TR NEWS
July–August 2023
NUMBER 346

Addressing Transportation and Accessibility for All

PLUS

An Accessible Chain of Travel

Invisible Disabilities

People with Disabilities in the Transit Workforce

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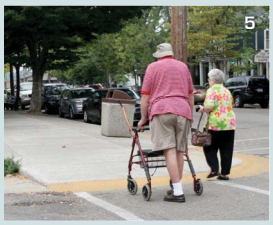

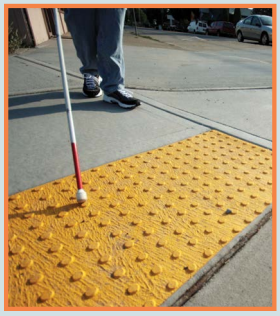

COVER As deftly as trained fingers read braille, the rubber tip of an assistive cane detects raised dots on pavement. Such an infrastructure enhancement (this one designed to help people with vision disabilities safely navigate across a street) is just one way the transportation industry is addressing the mobility needs of people with visible and invisible disabilities, as well as older adults. (iStock)

Coming Next Issue

The September–October 2023 issue of *TR News* explores the theme of transportation in rural areas. The authors look at such topics as the availability of automated vehicles and associated infrastructure, how research and workshops inform transportation along low-volume roads, and how a vast network of airports serves Alaska's traveling public.

A Pilatus PC-12 aircraft, part of the Ryan Alaska Air fleet, is prepared for take-off in the state's rural outreaches. Larger than Texas, California, and Montana combined, much of Alaska is inaccessible on the ground. However, a broad network of private airlines, airports, and airstrips keeps the public moving.

Courtesy of Ryan Air Alaska, Wikimedia Commons, CC BY-SA 4.0

ALSO IN THIS ISSUE

TRB COVID-19 Resources

Agencies and organizations can use TRB publications and online resources for useful and timely information to help address issues related to the COVID-19 pandemic. To read about TRB's current research and activities, and for a list of relevant publications, visit www.nationalacademies.org/trb/blog/transportation-in-the-face-of-communicable-disease.

The *TR News* Editorial Board thanks Karen Febey, TRB, for her work assembling and developing this issue.

TR NEWS

features articles on innovative and timely research and development activities in all modes of transportation. Brief news items of interest to the transportation community are also included, along with profiles of transportation professionals, meeting announcements, summaries of new publications, and news of Transportation Research Board activities.

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ADDRESSING TRANSPORTATION AND ACCESSIBILITY FOR ALL

TODD HANSEN, JILL HOUGH, AND JUDY SHANLEY

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Transportation improvements and innovations are too often focused on providing benefits for the greatest number of people. While this approach seems logical at face value, it leaves glaring gaps in mobility and creates barriers in accessibility to transportation for people who may be most dependent on the availability of safe, reliable, transportation services and infrastructure.

Mobility barriers and access to safe and reliable transportation can affect multiple populations, including persons with disabilities and people living outside of metropolitan areas. Challenges may include the following:

- Long distances to travel from home to a store or medical appointment,
- Advanced reservation required to book a trip with a transportation provider,
- Inability to comfortably transition away from driving a vehicle (especially for older adults with decreasing vision), or
- Service features that exclude accommodations for different types of disabilities.

These barriers can be further compounded for people in both groups, meaning persons with disabilities who also live in rural areas. This population has multiple challenges to travel to the places they need to go, access needed services, and stay connected with family and friends.

The articles in this special issue focus on improving transportation and mobility for people with disabilities, as well as those living in rural areas. Article themes include improved service principles and models, innovative technology implementation, and understanding different needs from person to person. For instance, persons with disabilities are often thought of as a single group who only need improved wheelchair access. However, individuals with different types of visual, auditory, and cognitive disabilities encounter their own barriers to

transportation. Some rural residents may have special health and service needs or work nontraditional hours outside of available transit service. Safety challenges such as biking and transit use that may affect pedestrians and other active travelers will vary depending on the built environment and the individual's own comfort levels. This collection of articles delves into these nuances and provides solutions to overcome transportation and mobility barriers.

The central focus in these topics is improving accessibility for all kinds of travelers. The issue begins with articles discussing how to integrate universal mobility principles into transportation to enable accessible mobility for all types of disabilities. These articles provide models for accessible transportation across different types of transportation services as individuals move from one travel mode to the next. Next, innovation in demand-responsive transit service in rural areas is highlighted, followed by applications of technology to overcome barriers to accessibility in transit. The issue continues with detailing approaches in human-factors research to improve transportation service and public engagement in transportation decision making. Concerns about access to healthy food options and medical care relative to these key population groups are discussed next. The issue concludes with articles on solutions to improve transportation for people with invisible disabilities—that is, those not readily identified by others—and strategies to improve workforce opportunities for persons with disabilities.

Chona Kasinger, Disabled and Here

A cane makes it easier for Leila—a disabled artist, activist, and organizer—to walk around the streets of Portland, Oregon, but navigating safely and with confidence relies on conscientious pavement maintenance.

This theme issue is a joint effort of two TRB standing committees: the Accessible Transportation and Mobility Committee and the Rural, Intercity Bus, and Specialized Transportation Committee.[1] We hope this collection provides insight on individual needs in transportation and mobility and delivers lessons that industry professionals can incorporate in their work to improve transportation.

[1] Learn more about these TRB committees at https://www.trbaccessmobility.org and https://trbap055.multiscreensite.com/.

"Individuals with different types of visual, auditory, and cognitive disabilities encounter their own barriers to transportation."

One Step at a Time

Integrating Inclusive Mobility into Transportation Planning and Service Delivery

Dan Burden, Pedestrian and Bicycle Information Center

JORDANA MAISEL, ALBERT BENEDICT, NATE SEESKIN, STEVEN WINTERS, AND JUDY SHANLEY

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Crossing the street is made easier for a couple in Saugatuck, Michigan, where a wide, textured curb cut graded to street level allows access for walkers and other assistive devices. Across the United States, communities are addressing barriers to mobility through inclusive transportation policies that help everyone navigate freely and safely.

At some point, everyone experiences disability—whether they are sick, injured, aging, or in an unfamiliar place where they don't speak the native language and have difficulty communicating. Thus, transportation programs and services that benefit a wide spectrum of passengers have broad appeal. For those who rely on publicly available transportation options as their only way to reach school or employment, the lack of transportation programs and services can create barriers to activity and participation—regardless of whether they are impaired.

It is an equitable society's responsibility to ensure that everyone has access to the same opportunities. Such a society recognizes that advantages and barriers exist but acknowledges that individuals may have unequal starting places and diverse backgrounds. It also commits to correcting and addressing these imbalances.

The current lack of transportation programs and services in many American communities is a major barrier to social participation, particularly for older adults and people with disabilities. These barriers are being addressed by introducing and implementing inclusive mobility policies and practices across transportation modes.

Over the past 40-plus years, much effort has been devoted to making the built environment—including transportation systems—accessible, while addressing existing imbalances. Accessibility laws—such as the Architectural Barriers Act of 1968, Section 504 of the Rehabilitation Act of 1973, the Fair Housing Amendments Act of 1988, and the Americans with Disabilities Act of 1990—specify minimum requirements to ensure that the built environment does not reflect discrimination against people with disabilities. In the mid-1980s, experience with accessibility laws led some individuals to recognize the need for a different approach to the built environment design, which they termed "universal design" (*1*). The premise for this new

approach—also called inclusive design—was that infrastructure could be more inclusive than laws mandated at the time, based on nondiscrimination. Universal design does not eliminate the need for standards that define the legal baseline for minimum accessibility. Instead, it seeks to provide aspirational goals beyond minimum regulatory requirements.

Universal design has evolved from initially focusing on supporting independent function to addressing additional performance goals. It strives to ensure that individuals with various abilities and identities are valued. To encompass these ideas, researchers further defined universal design as a "process that enables and empowers a diverse population by improving human performance, health and wellness, and social participation" (*2*).

An inclusive mobility system must be understood from a multimodal perspective across the entire travel chain (*3*). The links in the travel chain include planning the trip, traveling to the station, using the station or stop, boarding vehicles, riding in vehicles, leaving vehicles, using the stop (or transferring), and traveling to the destination after leaving the station or stop. If one link is not accessible, then access to a subsequent link is unattainable and the trip cannot be completed. The first–last mile problem—the distance a commuter needs to travel from a transit stop to their destination, or vice versa—is a persistent issue that can prevent an accessible travel chain. Specifically, the inability to get to and from stops and stations results in a lack of mobility or a dependency on costly paratransit.

To address this problem, researchers are developing ways to gather data that illustrate streets that do not accommodate diverse uses. For example, Project Sidewalk—an interactive data-gathering tool that employs crowdsourcing and online map imagery—catalogs pedestrian rights of way across cities and highlights where these communities fall short in providing accessible amenities to people with disabilities.[1] Such images can include abrupt surface changes from paved sidewalks to grass or multiple large cracks in sidewalks.

Laura Sandt, Pedestrian and Bicycle Information Center

A hopscotch of broken sidewalk presents an accessibility challenge for everyone, including people with disabilities. Multiple large cracks impede navigation of assistive devices, such as wheelchairs and walkers.

Likewise, current transportation fleets do not adequately address the usability needs of all riders and lead to challenges and frustrations for riders with disabilities, bus operators, and transit agencies. Public transportation services often operate on infrequent or limited schedules, and shared mobility services more broadly fail to bridge these gaps in peoples' transportation journeys. Similar usability concerns are evident in aviation; travelers with mobility needs face barriers because of aircraft design, equipment use policies, and lack of training for airline industry personnel.

Universal Design and Micromobility Programs

Transit agencies or communities with micromobility services, such as bike-share or scooter share, often exclude people with disabilities by not providing accessible vehicles. Reasons for this exclusion might include poor knowledge of accessible vehicles and costs associated with maintaining and operating a fleet designed for people with disabilities. Micromobility programs often have unreliable funding sources as they are commonly supported by external sponsorships and small grants. This instability may require micromobility operators to eschew more inclusive

[1] Learn more about Project Sidewalk at https://sidewalk-sea.cs.washington.edu.

Courtesy of MoGo Detroit

Broad sidewalks and extra wheels open a pathway of possibilities for MoGo riders in Detroit, Michigan. The city's bikeshare program offers an adaptive fleet for riders of every ability.

design considerations. However, some agencies and mobility providers have stipulated or tested the provision of accessible vehicles under their jurisdiction. For instance, in 2021, Milwaukee, Wisconsin, operated a shared e-scooter pilot with three vendors. In their contracts with the city, each vendor had to provide 100 adaptive e-scooters in their fleets (*4*).

On a seasonal basis, people in Detroit, Michigan, have access to a fleet of 16 accessible bikes through MoGo, the city's local bikeshare partner. These vehicles include a box bike, hand tricycles, recumbent tricycles, side-by-side quadricycles, tandem bicycles and tricycles, and upright cargo tricycles (*5*). While these programs in Detroit and Milwaukee have been limited, they serve as early procurement and deployment models for accessible micromobility programs. To create a universally designed system, transit agencies and cities could consider prioritizing accessible vehicles and gaining a better understanding of the financial considerations needed to deploy an accessible fleet.

