urban, rural and tribal transit systems are rolling out mobile fare payment system. For a couple of examples, contact:
  - Kendra McGeady, Director of Transit, Pelivan Transit/Northeast Oklahoma Tribal Transit Consortium, Big Cabin, Okla., kmcgeady@grandgateway.org
  - Scott Chancey, Transit Program Supervisor, Josephine County, DBA Josephine Community Transit (JCT), Grants Pass, Ore., schancey@co.josephine.or.us
- TCRP Synthesis 125: Multiagency Electronic Fare Payment Systems https://www.nap.edu/download/24733#
- TCRP Report 177: Preliminary Strategic Analysis of Next Generation Fare Payment Systems for Public Transportation https://www.nap.edu/download/22158#
- TCRP Synthesis 148: Business Models for Mobile Fare Apps https://www.nap.edu/download/25798# https://sharedusemobilitycenter.org/panel-making-mod-happen-through-payment-integration/

Johnson County, Kansas Flex Service Pilot

PROMISING PRACTICE: USING FLEXIBLE SERVICE TO MAKE FIRST AND LAST-MILE CONNECTIONS TO FIXED-ROUTE TRANSIT

In 2019, Johnson County, Kansas, located in the Kansas City metropolitan area, implemented a demand-response service to connect residents to fixed-route transit. The service quickly grew, with the number of vehicles needed to provide the service more than doubling in the space of a few months, spurring ridership growth on the county's fixed-route services as well. In 2020, Johnson County has simultaneously had to work to ensure that the program continues to meet demand, while also navigating the constraints of COVID-19 related capacity and budget issues.

Context

Johnson County, located southwest of Kansas City, is the economic engine for the state of Kansas, as well as its most populous county. Historically the County has had limited transit service, and today it has an infrequent fixed-route network which, due to Johnson County's sprawling development patterns, does not reach most county residents.

Figure 13: RideKC Microtransit Vehicles

Source: RideKC Twitter

Johnson County's Flex Service was created to serve two main goals. One was to serve as a first and last-mile connection to the region's fixed-route network, to connect residents to existing transit options better. The second was to offer additional transit capacity to support the county's effort to create urban destinations that will attract young adults to move in. Rides cost $1.50 and include a free transfer to fixed-route transit. The first year's ridership data suggests that riders are using the service for both short and medium distance travel.

To develop the service, Johnson County worked with RideKC, the Kansas City region's largest public transit agency, and partnered with microtransit vendor Transloc and a local taxi service under their preexisting contracts with RideKC. Transloc provided the software that powers the service, including a mobile app for hailing rides as well as the dispatching software. The taxi service provides additional vehicles to operate the service when the seven vans purchased for the program cannot meet demand.

The service operates Monday through Saturday. The service operates in a roughly 40 square mile area on weekdays, with an expanded Saturday service area covering roughly 60 square miles. These service areas were chosen to take advantage of existing pockets of density in the county, and to maximize connections to the fixed-route system in Johnson County, as well fixed-route services in other parts of the Kansas City metro area. The expanded Saturday service area is intended to improve access to Overland Park, which with a population of nearly 200,000 is the second largest city in the state of Kansas, as well as the second largest city in the Kansas City metropolitan area.

State of the Practice and Trends

Demand-response services have long been offered by public transit agencies all over the United States, particularly in small towns or rural areas with insufficient demand to support fixed-route services. But the expansion of Transportation Network Companies (TNCs) like Uber and Lyft have shown that allowing riders to book at any time through a mobile app can make demand-response transportation viable even in many suburban areas. As a result, demand-response services are being piloted across the country in areas that had underperforming or no fixed-route services.

Resources

The first year of the Flex Service pilot cost Johnson County about $600,000, including just under $100,000 spent to acquire the county's first three Ford Transit Connect vehicles to operate the service. The cost was carried by the county, using funds earmarked for transportation service. Additionally, the county was able to take advantage of preexisting contracts between RideKC and Transloc as well as one between the county itself and a local taxi service. The Transloc contract allowed for the rapid creation of an app for the flex service pilot, while also ensuring that the app would be customized to meet the county's needs. The taxi contract, initially designed to provide paratransit rides, became extremely useful when the county found demand for its Flex Service outstripping the number of vehicles it had available for the service, causing wait times to spike and rider satisfaction to fall. Transloc very quickly put together a version of its dispatching software that works on Android devices, allowing the taxi service to be used for transporting Flex Service users as well. The agency pays for these rides on a per-trip basis, making it a cost-effective solution.