Universal Design for Shared Mobility Options

Most transit agencies operate under significant financial constraints, prompting them to look to innovative technology and cost-effective service delivery mechanisms. Conventional public transportation practices are continuously challenged by the disruptive technologies—sudden innovations that force a change in transportation and policy—of ride-hailing, ride-sharing, and crowdsourcing used by popular rideshare companies. Although these services initially competed only with taxis, they have rapidly entered the public transit arena by contracting with public transit agencies to provide services, particularly where agencies have limited resources.

Fortunately, some promising practices of innovative shared mobility pilot programs exist and demonstrate how they can help to create more equitable and sustainable transportation systems. Officials may consider identifying and allocating resources to evaluate and support these efforts to determine their intended and unintended consequences. These transportation agencies and communities implement some form of universal design through the following:

- Reimagining transit agencies as mobility managers and thinking of shared mobility as core services beyond just bus and rail, and
- Offering accessible forms of shared mobility.

Early mobility pilots demonstrated the potential of shared mobility to provide on-demand options to enhance and connect transportation services. Through these partnerships and pilots, the mobility industry continues to evolve and is now recognizing the benefits of adopting and implementing open data architectures and systems that promote interoperability across modes and platforms.

Seattle's plan to pilot a One-Call/One-Click platform demonstrates this paradigm shift. Through the platform, users will be able to discover and book trips from human service agencies, nonprofits, taxi companies, and transit agencies. Notably, the community-based King County Mobility Coalition is spearheading this effort and gaining the cooperation of transit and human service agencies. The coalition earned two rounds of

inclusive planning grants from the Federal Administration for Community Living to support targeted outreach efforts to rural communities and people with disabilities, people with mental illness, those experiencing homelessness, and immigrant communities. Inclusive planning accounts for different voices and perspectives, offers an understanding of peoples' mobility needs, can eliminate costly retrofits to ensure accessibility, and builds awareness and support within the disability community and others, given their involvement in the process (*6*). Beyond this, the King County Mobility Coalition hopes that One-Call/One-Click and its open-source architecture are replicable in other communities and bolster the state of data discovery and interoperability across mobility providers in other regions (*7*).

Universal Design Integration Within Transportation Systems

In addition to programs, public policies may also be informed by and developed through an intersectional lens that engages and consults directly with the community of people with disabilities and other equity-seeking groups when designing new and retrofitting existing public transit infrastructure. In an attempt to bridge the gap between fixed-route public transit and shared mobility services, the City of Los Angeles awarded a contract to RideCo to provide on-demand trip technology in Los Angeles County via the county's Metro Micro fleet (*8*). In addition, as part of a first–last mile strategic plan, Los Angeles County set up a contract with Via to offer wheelchair-accessible transit options from three high-use metro stations in the county (*9*).

The Greater Toronto and Hamilton area of Ontario, Canada, as well as the capital city of Ottawa are demonstrating system integration via Metrolinx and its Presto Card. Fare payments for bus, metro, and light rail transit of several municipal transit agencies are integrated by using a single card through a contactless system that also complies with provincial accessibility requirements (*10*). Similar fare integration models include the Octopus Card in Hong Kong and the Oyster Card in London (*11*).

Universal Design in Passenger Rail and Aviation

Passenger rail plays a vital role for travelers, particularly in countries that are smaller in geographic size and where public policies include rail transit as part of an integrative transportation network.

Train cars traditionally do not offer much design flexibility and are not typically cited as best practices in universal design. They have several constraints, including limited usable space in rail cars, static railway track infrastructure, and typically long revenue service lives with few incentives to retrofit existing or procure new fleets. Other concerns include train car floors that are not level with the platforms and rail stations that are noncompliant with accessibility laws and regulations.

In some cases, access issues affect users disproportionately. For example, people with disabilities who use mobility aids, people who are blind or who have low vision, and older adults often encounter more barriers than other users while traveling by passenger rail. When making procurement decisions, rail operators should always look to maximize inclusivity and involve people with disabilities in the design and testing process. VIA Rail, Canada's national rail carrier, recently adopted inclusive and participatory practices in procuring a new fleet of trains. As part of the design and testing process of its new fleet, VIA Rail consulted with advocacy groups representing people with disabilities and other key stakeholders (*12*).

Air travel can present unique challenges for people with disabilities, as it involves many interactions that can impede universal access, such as boarding aircraft and the lack of accessible signage, liftable seat armrests, accessible onboard entertainment, and accessible lavatories. Many countries, including the United States and Canada, have put in place rules and regulations to ensure that air carriers comply with standards that promote minimal accessibility. However, few advances have exceeded these minimum requirements and embraced more inclusive practices. Given that air travel is global, policies that aim to harmonize standards and practices internationally—where appropriate—can help the aviation sector become more inclusive and ensure a better travel experience for all users.

Universal Design Processes in Future Technologies

Experts looking toward the future of transit view vehicle automation as a potential game changer in the public transportation realm. This disruptive technology has the potential to provide inexpensive, on-demand mobility services to all riders, as well as greatly impact land-use planning and street design (e.g., parking, curb management, and street cross-section). Despite the numerous claims that automated vehicles and connected automated vehicles can increase transit ridership, reliability, and access for people with disabilities, there is little evidence that the industry is prepared to provide accessible and inclusive automated vehicle designs, technology, and practices. While there is literature on policies and practices about automated and connected automated vehicles and their effects on people with disabilities, progress in establishing a consensus of policies and standards to understand accessibility requirements for automated and connected automated vehicle deployment and user needs is limited. In addition, public acceptance and adoption of automated and connected automated vehicles remain unclear.

The U.S. Department of Transportation (U.S. DOT) launched its Inclusive Design Challenge in January 2020. It was published in the *Federal Register* on January 7, 2020, as part of a request for information process. This initiative, which concluded on July 26, 2022, focused on innovative design solutions to enable people with disabilities to use automated vehicles daily. Further, it underscored the importance of leveraging the expertise of the disability community to inform the

universal design process for automated vehicles (*13*). The challenge also served to nudge interest in promoting accessibility in the automated and connected automated vehicle realms, which in turn may increase the likelihood of adoption by manufacturers and service providers to include accessible design considerations for automated vehicles. Complementary to the initiative, U.S. DOT commenced work on an inclusive design reference hub to provide resources for engineers, designers, and the disability community in designing accessible automated vehicles (*14*).

Conclusion

In a just society, multimodal transportation policies, programs, and systems must benefit all, regardless of ability. It is not sufficient to design for disability alone because people are not defined solely by their abilities. Avoiding inconvenience, stigma, and embarrassment is as important for people with disabilities as it is for everyone else. The philosophy of universal design provides a more holistic framework for conceiving, designing, and operating inclusive transportation systems than does the traditional accessibility model. It addresses issues beyond function. Universal design in transportation systems ultimately requires a service design approach. It needs to address not only the physical design of the vehicle but also the communications, user interfaces for hailing and operation, pricing structure, response time, driver training, complete trip including accessible paths to access public transportation, and many other factors. While some transportation barriers will persist, working toward inclusive mobility for all will help remove some of these systemic and structural barriers. Universal design allows transportation providers at all levels to reimagine their roles as they navigate challenges such as labor shortages, supply chain hold-ups, and increasing costs.

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"Universal design has evolved from initially focusing on supporting individual function to addressing additional performance goals. It strives to ensure that individuals with various abilities and identities are valued."

CHALLENGES AND OPPORTUNITIES

Accessible Paths to Transit

Mackenzie Hayes, University of Illinois at Chicago

AMY O'HARA, YOCHAI EISENBERG, AND NED SCHWEIKERT

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Curb ramps like this one, missing a large portion that would align with the adjacent crosswalk, pose a barrier to people with low vision—essentially breaking the chain of travel from one side of the street to the other.

Typical travel outside the home begins and ends with walking or wheeling on a solid path or sidewalk. This path of travel is a critical link in the chain of travel—a chain made up of multiple links or trip segments. These segments include all the physical environments and transit services that an individual may use in a journey, such as walking and wheeling paths, buses, trains, transfers, and passenger vehicles. If one segment is broken because it is inaccessible, unreliable, or inefficient, then the overall trip cannot be completed.

The U.S. Department of Transportation (U.S. DOT) has promoted the concept of a complete trip, one in which an individual can travel from origin to destination without any broken links in the travel chain (*1*). Many people with disabilities experience numerous barriers across the chain of travel. This makes complete trips an ideal instead of a reality for those with disabilities.

Barriers on the path of travel are often highlighted in studies on challenges to and supports for transportation (*2, 3*). They pose critical challenges for accessing employment, promoting or maintaining health, and participating in other types of community activities (*4*). Certain barriers affect some people with mobility limitations more than others. For instance, people who are blind or who have low vision often use tactical warning strips—also called detectable warnings—on curb ramps to know when they are leaving the sidewalk and entering the street. When these warning strips are missing, the trip may become unsafe—breaking the chain of travel. Similarly, a missing curb ramp is a barrier for an individual using an assistive mobility device, such as a wheelchair or walker.

This article describes some of the challenges—as well as the opportunities—for U.S. transportation stakeholders to develop and sustain accessible paths of travel by using new modes of data collection, route planning, implementation plans, and resources. The other segments of a complete trip—such as buses, trains,

and transfers—are important. However, if these segments cannot be accessed, they are not useful to those who need them but cannot reach them—no matter how good they are.

Why Paths of Travel?

Barriers on the paths of travel create unsafe conditions for travel by vulnerable populations, such as older adults and people with disabilities. These unsafe conditions can limit where people go in their community, how they get around, and even their decision to leave the home at all. Furthermore, these barriers can affect access to employment, healthcare and health promotion, and overall community participation. Many people with disabilities who routinely use transit have learned how to temporarily—or permanently—overcome barriers they encounter on the path of travel (*5*). However, these workarounds require additional time and effort that combine to make travel more difficult and burdensome. Developing and sustaining accessible paths of travel is a critical goal for transportation stakeholders to improve opportunities and quality of life for people with disabilities.

One of the greatest challenges to removing barriers is the lack of information on where and how many barriers exist on paths of travel. These data are not routinely collected by state and local departments of transportation. A recent systematic evaluation of Americans with Disabilities Act transition plans identified that, among communities that conducted inventories of their paths of travel, 65 percent of curb ramps and 48 percent of sidewalks presented barriers (*6*). The lack of information on these barriers limits how well localities plan for infrastructure improvements and also restricts people with disabilities from accessing information that would promote safer wayfinding and navigation.

Solving the Problem

Major efforts are needed to address critical gaps in wayfinding and navigation that prevent travelers from taking barrier-free complete trips and traveling independently. These gaps exist for outdoor and indoor navigation. Solutions to these problems are still in their infancy but focus on more robust and accurate data, better tools for route planning, and complete—not piecemeal—implementation strategies.

Chona Kasinger, Disabled and Here, CC BY 4.0

Smooth pathways and crossings with cut curbs, as well as detectable warnings, consider all people—including disabled individuals—and help them to interact with others.

GETTING FROM THE DOOR THROUGH *THE DOOR*

Improving local inventories of sidewalks and pathways can provide valuable accessibility data for the community. This information can, for example, be leveraged for wayfinding applications and dynamic maps that enable travelers to identify accessible routes that avoid barriers specific to their personal abilities and preferences. Americans with Disabilities Act inventories performed by state and local DOTs can help address this need, but these inventories may be out of date, are often not in machine-readable formats, and are unlikely to be updated regularly to account for dynamic barriers such as construction.

The Transportation Data Equity Initiative at the University of Washington's Taskar Center for Accessible Technology (funded by the U.S. DOT's ITS4US Program) is a major effort seeking to combat this information gap and support the development of mobile and web applications (*7*). This project is currently using the OpenSidewalks data specification to collect and publish sidewalk data and is building open-source tools to assess data quality and support data maintenance and data sharing in a manner replicable across the country (*8*).

While traditional approaches for wayfinding—such as through Google Maps—focus on door-to-door navigation with guidance ending upon arrival at the destination building, a new effort seeks to support door *through* door wayfinding that includes wayfinding inside facilities. The Health Connector Project, implemented by the Heart of Iowa Regional Transportation Agency and also funded by the ITS4US Program, includes localized wayfinding and navigation within some major medical facilities to support travelers finding their destination after they are dropped off at the curb by an agency transit vehicle (*9*).

BETTER ROUTE PLANNING AND INDOOR NAVIGATION

With additional information about pathways, new and improved tools can be built to support travelers seeking travel paths that meet their unique constraints

and preferences. Built using standardized data formats, these tools could be widely replicable and interoperable across municipal boundaries. These improved data may also enable navigation inside buildings or from a transit stop to a building entrance.

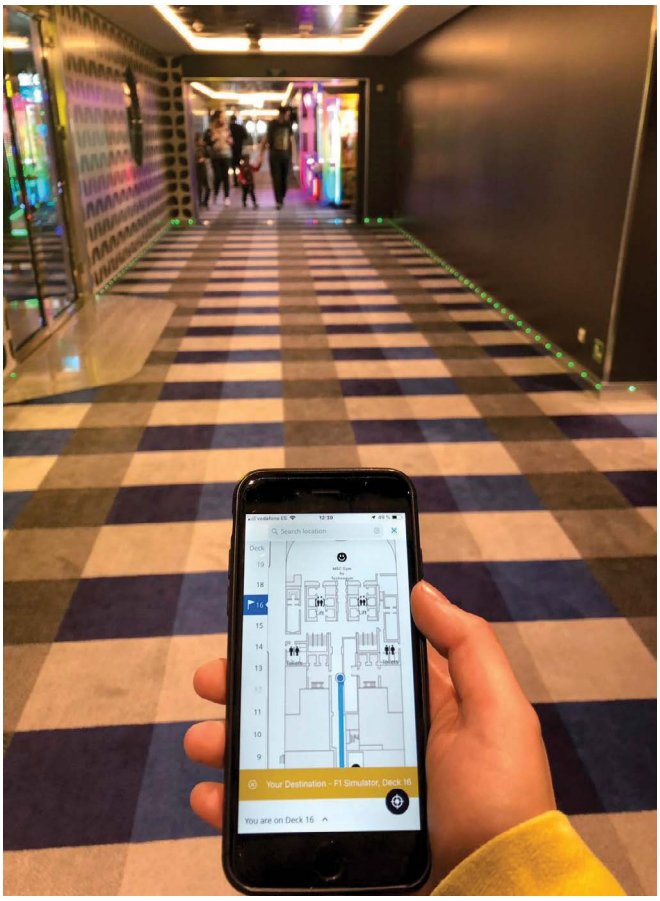
Indoor navigation is an area in need of broader data standardization to support interoperability between applications. One standard currently in use is the Indoor Mapping Data Format, developed by Apple and now governed by the Open Geospatial Consortium (*10*). This format can be used to describe the layout of a building so that navigation applications can provide localized guidance to a traveler to improve independent access to a destination.

Other efforts to support indoor navigation include using Bluetooth beacons or radio frequency identification tags for improved signal accuracy in localizing a traveler in spaces where GPS information may be unreliable. Gatwick Airport in the UK was one of the first to implement such technology in an effort to improve its customer experience.

IMPLEMENTATION FOR COMPLETE TRIPS

Without measuring and inventorying entire networks, most efforts to address shortcomings can only be piecemeal solutions. Many state and local DOTs only address sidewalk compliance issues as part of planned paving projects because they are legally required to implement accessibility upgrades at that time. This may, for example, result in only some of the corners of an intersection being upgraded to remove curb ramp barriers.

Enhanced information about the state of the pedestrian network and its accessibility, combined with other important data—such as desired origin–destination pairs and crash and safety data—can help communities prioritize and develop implementation plans for closing gaps that improve accessibility for people with and without disabilities.



ThomasM72, Wikimedia Commons, CC BY-SA-4.0

A passenger on the cruise ship *MSC Bellissima* uses a handheld system for wayfinding among the many decks and corridors. Indoor navigation can improve access and mobility for all, not only for those with low vision or cognitive issues.

Mackenzie Hayes, University of Illinois at Chicago

Broken to the point of being dangerous, this sidewalk would create a barrier for a person with a disability who may need to navigate it to access transit, work, a medical appointment, or simply to leave the house.

Funding Resources

At the time of this writing, several efforts that aim to improve access and mobility for all travelers are being funded by U.S. DOT. In July 2022, U.S. DOT Secretary Pete Buttigieg announced the adoption of a set of disability policy priorities, including "[enabling] multimodal accessibility of public rights-of-way" (*11*). Documentation developed by ITS4US Deployment Program awardees is publicly available through the National Transportation Library as a resource to potential deployers (*12*). Additional U.S. DOT programs seeking to address barriers to complete trips include FHWA's Transportation Alternatives Program (*13*) and several FTA mobility innovation programs (*14*).

In mid-2022, the Coordinating Council on Access and Mobility (chaired by U.S. DOT) released its 2023–2026 strategic plan (*15*). This plan set forth a bold commitment by the federal government to improve opportunities to collaborate and coordinate funding between related offices at the federal, state, and local levels to achieve improvements in quality of life and health outcomes across the United States. FHWA's Safe Streets and Roads for All grant program is an opportunity to plan for and implement improvements to the transportation network. The program includes funding for closing gaps in sidewalk networks and improved data collection to identify where gaps are located (*16*). Several other potential U.S. DOT funding sources for projects to improve accessibility in pedestrian networks are identified in the Coordinating Council's strategic plan under Goal 2, which promotes the development of safer and more accessible transportation networks (*15*).

Future Efforts

The Infrastructure Investment and Jobs Act of 2021 is a historic investment in U.S. infrastructure that can improve the accessibility of paths of travel for people with disabilities by removing barriers to and from public transportation, especially when they occur in the first and last mile (i.e., getting from a starting point to transportation, then getting from transportation to the destination). However, the impact of this funding on barriers to paths of travel and the complete trip is unclear and requires further evaluation and monitoring.

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"One of the greatest challenges to removing barriers is the lack of information on where and how many barriers exist on paths of travel."

Enter Innovation!

Rounding Out Rural Mobility Service Design and Delivery

National Aging and Disability Transportation Center

TODD HANSEN, STEVE YAFFE, WILL RODMAN, AND MATTHEW DAUS

Hansen is an associate research scientist at the Texas A&M Transportation Institute in Houston; Yaffe is the proprietor of Yaffe Mobility Consulting in Charlotte, North Carolina; Rodman is a research scientist at Texas A&M Transportation Institute in Dallas; and Daus is a partner at Windels Marx Law Firm and chair of its Transportation Practice Group in New York.

Weathered wood and rusted farm implements mark a rural setting in Athens County, Ohio, where a passenger prepares to maneuver his motorized scooter into an accessible van. Such on-demand microtransit services—and other innovations—are helping to fill the mobility gap in rural communities, where coverage is typically limited and the need for access to everyday facilities is growing.

Providing rides in rural areas is challenging because of the distance between homes and destinations, as well as budgetary and resource constraints imposed on transportation providers. Ride distances are longer than in urban areas, and funding for operations is less—even though the service areas are larger. As the average age of rural residents increases, more individuals are progressively becoming reliant on transportation providers to reach grocery stores, healthcare facilities, and other destinations. The lack of personal mobility options in rural settings increases the risk of social isolation and worsening health outcomes for rural residents (*1*).

Innovative rural service models and new performance metrics are starting to address and overcome some of these challenges. On-demand service technologies—which reserve or dispatch a service upon user request—and volunteer-based providers are bringing additional capabilities for scheduling flexibility, increasing traditional service areas, and filling in the gaps of existing transit options.

Public Transportation Challenges in Rural Settings

Larger distances and greater dispersal of riders in rural areas make grouping rural demand–response trips together in the same vehicles harder to accomplish. Consequently, boardings per vehicle hour are lower, travel times are longer, and the cost per ride is higher. Providers face these challenges with less money available to support operations, although the service areas to be covered are larger. Additionally, both urban and rural ride providers have increased difficulties in hiring and retaining drivers to operate their vehicles. The effect of losing a driver can be even more drastic for a rural transit agency with fewer people available to recruit for these positions.

From the individual perspective, people in rural communities who rely on public

transportation often do not own a vehicle and are unable to drive themselves to where they need to go. People who have ceased driving need mobility options for a variety of travel purposes. For example, dialysis patients need to visit a clinic for regular care two or three times every week and must have the assistance of a driver. Relying on family and friends for regular or spontaneous travel can be unreliable and impose a burden on personal relationships. Aside from making nonemergency medical trips, people who lack personal mobility options are at risk of increased social isolation and worsening health outcomes.

While demand–response transportation options available in rural areas now include microtransit (technology-enabled service with real-time routing), ride-sharing/ride-hailing, and mobility-as-a-service models that integrate various forms of transport, riders using traditional paratransit operations (complementary transit for those who cannot use fixed-route service) are required to schedule a trip at least a day—and sometimes a few days—before, depending on capacity. Paratransit riders with disabilities who need additional support, such as curb-to-curb or door-to-door service, may not be able to use some mobility-as-a-service modes. While newer cellular and broadband Internet communication technologies support improved efficiency and service delivery, they are—unfortunately—less dependable in rural and frontier areas (more than an hour's travel time from metropolitan regions) where communication infrastructure is lacking or unreliable.

Innovative Rural Service Models

Many resources are available for improving rural mobility—if they can be successfully tapped. Some of these modes include the newer microtransit, alternative services, and for-hire ride services (e.g., on-demand ride-hailing services), while others are newer twists on traditional paratransit, dial-a-ride, or volunteer driver programs that use dynamic optimization scheduling technology with the service.

National Aging and Disability Transportation Center

A bus is parked for passenger pickup in a tribal neighborhood, courtesy of Capacity Builders in Farmington, New Mexico. The nonprofit organization's transportation service provides trips for older adults and people with disabilities in rural areas, connecting them to faraway places and needed care and services.

Mixtures of dedicated and nondedicated service providers and types of fleet vehicles offer additional flexibility for rural transportation programs. A provider-side subsidy model—such as used in Flagstaff, Arizona's, Mountain Line—would allow the agency to reassign a trip to another provider. In Florida, Broward County Transit's user-side subsidy model allows riders to choose between ride providers. These subsidy models are primarily used by urban transit agencies but may have further opportunity for rural agencies in places with enough private taxi or ride-hailing providers. Rural agencies can also consider developing the program to attract private providers if the new service can provide a steady stream of trips.