The state of Kansas has offered the county a $500,000 grant to expand the service to the county's northern border, allowing riders to connect with the transit options in neighboring Wyandotte County more effectively. As of this writing, the agency has yet to decide whether to take the grant and expand service. The sticking point is that expanding the service area would increase the program's operating cost to an estimated $1.2 million per year, which, with a pandemic-related budgetary crunch looming, may not be feasible for the county.

Barriers

Historically, the biggest barriers to improving transit service in Johnson County have been low-density development patterns and a lack of support for transit in the community. Both of these are beginning to change: mobile app technology makes flexible service a much more appealing option to potential riders, and several elected officials expressed support for expanding transit options. The county was thus able to benefit from existing partnerships in the region.

Once the service launched, the biggest barrier that Johnson County faced was dealing with the consequences of its own success. Within two weeks of launch, the service was providing 100 rides per day, surpassing the county's projections and creating more demand than the original three vehicles could meet. Johnson County overcame this barrier by turning to its existing taxi partnership, paying per-ride for taxi trips for riders when county vehicles were unavailable, while also purchasing additional vehicles for use in the Flex Service pilot.

Recently, the COVID-19 pandemic has also posed problems for the Flex Service pilot, as it has for transit providers all over the country. Ridership dropped by 55 percent within a matter of weeks. To create a safer environment for both riders and passengers, the agency began limiting trips to one rider at a time and bought ozone foggers to sanitize the fleet daily. While the county does not require masks on public transit, it does strongly encourage them. To the extent it can, the county has been distributing masks to riders, though a limited supply of masks has made this difficult. The county reports that these precautions have helped Flex Service ridership rebound faster than fixed-route ridership and that, to date, there have been no confirmed cases of the virus among either riders or drivers.

Results

From the perspective of County transportation officials, the service has provided significant mobility benefits by increasing transit ridership among Johnson County residents. Additionally, the service's success has helped build political support for transit, as the agency can point to the Flex Service's benefits for both job access and access to social services.

Lessons Learned

County officials were pleasantly surprised to discover that the Flex Service was far more popular than they had anticipated. For a time, this led to a reduction in the quality of service they could provide, as they simply could not meet the demand for the service with the vehicles they had available to them. They learned two lessons from this experience: first, that when planning a new service, agencies should be prepared for the service to be more popular than they expect, and second, that taking advantage of existing partnerships, as Johnson County did with Transloc and its local taxi service, is often the most efficient way to address unexpected issues. Using these existing partnerships, as Johnson County did, can help even small communities launch flex service and enhance mobility for their residents.

Johnson County has not only seen ridership on its Flex Service exceed expectations, but it has also seen the Flex Service pilot bring new riders to its fixed-route services as well.

Key Takeaways

1. Johnson County partnered with microtransit vendor Transloc and RideKC, taking advantage of a preexisting contract between RideKC and local taxi service, to develop the service.
2. When planning a new microtransit service, agencies should be prepared for the service to be more popular than they expect and have contingency plans to address demand exceeding service availability.

For more information

- For more information about this practice, contact Joshua Powers at Johnson County, Joshua.Powers@jocogov.org.
- Government Technology magazine article about Johnson County's Flex Service and its response to the COVID-19 pandemic: https://www.govtech.com/fs/transportation/Transit-Is-Being-Drawn-to-an-On-Demand-Model-in-Kansas.html
- Kansas City Area Transportation Authority: https://www.kcata.org/

Minneapolis Mobility Hubs Pilot

PROMISING PRACTICE: STRENGTHENING COMMUNITIES BY BUILDING BETTER CONNECTIONS BETWEEN MODES.

The Minneapolis Mobility Hubs Pilot increases access to convenient, low or no carbon transportation options, including transit, shared scooters, and the Nice Ride bikeshare system, by creating centers where riders can transfer between these modes easily. Implemented in September of 2019, the original pilot covered 12 locations marked by specially designed wayfinding signs in North, Northeast, and South Minneapolis. Mobility hubs include seating, bikeshare docks, transit stops (often on high-frequency routes), and designated parking locations for dockless shared bikes and scooters.

The City of Minneapolis Department of Public Works is expanding the defined use of Mobility Hubs beyond being a place where people can connect to multiple modes of transportation safely and conveniently. In this year's pilot, the city expanded the number of locations in their Mobility Hub program and is now pivoting hub usage to respond to the new needs of the community due to COVID-19 and civil unrest. The city will be working with local community partners to identify the evolving needs of the low-income neighborhoods disproportionately impacted and use the Hubs as a neighborhood level distribution point.