Usage and financial sustainability of rural mobility programs in Pennsylvania—such as the Crawford Area Transportation Authority—and across the nation are enhanced by ride-sharing sponsored by subsidy programs. People who are traveling from the same area in the same direction ride together. Efficient grouping of rides helps determine the need for different types of vehicles and staff within flexible service models. All the while, agencies must note that some riders require extra assistance to and from the vehicle and others require extra supervision because of their disabilities (which may not be guaranteed by some private providers). Some riders may require transit and microtransit travel-training programs to learn how to properly use the service. These programs teach riders about reservation and riding procedures and help overcome perceived technology and safety barriers.

Rural services can take advantage of using demand–response booking, scheduling, and dispatch technology platforms that geostamp and timestamp each pick-up and drop-off for use in automated back-end reporting and customized billing to subsidy programs. Transit technology data feeds can also be applied for efficient timed transfers between demand–response and fixed-route transit to complete multimodal–multiprovider linked trips. Regional standards for open-source standard format technology platforms to plan, book, and pay for multimodal–multiprovider linked trips are convenient for riders and reduce administrative costs for the service providers. Mobility wallets—account-based platforms for fare payment—that can accommodate available commuter benefits, agency subsidies, and individual

or family contributions are a technology resource that enable the rider to choose the ride providers for their destinations. Obtaining technology is considered a capital expense and carries a 20 percent local match requirement for FTA transit grant programs. Finally, recurring operating subsidies can effectively be justified by presenting data that demonstrate program benefits in combination with rider–caregiver anecdotes showing the need for their rides.

The following examples of these models include on-demand microtransit services tailored to meet the needs of riders who are the most dependent on transit and volunteer driver programs that use technology to coordinate rides among multiple providers.

ON-DEMAND MICROTRANSIT SERVICES

- Capital Area Rural Transportation System (CARTS) is a public transportation service offering low-cost rides and using a variety of service models in and around nonurbanized areas across nine counties in Central Texas. CARTS Now is an on-demand microtransit system for outlying areas that is more responsive to the needs of general public riders.
- The RIDE in Wilson, North Carolina, replaced all existing fixed routes with a fully on-demand microtransit service powered by Via. Since it launched in September 2020, public transportation has reached 100 percent of the city—compared with only about 40 percent with fixed-route transit. With a population of 49,310, Wilson has a large number of riders who are older adults, people without bank accounts, people with disabilities, and people who do not have access to a smartphone. According to the city, 90 percent of RIDE users responding to a rider survey reported not having a car. Almost half earn less than $25,000 annually, and more than one-third do not have access to a smartphone (*2*).

RIDE in Wilson

Some rural communities have denser small towns, which have made microtransit service effective within strategically geofenced zones: service areas with virtually defined boundaries. For example, Wilson, North Carolina's RIDE service with Via transportation service has reported higher service productivity than typical for a rural area after it replaced all existing fixed routes with a fully on-demand microtransit service.

Learn more at https://www.wilsonnc.org/residents/all-departments/public-works/wilson-transit-ride-wilson-industrial-air-center/ride.

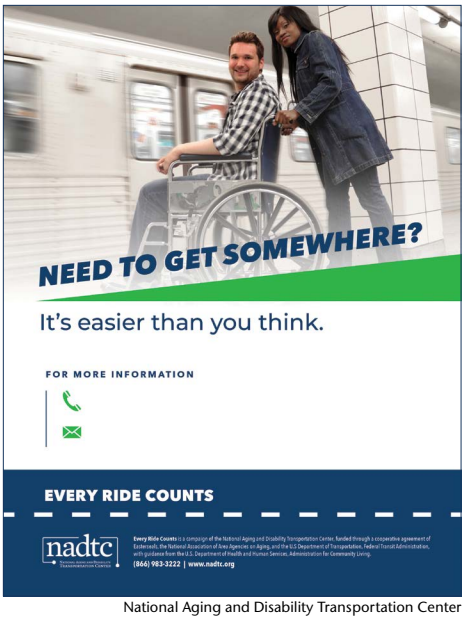
VOLUNTEER DRIVER PROGRAMS

More than 800 transportation programs that rely on volunteers who use their own cars are operated across the United States (*3*). Most volunteer driver transportation programs are provided by religious, secular not-for-profit, or health and human services organizations. These primarily meet the needs of older adults who are ambulatory. Some, such as Via Mobility in Boulder, Colorado, are operated in conjunction with paid drivers of dedicated accessible vehicles (*4*). Volunteer programs are especially important in rural America, where transit services and other ride providers are lacking.

Other examples of innovation in volunteer driver programs include the following:

- NV Rides of Northern Virginia and many Shepherd's Centers of America locations use a volunteer transportation technology platform that allows participating institutions to swap rides that they have difficulty accommodating.
- The Volunteer Transportation Center in Jefferson County, New York, uses a technology platform that accommodates billing for Medicaid nonemergency medical transportation, as well as other subsidy programs.
- Freedom Transit in Washington County, Pennsylvania, uses a technology platform that groups rides, handles billing to multiple funding sources, supports multiple payment methods, and supports a variety of services.

Despite what these programs offer, recruiting and retaining volunteer drivers is challenging. Crafting a concise recruiting message that can be shared by religious and nonprofit organizations that sponsor volunteer transport is helpful (*5*). Messages aimed at active, younger retirees who want to contribute to their communities are likely to be productive. The National Aging and Disability Transportation Center has developed a volunteer driver recruiting tool called Every Ride Counts (*6*). However, a major



National Aging and Disability Transportation Center

Drivers are as important as the passengers: That's the message the National Aging and Disability Transportation Center aims to convey via its Every Ride Counts campaign, designed to recruit volunteer drivers who want to contribute to their communities.

impediment to recruitment is the 14-cent volunteer mileage rate at which the drivers' expenses can be reimbursed (*7*). This amount has not increased with inflation, although the operating cost of a car for business travel in the final six months of 2022 increased to 62.5 cents per mile (*8*). That said, volunteers will likely be able to deduct the out-of-pocket expenses they incurred in providing services to qualified, tax-exempt organizations.

A second impediment—which may vary based on laws from state to state—concerns insurance (*9*). Most states have civil liability statutes addressing volunteer activities, but only 15 specifically address volunteer drivers. Consequently, insurance rates and the danger of policy cancelation vary. Umbrella policies for organizations sponsoring volunteer drivers, along with focused risk management procedures, are often necessary (*10*).

There are mandatory state insurance requirements for motor vehicles that afford financial protection to volunteer drivers and owners of vehicles who may get into an accident during the course of their volunteer duties. Additionally, if the organization is set up in such a way that it leases or rents vehicles to the volunteer drivers, then the organization—as the owner of the vehicles—may be able to avail itself of protections under the Graves Amendment, which shields the owner of a motor vehicle from liability if the owner or an affiliate of the owner is engaged in the trade or business of renting or leasing motor vehicles.

Rural Service Performance Measures

Common metrics in on-demand and microtransit services are customer wait time (i.e., from when the trip request is made to when the vehicle arrives) and percentage of shared rides (i.e., groupings of riders in the same vehicle). These measurement forms—along with boardings per vehicle hour, service equivalency, and trip lengths—can be useful in rural settings, provided that expectations for service in rural areas are appropriately set and agency requirements for high-need customer groups are met.

Some rural government organizations and state departments of transportation have included components of equity and accessibility for people in rural communities as part of their service evaluation processes. Oregon's Statewide Transportation Improvement Fund tracks equity through service enhancements to people with low incomes and to address high rates of absenteeism among students in Grades 9 through 12 (*11*). Connectivity metrics can consider access to locales such as specialized medical care centers, Veteran Affairs facilities, opioid treatment clinics, and transportation hubs.

The performance of rural mobility options cannot be measured alone by traditional efficiency and effectiveness metrics. Neither traditional public transit nor newer on-demand technologies can provide rural rides at similar costs as in dense urban areas. Community mobility goals and objectives must be realistic and include creative strategies and supportive technology. Successful transportation programs in rural geographies have focused on providing service that improves ride quality, efficiency, and reliability—as measured by key performance indicators.

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"The lack of personal mobility options in rural settings increases the risks of social isolation and worsening health outcomes for rural residents."

Transit Technology for Everyone

Prescott Valley, Arizona, Public Works Department

KRISTA PURSER, KEVIN CHAMBERS, AND THOMAS CRAIG

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Key in the pick-up and drop-off points, and the app-based, on-demand, wheelchair-accessible YavaLine van takes riders where they want to go, as it has at this Prescott Valley, Arizona, stop. Such mobility innovations give equal access to all riders—despite their abilities.

Equal access to the U.S. transportation system—and its associated technology—is still a goal, rather than a reality. Even wealth and training do not guarantee that someone with a disability will enjoy equal access. To date, public transportation technology has largely been designed for urban riders without disabilities. Providing accessible and useful technology to riders with disabilities and riders in rural areas will require the transit industry to design and operate technology differently.

The disparity between urban fixed-route services and rural and specialized transportation is apparent on provider websites and in third-party resources, such as public trip-planning apps. For example, searching a mapping app for directions by transit in any U.S. city will yield walking directions to a fixed-route bus. However, the same search may not work in a rural area, even where there is fixed-route service. For example, if a rider has a disability, then that rider is unlikely to find a way to confirm the route's accessibility. Paratransit, rural transit, and intercity transit have seen significant technological innovations in recent years, including tools geared toward people with disabilities. An example is the work of the Transportation Data Equity Initiative from the University of Washington (*1*). However, the gap between these services and the relative effectiveness of urban fixed-route technology is significant.

For many rural residents and riders with disabilities, technology can be a barrier rather than an opportunity. For example, if a provider begins to focus on an app instead of a printed rider guide, then technology access for riders who do not have consistent Internet access may worsen. Likewise, if a service is only offered online through an inaccessible website or app, then a user who is blind or has low vision, for example, may not have access to the service. Section 508 of the Rehabilitation Act, which defines federal standards for websites, offers a solid start to improving digital accessibility. However, its application must be

paired with rider feedback to ensure full accessibility of the specific system being used (*2*).

Transit technology is meant to offer opportunities to all riders, regardless of their physical location or disability. It can also help agencies save time and improve decision making. This article defines what public transportation technology is, describes how it can sometimes be a barrier to accessibility, and offers strategies that agencies and regulators can implement to innovate accessibly and equitably.

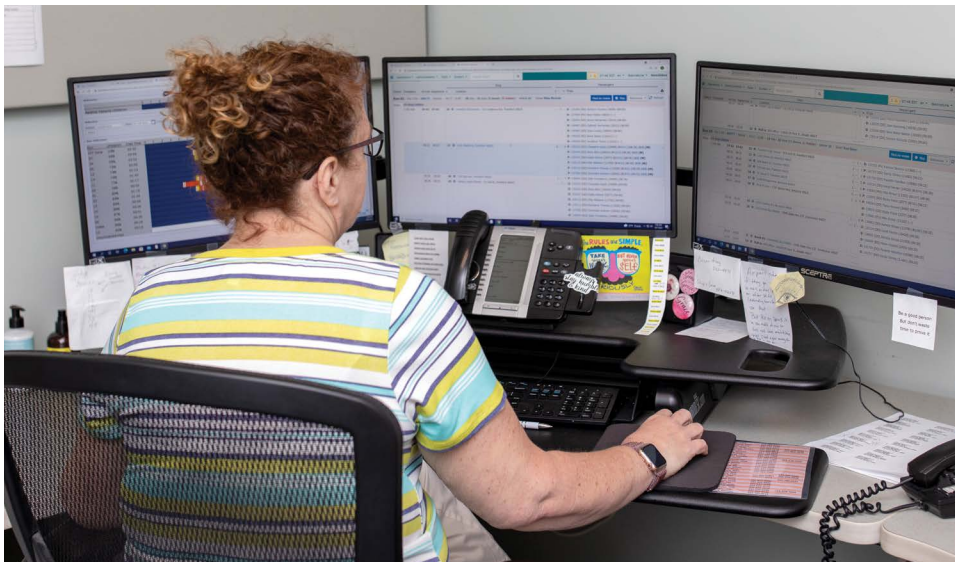
What Is Public Transportation Technology?

Public transportation technology includes software, hardware, and service applications that help decision makers evaluate and plan services, providers perform day-to-day operations, and riders access and use services.

Examples of common public transportation technology include the following:

- *For customers*—trip planning applications, ride request methods (i.e., website, phone, text, and app), fare payment options, mobility wallets, onboard Wi-Fi, digital bus stop signage, and real-time alert notifications.
- *For providers*—internal communication tools using radio and dispatch systems, external communication systems that contact other providers or push information through customer tools, tracking software for data reporting and maintenance tracking, automatic vehicle location, passenger counters, adaptive dispatch software in microtransit implementation, electrification and alternative fuels, automated and connected vehicles, and transit signal priority, which occurs when a system for road signals—such as stop lights—communicates with buses and changes signals to green to allow transit drivers to proceed.

These technologies benefit decision makers, providers, and customers in different ways. To attain equitable technology use, it is critical to understand how data and information are obtained, perceived by riders, and recommended to be used by operators.



Jacqueline Southby, Southby Photography

Once a rider books a trip, Benzie Bus dispatcher Arlene Killeen makes it happen. Headquartered in the village of Beulah in Michigan's Lower Peninsula, the transportation service allows passengers to schedule and pay for rides via an app.

How Can Technology Promote Opportunities?

Technology works best when it removes barriers for riders and providers. When riders use an app to book a ride or providers use software applications to schedule rides, these technologies are considered good if they facilitate these activities.

Riders in rural areas or with disabilities face additional barriers because some of the ways providers deliver services are not accessible to them. There is comparatively less fixed-route service in rural areas, which often makes the visibility and convenience of public transportation lower as well. Another problem some riders encounter is that bus stops—or pathways to those stops—may be inaccessible.

Technology cannot fix every service barrier. No app can pave a sidewalk or increase fixed-route frequency. But technology can inform riders about existing access by showing accessible pathways or allowing riders to book a demand–response trip when the fixed-route option won't work.

Technology cannot be designed for urban fixed-route transit and then simply adjusted for use by riders who live in rural areas and who have a disability. Technology also cannot be used as a substitute for fixing broader service or accessibility issues. To be equitable, transit technology needs to be intentionally designed to serve the needs of varying riders and the agencies providing those services.

What Works for My Organization and Riders?

Because some transportation technology has become so advanced, rural and demand–response providers assume that they urgently need newer, better technology. This has led providers to purchase all-encompassing intelligent transportation systems, without fully investigating which parts of those systems they need—if they need those systems at all. Many well-funded projects are succeeding, but public transportation technology is not proving to be a panacea for the difficulties faced by the industry. The most prominent tools remain focused on urban and fixed-route services and do not always work as well as expected when transferred to other contexts.

Jacqueline Southby, Southby Photography

Driver Sandi Saxton (*left*) makes sure that Virginia Gardner boards safely for a Benzie Bus ride. Serving Benzie County and beyond in the northwest of Michigan's Lower Peninsula, Benzie Bus offers Medicaid recipients free nonemergency medical transportation—a feature that is a response to riders' stated needs and fills a transportation gap in the region.

Providers do not only need new and better technology to serve their riders in the future, they also need to serve their current riders' needs today and continuously improve their services by solving procedural issues and integrating new tools. Good technology is not just having the newest, most advanced software. It also involves applying knowledge about real rider issues to solve real rider problems with available tools. Start by defining the specific problems to be solved. Then focus on solving those problems, integrating the best available software and hardware where those tools are the best option for the specific situation.

Defining and solving rider and operational problems require engagement with riders and staff. Providers make the final technology decisions and may work with affected parties before, during, and after the change. If management has no capacity to understand and implement a new technology in collaboration with users, then it is not time for a new technology. Identify the problems you can solve and solve those.

How Can Organizations Improve Their Technology?

Organizations can improve their technologies by doing the following:

- *Solve the problems riders and staff identify*. The first step is always to listen to the people who experience the problem. Craft conversations that help riders and operators identify their pain points. Listen to their ideas for solutions; however, remember that such solutions can only be chosen from options that are not only on the market but also fall within the available budget and staff capacity.
- *Expand technology in small steps*. Use small steps as feedback loops for course corrections and institutional learning. Transportation providers who use relatively little technology might benefit from innovating their systems by adopting simple and low-priced technology that can be adopted easily. The most complex new technology might not be effective for their situations. Successfully operating simple technology will support capacity for more sophisticated technologies later.
- *Investigate and adopt technology that promotes openness, interoperability, and standards*. It takes involvement from multiple sources to create, sustain, and expand accessible technology—from browsers and screen readers to data feeds and apps. While one-time and proprietary solutions may be the only options for some new technologies, focus on adopting proven best practices and interoperable systems. The Mobility Data Interoperability Principles are best practices for providers and vendors in developing and maintaining open and standardized technologies (*1*).
- *Strengthen support systems*. Documenting systems and processes, cross-training staff, and closely monitoring technology vendor performance are cost-effective ways to keep technology in good working

order. Like preventive maintenance of vehicles, these tasks offer resilience in the face of organizational changes, such as staff turnover. Like deferring preventive vehicle maintenance, failing to maintain technologies can also have severe consequences—including website outages and real-time system downtime. These issues erode rider trust.

Rural Transit Technology in the Next Decade

Rural and demand–response public transportation technology has not kept pace with urban, fixed-route technology. However, the story is changing.

The innovations of public transportation technology in the past decade were built on earlier foundational technologies. The General Transit Feed Specification data format that is commonly used by transit agencies was developed in 2005. Smartphones went to the mass market in 2007. However, it is only in the past five years that mobile trip planning has become ubiquitous for urban fixed-route providers.

The first online trip planner that used General Transit Feed Specification-flex[1] to display rural intercity services and paratransit was launched in 2018 (*2*). The data standard to allow for real-time trip scheduling in mobile apps was developed in 2021. Numerous technologies that required an IT team in 2013 are now available to a rural public transportation manager with no staff today, thanks to the past decade's software-as-a-service revolution in which software is accessed online via a subscription. Vehicle technologies are also improving, with increased ranges for electric transit vehicles and expanded usefulness in long-distance, rural settings.

The next 10 years belong to the rural and demand–response providers who focus on implementing and improving practical technology solutions to solve real problems their riders and staff face. This—and thinking through accessibility and equity needs—is what providers and regulators do. They are ready for this task.

[1] General Transit Feed Specification-flex is an extension of the General Transit Feed Specification that incorporates demand–response.

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"Technology cannot be designed for urban fixed-route transit and then simply adjusted for use by riders who live in rural areas and who have a disability. To be equitable, transit technology needs to be intentionally designed to serve the needs of varying riders and the agencies providing those services."

Mobility for All

Kampus Production, Pexels

MEI-YEE MAN ORAM, EAZAZ SADEGHVAZIRI, RAMINA JAVID, ANABELA SIMÕES, AND DEL PETERSON

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The speed of a wheelchair doesn't slow the fun among friends hanging out on a pier. Individuals with disabilities, as well as older adults—whether in rural or urban areas—rely on mobility for everyday life. To help these transportation users, aligning transportation services with the diversity of end users' needs improves the transportation network for all.

Transportation infrastructure and services are a conduit for improving social mobility, providing access to work, education, healthcare, and other important facilities within our communities.

While these should accommodate the highest number of people, historical biases in data collection, enforcement of standards and guidance documents, and engagement with end users—to name but a few—have all contributed to gaps and barriers to mobility for different groups of people. This includes older adults and people with disabilities.

Examples of these barriers may include the following:

- The inability to safely drive a private automobile due to aging or the financial barriers to suitable accessible vehicles and their associated upkeep;
- Usability of technology by people of different ages and technical capabilities;
- Incomplete or inaccessible walking pathways for pedestrians to access transit stops; and
- Innovative transportation solutions that only focus on the densest urban areas, not exurban or rural settings.

These challenges can be exacerbated if transportation providers do not provide ample opportunity for input and feedback from travelers who use their services. Without such information, providers can neither learn from the lived experience of end users nor identify and address the gaps these users experience in existing approaches, standards, and practices. Without proactively addressing these issues, transportation systems may ultimately present barriers to some users, making it uncomfortable, difficult, unsafe, or impossible to travel to the places they need to go.

According to Covey, a nonprofit organization focused on individuals with disabilities, although the Americans with Disabilities Act of 1990 requires

public transportation to be accessible, many taxis and public transit systems—especially older ones—remain largely inaccessible for people with disabilities.[1]

Fortunately, innovations in transportation and refocusing on user-centered design approaches are helping to address some of these challenges and improve travel for a wider user base. Using a holistic approach and designing inclusively can move transportation networks (including service models, infrastructure, vehicles, payment systems, and scheduling technologies) to a higher level of travel opportunity. The impact of such innovation in accessible transportation—and resulting increased freedom to travel—can lead to additional employment opportunities, improved health outcomes, increased access to medical care and resources, and higher quality of life.

The Importance of Mobility

Mobility is a human right. This is expressed in the Universal Declaration of Human Rights as the freedom of movement from one place to another to accomplish any human activity such as for work, school, health, leisure, recreation, social engagement, or shopping (*1*). To provide efficient, safe, and sustainable mobility to all users, requires considering the five As:

1. Acceptability,
2. Affordability,
3. Accessibility,
4. Adaptability, and
5. Availability.

When transportation authorities include these considerations, decisions are made and frameworks created that align the provision of transportation services with demand based on existing and planned land use and the diversity of the needs of the end users (*2*).

According to *Transport for All*, "even at the best of times, the transport system in the UK is profoundly inaccessible to disabled people." As the post-pandemic cost-of-living rises, "many disabled people are finding the limited transport options we had available to us [are] too expensive" (*3*). This includes accessibility requirements from people with disabilities and older adults. Such requirements have implications on spatial design (e.g., considering the physiology of people, size of mobility equipment, assistive technologies that people may use, assistance animals, personal assistants, and family), as well as technological interfaces and management and operational strategies in general, day-to-day use and during an emergency. Designing with these marginalized groups in mind creates better designs overall and benefits everyone.

Barriers to Travel

As used here, transportation inclusion is considered holistically. It incorporates public transportation and private automobiles, as well as walking and cycling infrastructure. Trips are not isolated; the whole journey and the multimodal aspects of journeys are considered integral to providing equity in transportation networks.

Recent research emphasizes that the first and last part of most public transport journeys are walked or wheeled. Public transportation allows for long journeys by bus or rail that are sustainable. However, when public transportation services are inadequate, too expensive, or poorly located, many people choose to drive or are left isolated (*4*).