Context

Minneapolis' Mobility Hubs were created for two main reasons. One was the desire to address transportation sustainability goals, reducing the carbon footprint of transportation in the region. The other was the desire to improve job access by transit, a major goal of both the region's MPO as well as large philanthropies in the area. The practice allows easier access to and transfers between a variety of different transportation options, including docked and dockless shared bikes and scooters and bus lines. The pilot was initiated by the City of Minneapolis, which chose to focus on this intervention because the city has a lot more power to change streetscapes and sidewalk furniture than, for instance, change public transit service, which is operated by a regional transit authority. The city believed that this was the best way to use its power over street space to promote mobility.

> Mobility Hubs are centers where access to shared mobility modes such as carsharing, bikesharing, ridesharing, and other shared mobility modes are located near public transit stops and centers of population and employment to facilitate transfer activity, access to services, and expand accessibility and mobility for all.

Major stakeholders included the City of Minneapolis, Hennepin County, MnDOT, Metro Transit, NiceRide (the Minneapolis area's public bikeshare system), shared scooter companies operating in the city (e.g., Lyft, Spin, and Lime), as well as representatives of community organizations in target communities. Targeted communities included neighborhoods of North Minneapolis, Northeast Minneapolis, and South Minneapolis, which were chosen because minorities, low-income households, and individuals without access to a car are disproportionately likely to live in these areas of concentrated poverty in the city. In each community, four specific locations were selected for their proximity to major bus lines and community resources such as groceries, health care centers, libraries, and other social services.

Stakeholder and public engagement were key elements of the practice from the very beginning. Stakeholder engagement began with a day-long regional workshop designed to flesh out a common vision

for the roles mobility hubs would play in their communities and some of the features they might offer. For the pilot, project staff then approached the communities in which mobility hubs were planned to discuss specific locations and site plans developed through comprehensive data analysis. This community feedback was integrated into the mobility hub designs. During the initial pilot implementation in Fall 2019, surveys of mobility hub users were conducted both at the hubs themselves and via the internet. Additional feedback was also gathered from community organizations in the target neighborhoods. This feedback, in turn, led to planned improvements for the next round of mobility hub implementations.

State of the Practice and Trends

The Mobility Hub pilot was evaluated in a variety of different ways. The City of Minneapolis looked at ridership on all modes of transportation served by the mobility hubs: buses, shared bikes, and scooters. The pilot was also evaluated through extensive surveying both at mobility hubs and online. Across all modes, 800,000 trips were made either starting or ending at a Mobility Hub location. Some locations, but not all, saw substantial upticks in shared bike and scooter ridership. This was especially true in locations where existing transit ridership was high, as well as locations away from major arteries where riders felt safer using bikes and scooters.

More important to the City's evaluation of the program were the results of its surveys, particularly the surveys conducted at Mobility Hubs. They found that the most important features of Mobility Hubs to users were that they be places that feel safe, places that provide access to several different transportation options, and also places that people can sit and gather. The street furniture provided at Mobility Hubs was a welcome addition for community members, and members of the community felt that the engagement process clearly took their needs and concerns into consideration. Most importantly, to project staff and city leaders, they found that the Mobility Hubs helped people move around by providing easier access to a variety of low-carbon and no-carbon transportation options.

Figure 14: City of Minneapolis Mobility Hub micromobility parking areas, signage, and seating part of placemaking strategies.

Source: City of Minneapolis

While the initial pilot was successful, the expansion of the pilot, originally planned for Spring 2020, has been delayed due to external circumstances. The reasons for the delay include pandemic-related funding constraints and delays in getting bikes and scooters onto the streets. Additionally, the series of protests and civil unrest in response to racism in Minneapolis that began in late May 2020 led stakeholders to re-evaluate their plans. The City of Minneapolis saw the unrest as an impetus to return to the drawing board with their site designs and move forward based on the new needs of the neighborhoods.

MINNEAPOLIS ISN'T THE ONLY PLACE IN NORTH AMERICA IN WHICH SOME FORM OF MOBILITY HUB HAS BEEN TESTED, WITH LOS ANGELES, BOSTON, COLUMBUS, OHIO, AND SEVERAL CANADIAN CITIES AMONG THE OTHER PLACES THAT HAVE PILOTED THIS PRACTICE.