Different marginalized user groups have different needs. For example, tactile warning surfaces at road crossings are essential to inform people who are blind or partially sighted of the junction between vehicle and pedestrian routes, but these surfaces are not comfortable for wheelchair users. Considering this diversity of needs is important when thinking about the whole-journey approach. [See Walking and Wheeling by the Numbers (Page 24).]

When considering the whole journey for the vast variety of travelers, it is important to think beyond minimum compliance with codes. Demographic trends point to an aging population and the correlation between older age and disability. According to the United

Cathy Frye

With the sidewalk ahead closed for construction, a blind woman navigates an obstacle-filled New York City street. The walking stick in her curbside hand helps her detect hazards—such as trash bags and landscape edging—that few sighted people would even notice.

[1] Learn more at https://covey.org/public-transportation/.

Nations, rural areas are likely to see an increase in the population of older people in North America (*5, 6*). In the near future, providing inclusive and regular transportation services in rural communities will be increasingly vital for older adults and people with a disability who cannot or prefer not to drive. In rural areas with fewer transit choices, this issue is particularly significant, and transportation disparities are even more apparent.

The transportation needs of older adults in rural areas are complex and reflect a convergence of the following issues:

- Geography, such as inadequate road and telecommunications infrastructure and long travel distances to access local services;
- Population, such as the loss of driving ability with advancing age, together with low population density and low demand for services, as well as cultural norms and values; and
- Structure, related to the low population density and low demand for services in rural areas.

For aging adults, accessible and inclusive public transportation is often an important link to family, friends, and the community, allowing them to maintain some independence. Research has shown that limited mobility can prevent older people from joining social activities. This may lead to low confidence, depression, and loneliness. Adults with disabilities who reside in rural locations also frequently rely on less formal and specialized assistance. In comparison to their urban counterparts, they often must drive farther, pay more, and receive care that is of lower quality (*7*).

Innovation and Best Practice

Specifically designed and developed assistive, adaptive, and rehabilitative devices are used by people with disabilities and older adults to overcome individual functional accessibility requirements in performing daily activities. A 10-year comparison of technology usage in small urban and rural transit agencies found that significant increases have occurred (*8*). The most prominent increases have been in automatic vehicle location technology, which increased from 6 percent to 51 percent, followed by an increase from 9 percent to 45 percent in the use of mobile data terminals. Smartphone use also increased significantly and was followed by traveler information systems technology. Likewise, geographic information systems nearly doubled in use, and electronic fare payment as well as computer-aided scheduling and dispatching software saw significant increases during the same 10 years.

With a general trend in the advancement and use of technology that results in more affordable and accessible smart devices, the possibilities for personal devices to facilitate a positive impact on accessibility in the transportation sector are immense.

Increasingly, communities are implementing programs that provide transportation on demand, as well as ridesharing using volunteer drivers to improve access to transportation, overcome transportation barriers, and improve safety for people with a disability and older adults. These programs are important, especially in reducing social isolation for older adults and people with disabilities. However, it is necessary to disseminate information about such transportation services, how to access these services, and service costs. There will also be limitations to these initiatives. This is particularly true of the ability for people to travel spontaneously without the need to preplan or prearrange assistance. These must be factored into wider discussions about transportation investment, development, and sustainability, as well as the development of platforms for accessing these services.

In addition to personal devices such as smartphones and operational measures such as volunteer-based rideshare

Walking and Wheeling by the Numbers

According to a report on the UK, a third more women than men traveled by bus, and a third more men than women traveled by rail. Twenty-four percent of journeys to work by bus were made by Black people. This was almost twice as much as any other ethnic minority group (12 to 14 percent) and four times as much as for White people (6 percent).

Car access is far less among women, people from ethnic minorities, and people living in low-income areas. Dependency on public transport is often greater for these groups. Older adults often rely on public transportation. For example, in the UK, older adults use their free bus pass, as do children who are too young to drive.

The current public transportation system is often insufficient for many people's needs. It can be expensive, infrequent, and involve waiting late at night. Fears about walking or wheeling and public transportation are connected as these travel modes are frequently undertaken within the same journey.

People with disabilities are more reliant on public transportation because of limited vehicle access; however, accessibility issues persist. On average, overall journey times by public transportation can be 80 percent higher for people with disabilities than for those without.

Adapted from Sustrans, Living Streets, and Arup. Walking for Everyone: Making Walking and Wheeling More Inclusive, *March 22, 2022*.

initiatives, the wider infrastructure interface with technology can have a huge impact on accessibility and inclusion. For example, community-scale wayfinding through beacons that connect with personal devices can help to create spaces with legible signage and that are easy to navigate independently. Deployed appropriately, this type of technology use also makes it possible to connect the whole journey.

The use of technology to help monitor and measure the success of interventions is a key application that allows for reflection and adjustment to the needs of end users over time. For example, in London the transit system is collecting data from 20 million passengers each day across the Transport for London network—alongside cameras and other systems—that can be used to plan and predict travel behaviors.

Using Data to the Max

Data is key. Collecting feedback on the use and quality of transportation provided is important to understand and build a comprehensive picture of travel patterns and behaviors, pain points, or gaps. It is also important to use the data to compare, plan, and improve services.

The assessment of the quality of a service—measured on criteria identified by customers and service providers through efforts such as customer satisfaction surveys—is necessary to build a full and holistic picture of how the experience of passengers and the operational requirements of staff can coexist without conflict. This should consider the whole journey, including interfaces between modes of transport, ticketing, wayfinding, customer help points, and other considerations.

On the user's side, the criterion of satisfaction will be measured on the expected and perceived service quality. For people with disabilities and older adults, this may include how accessible or convenient the service is compared with private automobile use. For providers, the criteria of performance will be based on the planned and delivered service quality, according to the approach's economic viability. This requires periodic assessment of the users' satisfaction level with regard to the provided services to meet their mobility needs. The identification of gaps between the provided service and the consequent difficulties in using such transportation services should be discussed, targeting the required solution in collaboration with specialists to provide a holistic, coordinated response.

Courtesy of Oregon DOT, Flickr, CC BY 2.0

Weighing in from their wheelchairs, Oregon Department of Transportation's (DOT's) Gary Epping (*left*) and Americans with Disabilities Act advocate and consultant Tony Ellis (*center*) work through Grants Pass street improvement plans with Dan Roberts, Oregon DOT transportation project manager. Listening to and designing with input from those who live with disabilities is key.

In addition to the use of data to inform internal decisions on the planning and design of transportation, data can be used to communicate to the public and inform personal choices with regard to travel options, such as identifying busy periods that some might wish to avoid.

Call to Action

There are an estimated 1.3 billion people with a disability (16 percent) across the globe (*9*). In addition, 962 million people in the world are over the age of 60, a number that is expected to increase to more than 2 billion by 2050 (*10*). There is a requirement to future-proof transportation networks to accommodate accessibility and inclusion needs (*11*). It is integral that this requirement is met with sustainable, inclusive solutions that can benefit the environment as well as people—all marginalized groups within communities, not only older adults and people with disabilities. Those who are pregnant, have a nonbinary gender identity, or face discrimination due to race, ethnicity, religion, culture, socioeconomic background, and the intersectionalities of people—that is, the interconnected nature of these identities and the overlapping and interdependent systems of discrimination or disadvantage—are part of the public and public transportation needs to meet their requirements, as well.

Emerging technologies—on a personal and community scale—present an opportunity to enhance the transportation experience for all passengers, regardless of their personal identity or circumstances.

While there is some great work being done in this space, more needs to be done, and such work needs to be rooted in lived experiences to acknowledge and address the gaps in current

understanding and data in this relatively new interface with the built environment.

Lara Jameson, Pexels

A man with an energetic stride makes using a modern prosthetic limb look effortless. However, walking with a traditional prosthesis can take about twice as much effort and is one-third slower than walking on two natural legs. For many who use traditional devices, this limits the distance that a person with a missing leg can traverse—including to or from public transit.

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"Using a holistic approach and designing inclusively can move transportation networks to a higher level of travel opportunity."

A Seat at the Table

Transportation Decision Making in Rural, Tribal, and Frontier Areas

iStock

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Questions and comments abound in a gathering of people who share a common interest. However, in rural, tribal, and frontier areas, engaging underrepresented populations in mobility planning and decision making remains a challenge.

Title VI of the Civil Rights Act of 1964 was passed in 1960 to prohibit discrimination in programs and activities receiving federal assistance. Since then, several other laws and policies—such as the National Environmental Policy Act of 1970, Executive Order 12898, and Federal Actions to Address Environmental Justice in Minority Populations of 1994—have been established that mandate that transportation projects receiving federal funds ensure inclusive and meaningful public involvement in transportation decision making and equitable distribution of the resulting benefits and burdens (*1*). Despite these federal requirements, engaging individuals who reside in rural, tribal, or frontier areas in the planning and decision-making process is a challenge, especially for those who are transportation-disadvantaged, older, or who have disabilities. Generally, rural areas are defined based on population density. However, frontier areas—sparsely populated rural areas that are isolated from population centers and services—are defined based on access to destinations, as well. While there is no set definition, frontier areas are also often defined as counties having a population density of six or fewer people per square mile. Public engagement remains more challenging in rural or frontier areas than it is in urban areas.

The United States relies on a state-centric transportation planning approach, which has traditionally been automobile oriented. Most urban transportation systems and urban public transportation services are planned and conceptualized through official processes guided by metropolitan planning organizations, city departments of transportation (DOTs), transit providers, and state DOTs. In rural areas, planning is carried out mainly through state DOTs and—if they exist—rural planning organizations, often in coordination with regional and local transit providers.

On paper, all federal requirements that apply to different planning levels

(i.e., state, regional metropolitan planning organizations, and city) are consistent, regardless of geographical location. Nevertheless, the standard of completion and quality of public engagement activities in rural, tribal, and frontier areas are often much lower for the following reasons:

- Lack of funding, personnel, and other resources;
- Challenging logistics of planning for rural, frontier, and tribal areas (often involving addressing low population densities, extensive land coverage, and less reliable Internet connections); and
- Lack of concise federal requirements and guidance.

Why Is This Discussion Needed?

The need for well-designed and well-executed public engagement plans in rural areas is pressing because of the overrepresentation of older adults and people with disabilities. According to the 2021 American Community Survey, in rural areas (defined here as nonmetropolitan or micropolitan areas), the population of older adults (i.e., aged 65 and older) represents approximately 21 percent of the total population (*2*).

Late older adults are defined as aged 75 and older. This population—who may need additional support measures to get to medical appointments, the grocery store, and social engagements—represents approximately 9 percent of the total population. In urban areas, defined here as metropolitan or micropolitan areas, the representation is 16 percent for older adults and 6 percent for late older adults. Addressing the rural transportation needs of the older adult population who, in their majority, still prefer to age in place is a challenging societal task, considering their limited rural access to services (e.g., healthcare) and resources to get there (e.g., public transportation) (*3*). The problem becomes even more daunting as rural aging has become pervasive throughout the United States. However, it occurs for diverse reasons in different rural communities, resulting in a nonhomogenous, rural, older adult population that is expected to change drastically as baby boomers age (*4*).

Courtesy of the National Aging and Disability Transportation Center

Belted for safety, a passenger takes a slow ride down on an accessible van in Ketchum, Idaho. Nestled in the Rocky Mountains, the community benefits from such services that help people with disabilities and others in need of transportation get where they want to go.

Along the same lines, people with disabilities in rural areas of the United States represent almost 18 percent of the population, compared with a little more than 12 percent in urban areas. Rural populations with disabilities may overlap but are not exclusively older adults because approximately 56 percent of people with disabilities are 64 years old or younger.

The mobility of these rural population groups remains a vital part of their well-being, enabling them to tend to life-maintenance and life-enriching needs. Moreover, because there is a strong direct link between engagement in the planning process, planning outcomes, and equity impacts, the single way to effectively identify and meet their needs is through just and fair inclusion in transportation planning and decision making (*5, 6*).

Given this pressing need, providing guidance to rural planners and decision makers and identifying best practices and strategies is imperative. Planners and decision makers—particularly in rural areas—fulfill many diverse responsibilities, largely because of lack of funding and personnel. Therefore, they need proven resources to design inclusive and meaningful comprehensive public transportation plans that attract and engage transportation-disadvantaged rural populations. These proven resources are likely the most efficient path to improving their planning practices. Researchers and funding agencies have started to acknowledge the shortage and need for work on transportation equity–related topics. Thus, several practice guides, technical reports, and scholarly publications associated with engaging underrepresented populations in transportation planning and decision making have been recently produced. The same is true for work that focuses solely on engaging rural populations. Unfortunately, though, guidance targeting rural areas and representation is practically nonexistent, while efforts targeting tribal communities are only very recent (*7, 8*).

The three cases that follow illustrate the diverse and unique challenges and potential opportunities for engaging underrepresented populations, including people with disabilities in rural, tribal, and frontier areas.

CASE 1
ENGAGING TRUSTED ADVOCATES

The Deep East Texas Council of Governments (DETCOG) created a transportation voucher program to provide mobility for older adults (*9*). As a result of the low population densities in some parts of the DETCOG region, not everyone who qualified for the program was engaged in its development. Consequently, some hesitated to use the service because of concerns about its validity, which likely stemmed from prior experiences with ongoing scams targeting older adults in the area.

Many older adults—and people with disabilities—may be cautious about using a program that seems too good to be true. Furthermore, rural communities' distrust of government and its processes has been documented as a major barrier to recruiting and engaging them. This mistrust can be partially attributed to the historical lack of engagement, which suggests a lack of focus on rural communities and cultivates the idea that public opinions will not be taken seriously (*10*).

What can planners and decision makers do? DETCOG has worked to establish rapport with family members who are trusted advocates of these individuals. Additional one-on-one conversations at facilities—such as housing authorities and centers for older adults—in communities where people who need transportation live were often the starting point for DETCOG to attract users.

CASE 2
ACCESSING ENGAGEMENT OPPORTUNITIES AND CLOSING THE LOOP

The Oregon Cascades West Council of Governments (OCWCOG) reached out to older adults and people with disabilities (and their caregivers) living in Lincoln County, with the aim to identify ways to encourage public participation (*11*). Participants voiced that they had not felt heard during prior engagement experiences. Even when planners were perceived as good listeners, residents believed that—in the end—their input was ignored. Distrust often arises from the lack of tangible outcomes that enhance transportation equity in a community (*5*).

CASE 3
ACKNOWLEDGING DIFFERENCES

According to a recent study, in most indigenous cultures the onus of the disability is on society, rather than the individual or family with the disability. American Indians and Alaska Natives face the highest disability rates—about 30 percent—of all ethnic or racial groups in the United States. However, the meaning of disability depends on cultural contexts and is perceived differently by the 574 federally recognized tribes, each with its unique customs and traditions. Hence, the study recommends designing community engagement with an understanding of the types of disabilities, such as those related to cognition, mobility, hearing, vision, independent living, and self-care. An illustrative example from this study focuses on the Pueblo of Jemez, located about 50 miles northwest of Albuquerque, New Mexico. According to its director of Planning and Development, future community plans include addressing inadequate pedestrian infrastructure that does not comply with the Americans with Disabilities Act, while proactively including people with disabilities in the planning and design process and expanding inclusion and engagement with current and future projects using various methods. Among the key challenges cited is that the number of people with disabilities in the community is unknown.

What can planners and decision makers do? They can acknowledge that there is truly no one-size-fits-all approach, and the minimum prerequisite for meaningful engagement includes an intentional design of an inclusive and accessible engagement process. Further, planners and decision makers can understand that "inclusive and accessible" mean that the differences between people with disabilities are recognized and addressed. The study also proposes considering engagement activities with familiar structures, such as "talking circles," a traditional practice in indigenous communities that facilitates and inspires respect and productive dialogue (*12*).

Online Participation

The COVID-19 pandemic necessitated online participation. However, representation cannot be achieved solely online. One reason online participation methods do not always work is that remote areas often lack dependable Internet access. In addition, the degree of access to—and

Governor Jay Inslee, CC BY-NC-ND 2.0

Helping hands and hardhats came together when the Yakama Nation Tribal Council agreed to Washington State Department of Transportation's plan to construct roundabouts on the Yakama Reservation in 2021–22. They continue to collaborate to improve highway safety through outreach, education, and community partnerships.

familiarity with—Internet and technology (such as computers) varies greatly (*8, 10, 13–14*). Furthermore, while online participation has value, having physical presence in the community is more valuable in rural areas. Holding engagement activities—in concert with other community events and in places where a desired population may be present (e.g., churches and centers for older adults)—can broaden reach.

Conclusion

Inclusive and meaningful public involvement in rural transportation decision making is imperative. Proven practices for the intersection of rural areas and underrepresented populations include removing barriers and providing equitable access to public engagement opportunities, acknowledging differences, and engaging trusted advocates to produce better outcomes. At the same time, transportation planners can acknowledge that not all established and emerging inclusion practices are suitable for rural, tribal, and frontier areas. Focused research, tailored regulatory requirements, and planning guidance that follow a community-centric approach to public engagement are needed.

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"Many older adults—and people with disabilities—may be cautious about using a program that seems too good to be true. Furthermore, rural communities' distrust of government and its processes has been documented as a major barrier to recruiting and engaging them."

Breaking Barriers to Healthy Food and Healthcare

Kampus Production, Pexels

JEREMY MATTSON, IPEK NESE SENER, AND JILL HOUGH

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For every older adult able to shop for and bring home healthy food, there are many others who can no longer drive, have limited mobility, or no transportation options for getting necessities. As a result, these individuals also have difficulty keeping medical appointments. Inclusive transportation can help.

Access to healthy food and healthcare services has a major impact on people's health, and transportation plays a role in ensuring that access. Transportation, which the U.S. Department of Health and Human Services refers to as one of the social determinants of health, affects communities in myriad ways. These determinants are defined as the "conditions in the environments where people are born, live, learn, work, play, worship, and age that affect a wide range of health, functioning, and quality-of-life outcomes and risks" (*1*). According to the National Center for Mobility Management, transportation affects nearly every social determinant of health by either facilitating or impeding access to services or destinations (*2*). This makes transportation one of the most critical among such determinants.

Consider the situation of chronically ill patients who lack access to public or personal transportation. What happens when they need to travel for medical appointments or get prescriptions to maintain their health? How would they continue to live on their own without relying on others who may not be available or willing to drive long hours whenever needed? Many individuals face such challenges accessing food or healthcare. In response, transportation agencies across the country have attempted various strategies to improve access for their vulnerable users. These practices can provide immense health benefits.

Barriers to Healthy Options

Food deserts—those areas with limited access to affordable and nutritious food—and food insecurity are problems in the United States that have received growing attention, as evidenced by the September 2022 White House Conference on Hunger, Nutrition, and Health.[1] The

[1] Learn more at https://health.gov/our-work/nutrition-physical-activity/white-house-conference-hunger-nutrition-and-health.

U.S. Department of Agriculture (USDA) identifies food deserts based on food accessibility, which is determined by

- The number of healthy food sources in the area and distance to the closest healthy food source;
- Individual barriers, such as low income or lack of access to a vehicle; and
- Neighborhood indicators, such as the lack of public transportation or average income below the poverty line (*3*).

Lack of access to food can lead to food insecurity. In 2021, USDA's Economic Research Service found that 10.2 percent—or 13.5 million households—were food insecure in the United States (*4*). Rates of food insecurity are higher for Black, Hispanic, and single-parent households. Further, food insecurity is more prominent in large cities and rural areas and lower in suburban areas (*5*). Access to food worsened during the COVID-19 pandemic when businesses closed and vulnerable populations were encouraged to stay home—including children who could not attend school, where they have more access to healthy foods.

Although food deserts and food insecurity are a hindrance to good health, the number of people who do not have access to healthcare is also alarming. According to a study based on findings from the 2017 National Health Interview Survey, 5.8 million people delayed medical care in the United States because they did not have access to transportation (*6*). Lack of transportation becomes a major barrier to maintaining a healthy lifestyle; it causes missed or rescheduled appointments, delayed care, increased healthcare costs, and emergency room visits that adversely affect health outcomes (*7*). This is especially true for specific population groups, such as people with disabilities and those living in rural or tribal areas.

Barriers Faced by People with Disabilities

People with disabilities face greater transportation barriers and are more vulnerable to transportation and health inequities. Examples of barriers include

- Lack of accessible transportation;
- Poor vehicle design that makes it difficult to enter, exit, or operate a vehicle (i.e., poor accessibility features, inadequate space, poor ergonomics, and so forth);
- Inaccessible curbs, crosswalks, and sidewalks; and
- Lack of or difficulty in locating signage and wayfinding (*8*).

Barriers related to access to care are exacerbated in rural areas because of limited transportation options, long travel distances, and lengthy wait times. Rural areas also tend to have limited access to various transportation infrastructures, such as a lack of sidewalks and street connections to safely access public transportation. A recent brief, published by the Kansas Department of Health, highlighted the challenge of patients who have frequent, regularly scheduled appointments to receive dialysis or cancer treatments but may be unable to keep these appointments due to a lack of transportation services. This puts them at a higher risk of negative health outcomes (*9*).

Improving Access

Transit agencies have attempted various strategies to improve access to food and healthcare. In response to people staying home during the pandemic, FTA allowed agencies to provide food delivery by using Sections 5307 and 5311 funding—which provide transit capital, as well as operating and planning assistance for urban and rural areas, respectively. Subsequently, transit agencies in urban areas worked to respond quickly to the need for food delivery. Agencies such as the Capital Metropolitan Transportation Authority in Austin, Texas, and the Regional Transportation Commission in Southern Nevada provided increased access to food for transit-dependent populations by delivering meals and groceries to people in need.

Likewise, rural transit agencies worked to improve access to food. North Dakota State University surveyed U.S. transit agencies in rural and urban areas to better understand how they were providing access to food. Most of the 392 responding transit agencies provide rides to a grocery store or supermarket within

Courtesy of the Regional Transportation Commission of Southern Nevada

When the Regional Transportation Commission of Southern Nevada noted a dramatic reduction in older adult ridership at the start of the COVID-19 pandemic, they repurposed their paratransit vehicles to deliver essential food to older adults in need. Their partnership with a local food bank was a win for all during program execution.