Resources

Funding for the Mobility Hubs pilot came from philanthropic organizations, with the city's contribution taking the form of staff time and expertise. Minneapolis was chosen as one of 25 Bloomberg American Climate Challenge cities, with this designation providing the city up to $2.5 million to spend on innovations that would reduce carbon emissions and promote sustainability. Mobility Hubs were specifically mentioned in the city's application as one of the practices they would be using the grant funding to implement. Other philanthropic organizations, such as the Energy Foundation and the Carbon Neutral Cities Alliance, provided additional support for the engagement work in the initial and expanded pilots.

While the City of Minneapolis did not spend any of its own funds directly on the initial pilot, city staff were involved throughout the process. Staff contributed with time and expertise in designing and implementing the Mobility Hubs (e.g., designing and constructing street furniture and artwork, restriping roads to accommodate bike and scooter parking areas), as well as conducting related stakeholder and public engagement. A total of $170,000 was originally budgeted by the city for implementing the next round of Mobility Hubs, including $100,000 in philanthropic resources and $70,000 in direct city funding. The city was able to secure $25,000 from the NACTO Streets for Pandemic Response and Recovery Grant program to cover budget shortfalls for the city portion. Some new Mobility Hub locations were also included in the city's 20 in 20 intersection safety improvement program to include additional pedestrian safety interventions such as curb extensions.

Barriers

Danielle Elkins, a strategic consultant who coordinated the Mobility Hub pilot for the City of Minneapolis, cited logistical hurdles as the most significant barrier they had to overcome in implementing the Mobility Hub pilot. Streetscape interventions, even temporary ones, required the city to go through time-consuming processes with multiple internal stakeholder departments to get county or state permission for various aspects of the project to move forward. Having all of the political leaders and agency heads in agreement, at least in broad strokes, about the path forward for Mobility Hubs made these processes easier to navigate. As Ms. Elkins is a contractor, not a city employee, she suggested that it may have been easier for her to navigate these logistical issues than it may have otherwise been for a municipal employee with a variety of other daily duties.

Many smaller and rural communities are home to successful shared mobility programs, such as bicycle libraries, publically-operated carsharing programs, and designated park-and-ride locations that facilitate carpooling and vanpooling. Rural communities can seek to integrate these systems with public transportation through physical mobility hubs and/or through integration in trip planning or fare payment systems.

Lessons Learned

One lesson pointed to by Ms. Elkins was the need to start the process earlier, because of both the need for extensive outreach and the need to navigate internal processes with a number of stakeholders. (The planning and design phase for this project took about 15 months.) As a result, the initial

12 pilot locations were not rolled out until September of 2019. Because of the city's harsh winters, shared bikes and scooters are usually not made available in winter in Minneapolis. To help drive traffic to the Mobility Hubs, their season was extended, but they were still taken off the streets for the winter shortly after the region's first major snowstorm. The city is still navigating how to provide multiple mobility options at these hubs during the winter months, but they did learn that snow clearance would be an important part of maintenance for these hubs.

Another lesson for the city was the importance of its extensive engagement process. Going to the target communities, listening to residents' concerns, and changing the Mobility Hubs as a result of that engagement, helped members of these underserved communities feel like this wasn't just another city project, but something that was intended to help meet their mobility needs.

At the time of this writing, the City of Minneapolis is trying to integrate into its Mobility Hub plan some of the lessons the city learned during the recent uprising in the community. It is trying to make sure that its Mobility Hubs provide essential services for residents of underserved neighborhoods, even as the unrest has temporarily or permanently forced those services to relocate.

KEY TAKEAWAYS

1. EXTENSIVE ENGAGEMENT HELPED RESHAPE MOBILITY HUBS AND DELIVER A PROJECT THAT MET THE NEEDS OF THE COMMUNITY, INCLUDING TRADITIONALLY UNDERSERVED POPULATIONS.
2. IMPLEMENTATION WAS SUPPORTED THROUGH FUNDING FROM PRIVATE FOUNDATIONS AND THE CITY OF MINNEAPOLIS STAFF TIME AND EXPERTISE.

For more information

- Contact Danielle Elkins at the City of Minneapolis: danielle.elkins@minneapolismn.gov.
- The City of Minneapolis' 2019 report on its Mobility Hubs Pilot can be found at http://www2.minneapolismn.gov/www/groups/public/@publicworks/documents/webcontent/wcmsp-224822.pdf
- The Shared Use Mobility Center's writeup of the Mobility Hub pilot can be found at https://sharedusemobilitycenter.org/mobility-hubs-in-twin-cities/?gclid=EAIaIQobChMIhr-MwtL16QIVFACGCh3JjAIeEAAYASAAEgKcDvD_BwE

Common Themes

While the promising practices profiled in this Guidebook are varied in nature and the types of benefits accrued to transit providers, there were several common themes identified that helped to facilitate practice adoption.

Partnerships

A number of the practices profiled were made possible via partnerships that contributed funding, staff hours, and expertise to bring a practice to fruition. Several of these partnerships engaged with organizations outside of the transportation industry, including the Tennessee Department of Intellectual and Developmental Disabilities funding of the development of CARTA's WayFinder technology and Blue Lake Rancheria's work with local university students to develop the plan for their waste oil to fuel solution. State governments also played key roles in realizing practices, including the development of the Connect app for Ann Arbor and Detroit created through the statewide Michigan's Mobility Challenge and South Carolina DOT's support for CATbus electric bus program. Johnson County worked with RideKC, the Kansas City region's largest public transit agency, and partnered with microtransit vendor Transloc and a local taxi service under their preexisting contracts with RideKC.

Vendor Research and Engagement

Many of the practices profiled were the result of or benefited from extensive vendor research and engagement. Mobile fare payment technologies scaled to smaller agencies were developed in response to demand from smaller agencies. CATbus worked closely with Proterra to resolve technical issues with first-generation electric buses. Portneuf, an agency with a staff of three, continued their long-term search for a vendor to provide a CAD-AVL and fare payment solution that was not cost prohibitive. This search led them to a French company, with whom they worked to adapt their product to the North American market.

Stakeholder Involvement

Engagement from key external stakeholders throughout the development and implementation of practice was also common. Organizations representing elderly and disabled Vermonters, such as the Vermont Association of the Blind and Visually Impaired and the Vermont Center for Independent Living, were heavily involved in the process of developing and marketing Go Vermont!. The development of Go Vermont! also benefited from existing strong relationships with employers and transportation management associations, and strong buy-in for transportation demand management strategies among state leadership. CARTA is working with Chattanooga's Orange Grove Center, a facility that serves disabled adults, to pilot their WayFinder technology. The development of the WayFinder technology and the development of Michigan's Connect app both benefited from strong relationships and communication with a variety of stakeholders.

Minneapolis' implementation of Mobility Hubs also relied upon its extensive engagement process. Going to the target communities, listening to residents' concerns, and changing the Mobility Hubs as a result of that engagement, helped members of these underserved communities feel like this was more than another City project, it was something intended to help meet their mobility needs.

Internal stakeholder involvement was crucial for Mountain Line. Given the large systemic nature of the shift from paper-based maintenance online, IoT-enabled asset management system, continuous internal stakeholder engagement and support from senior leadership were essential to the implementation. A range of staff, from the Business Manager to staff in the Facilities and Fleet Divisions, joined the

Implementation Team to provide detailed feedback during the initial development process and to ensure that the solution implemented would meet their needs and expectations.

Planning

While all of the practices profiled resulted from careful planning, lessons learned shared by interviewees often related to additional elements of planning or implementation undertaken or that would have been beneficial in response to the initial deployment. Go Vermont! noted that the lack of established measures of success at the outset of the project which made program evaluation more difficult, as did having as insufficient knowledge about why their desired end-users make the transportation choices they do. Portneuf spent double the time on training and implementation (six months versus three) in deploying their CAD-AVL system and training staff on its use. In Johnson County, demand for their Flex service quickly outstripped the County's ability to deliver it and the County had to quickly shift to planning for growth of their Flex service to meet the community demand.

The common themes speak to agencies that are resourceful in seeking out not only new practices but in finding ways to fund and implement new practices that are cost-effective and practical for smaller agencies.

Appendix – List of Interviewees

Interviewee Name, Position	Organization	Date
Lisa Maragnano, Executive Director	Chattanooga Area Regional Transportation Authority	June 26, 2020
Danielle Elkins, FUSE Executive Advisor	City of Minneapolis Public Works	June 29, 2020
Jameson Auten, Senior Vice President of Regional Services and Innovation	Kansas City Area Transportation Authority	June 30, 2020
Wade Forrest, Facilities Manager	Northern Arizona Intergovernmental Public Transportation Authority	July 1, 2020
Dan Currier, Public Transit Coordinator	Vermont Agency of Transportation	July 2, 2020
Maryse Perron, General Director	Corporation de Transport Régional de Portneuf	July 16, 2020
Jana Ganion, Sustainability Director at Blue Lake Rancheria	Blue Lake Rancheria	July 22, 2020
Valerie Lefler, Executive Director	Feonix - Mobility Rising	July 23, 2020