Courtesy of Feonix—Mobility Rising

Wheeling into place, an Ann Arbor, Michigan, rider secures her wheelchair in The Ride public transit bus, which offers transportation for people with disabilities and older adults through its shared, reservation-based A-Ride service. Buses include lifts and provide origin-to-destination, curb-to-curb, and door-to-door service during fixed-route service hours.

their service area. Several also reported providing some type of food delivery, including 57 agencies that had been doing so before the pandemic and 136 that began delivering food during the pandemic (*10*). In January 2022, FTA removed the waiver that allowed transit agencies to use these funds for food delivery (*11*). Many agencies reported that while they wanted to continue to provide food delivery, they faced shortages of staff, vehicles, and funding.

Transit agencies across the country have made several efforts to improve access to healthcare. In rural areas, this includes practices such as

- Adding service specifically for healthcare trips or routing trips to healthcare clinics;
- Grouping rides to medical facilities, when possible;
- Providing individual rides for long medical trips;
- Scheduling intercity trips to clinics;
- Coordinating dialysis schedules with hospitals or dialysis facilities; and
- Giving healthcare providers the capability to schedule rides for their patients.

For example, Paris Metro, the transit service provided by the Ark–Tex Council of Governments in Paris, Texas, partnered with the regional medical center, educational institutions, and local businesses to improve the community's transit service and increase access to healthcare. The medical center provided funding and office space, and after years of planning, the partnership resulted in new fixed routes with more reliable service to healthcare appointments. This effort corresponded with a decrease in emergency room visits (*12*).

Enhanced Partnerships

Establishing and maintaining partnerships is an important aspect of improving access. Over the past several years, successful partnerships have emerged to improve access to healthcare in communities across the United States. These partnerships include transit agencies partnering with medical providers, public health agencies, dialysis centers, as well as other organizations that serve older adults, such as for co-scheduling trips and appointments in rural communities to improve access to healthcare. Also included are partnerships with transportation services, programs, and organizations staffed by volunteers. Collaboration between public transit and emerging mobility services is a noteworthy practice for improving access. One exemplary initiative is from the Central Midlands Regional Transit Authority (the COMET) in the Columbia, South Carolina, area. The agency's mobility programs offer financial support to older adults and people with disabilities who reside outside the COMET's service area. This support is used for on-demand transportation services such as taxis or transportation network companies. Other examples of mobility-as-a-service initiatives include those services offered by Feonix—Mobility Rising. This nonprofit organization is serving communities across the country to improve access to transportation among vulnerable and underserved groups in collaboration with local and community-connected national organizations.

Benefits of Improving Access

Improving access to healthcare and nutritious food benefits individuals and society. Healthy diets help children develop properly and decrease their risk of diseases (*13*), and adults who eat healthy food tend to live longer and have a lower risk of chronic diseases such as obesity, Type 2 diabetes, certain cancers, and heart disease (*14*).

The benefits of providing healthcare trips are improved health and well-being, as well as cost savings. Missing a trip for routine care or preventive services may result in an emergency medical trip that is costlier than the trip that was missed. Nonemergency medical transportation can reduce emergency room and hospital expenditures. One study found that 31 percent of children who missed a healthcare appointment subsequently went to the emergency room for a condition associated with the missed appointment (*15*). Another study found the net

healthcare benefits of increased access to nonemergency medical transportation for transportation-disadvantaged individuals exceeded the additional costs of transportation (*16*). For some conditions, a net cost saving was identified. For others, improvements in quality of life or life expectancy were sufficient to justify the added expense. Other cost–benefit analyses have shown the tremendous benefits that transit agencies provide by improving access to healthcare, with the benefits far outweighing the costs of the service (*17*).

Key Takeaways

Transportation affects health in many ways.

People who cannot drive or do not have access to a vehicle are at risk of missing important healthcare trips or being unable to access healthy food.

Driving cessation among older adults has been shown to contribute to health problems (*18*).

Public transportation plays an important role in ensuring the needs of older adults, people with disabilities, and other transportation-disadvantaged populations are met so that they can maintain a healthy lifestyle and good quality of life.

Partnerships are critical in removing barriers and enhancing transportation, as well as emphasizing the important role of collaborative actions and decision making in access to healthy food and healthcare.

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Invisible Disabilities

Seeing the Unseen

Oran Viriyincy, Flickr, CC BY-SA 2.0

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Which person has a disability? Although the man in the wheelchair is the obvious answer, he may not be the only person with a disability. Those with no visible impediments may have any nonapparent condition such as epilepsy, a traumatic brain injury, chronic pain from diabetes, severe asthma, anxiety, or another hidden condition that affects their mobility or cognition and can limit the usefulness of available transportation for them.

Most people are willing to assist others when there are visual cues of a disability, such as a wheelchair or guide dog. However, many individuals have disabilities that are not visible and can pose significant transportation accessibility challenges for them.

What Are Invisible Disabilities?

Invisible disabilities include auditory impairments, color blindness, autism spectrum disorder, traumatic brain injury, learning disabilities such as dyslexia or attention deficit disorder, dementia, and conditions such as anxiety that limit the ability to recall and interpret information. Lung conditions such as asthma that make breathing difficult, as well as limitations imposed by long-term illnesses like cancer can increase fatigue levels during a journey. Conditions such as fibromyalgia can make standing for long periods painful.

To complicate matters, people with disabilities such as chronic pain may not use mobility aids on "good" days, and visual and auditory impairments can be difficult to identify in the absence of eyeglasses and hearing aids. Invisible disabilities—physical and mental—can affect the travel experience by reducing confidence in the ability and willingness to travel, thereby limiting overall mobility and accessibility.

While the successful deployment of engineering solutions, such as ramps and kneeling buses, has assisted people who use wheelchairs and tactile surfaces and audible traffic control devices have guided those who are visually impaired, most provide few benefits for individuals with invisible disabilities. There are, however, several examples of agencies recognizing the importance of making transportation more inclusive for those with invisible disabilities. This article gives a brief introduction to invisible disabilities within the context of transit accessibility and provides some key examples of programs throughout the world.

Unseen Challenges, Seen Solutions

According to Disabled World, an independent health and disability news source, an estimated 10 percent of people in the United States have a medical condition that could be considered a type of invisible disability.[1] This includes more than 32 million Americans. Travelers with invisible disabilities face many challenges, including the following:

- People with conditions, such as autism spectrum disorder, may have difficulty communicating with others, while dementia and acquired brain injury may affect the ability to interact. Hence, these individuals may avoid taxis and rideshare services.
- Some mental health conditions increase the propensity for anxiety and panic attacks while traveling, especially when taking busy urban transit. These may require the person to seek assistance or a quiet environment where they can recover or be recognized as being in need.
- Some invisible physical conditions (e.g., breathing difficulties or stroke-related symptoms) may require rest while traveling—on the street, at transit stations, and on transit vehicles.

These examples illustrate the complexity of challenges and the need for transportation professionals to be prepared to address them. Exemplary organizations that are addressing these challenges follow.

Transportation Interventions

Several efforts in the United States have explicitly addressed invisible disabilities within the transportation context. Will You Stand-Up for Me? is a campaign launched by the University of Maryland on its campus buses to make riders aware of the potential need to offer their seats to others who might have an invisible disability.[2] The campaign website encourages students to be inclusive by offering their own seats to others who may need to sit down. It also implores riders to ask others by using phrases such as "no explanation needed."

Other transit agencies have made efforts to be more inclusive. In 2018, New York City Transit initiated the Accelerate Accessibility Program to raise invisible disability awareness among riders and operators.[3] Such efforts are not limited to college campuses and major cities. The Heart of Iowa Regional Transit Agency in Urbandale maintains an open policy for identifying and serving those with invisible disabilities. Agency employees are trained to take the stance that they are not to judge or determine if someone has a condition that requires assistance. Their goal is to provide a service to allow everyone to move freely within their community. If someone indicates they have a disability, even one that is not visible, the only appropriate response from any employee is "How may we/I assist you?" In this way, the agency creates an inclusive space—letting the rider know they are heard, believed, and will be assisted as indicated in its signage (Figure 1).

In some cases, programs directly tailor services to people with invisible disabilities. For example, buses in Great Britain are required by law to display signs that dynamically indicate upcoming stops in addition to any audio announcing upcoming stops. Working in partnership with transit operators, the British government launched a campaign with the slogan "It's everyone's journey" to encourage members of the public to show consideration toward other travelers, including those with invisible disabilities.[4] The campaign uses images of cartoon "creatures of habit" and slogans—some of which are intended to raise awareness of the needs of those with invisible disabilities. For example,

FIGURE 1 Inclusive signage reminds passengers to consider others. (Source: Heart of Iowa Regional Transportation Agency.)

- Cartoon hyenas with the reminder, "Let's try to keep the noise down. Loud behavior can be overwhelming for some people, including those with mental health conditions. Remember, some people don't just want quiet, they need it."
- A cartoon chameleon with the message, "Please don't pull a disappearing act. An unexpected delay can be especially difficult for people with conditions like autism. So, if someone looks a little stranded, let's be ready to help."

Several UK transit operators issue travel support cards that users can show to staff to indicate their disability or particular needs.[5] Cards either have preprinted messages such as, "I have a hidden disability," or a blank space for users to write their own messages to the bus driver. Transport Ireland and Invisible Disability Ireland recently initiated the awareness campaign, Please Offer Me a

[1] Learn more at https://www.disabled-world.com/disability/types/invisible/.

[2] For more information, go to https://transportation.umd.edu/about-us/updates/will-you-stand-up-for-me.

[3] Read about this program at https://fastforward.mta.info/accelerate-accessibility.

[4] See the cartoon at https://everyonesjourney.campaign.gov.uk/.

[5] Find a sample card at https://content.tfl.gov.uk/using-a-travel-support-card.pdf.

FIGURE 2 **Awareness campaign materials in Ireland help people with disabilities to ask for a seat. (Source: Invisible Disability Ireland.)**

Seat (Figure 2).[6] A program by the same name was launched in Australia. To foster inclusivity, the Land Transport Authority in Singapore distributes lanyards to riders with disabilities stating, "May I have your seat?"

Creating Safer, More Inclusive Experiences

In addition to its onboard accommodations, the Heart of Iowa Regional Transit Agency conducts transit travel training programs. Many people with invisible disabilities have no experience riding the bus or train and benefit from targeted instruction—as well as practice—tailored to meet individual needs. Other programs, such as the Bradford Safe Place Scheme[7] in the UK, use cards that say, "Help I'm Lost." These cards contain a message explaining that because the bearer has a learning or communication difficulty, they may not be able to understand questions or to make themselves understood. The card also asks for help and provides a blank space for the bearer's name and the phone number of an emergency contact.

Moving Toward Solutions

Although there are myriad examples of individual agencies doing good work to be inclusive and accommodating persons with invisible disabilities, a wider understanding and acceptance is needed. Organizations like the Invisible Disabilities Association in Parker, Colorado, are working to create awareness campaigns, educational campaigns, and legislative support throughout the United States to improve the quality of life for those living with invisible disabilities.[8] This development and promotion of information is targeted at public transit users.

Perhaps more importantly, the Invisible Disabilities Association is pursuing legislation in every state to allow for voluntary disclosure on government identification cards for anyone with any disability, illness, or chronic pain, as well as a nationally recognized invisible disability identification card.

Moving Forward

In the public transit context, full inclusivity will require staff and the traveling public to be aware of invisible disabilities and to understand how to accommodate them. To help achieve this, the following actions are suggested:

- Implement awareness campaigns describing the needs and behavior of people with invisible disabilities.
- Offer transit travel training programs to anyone wishing to increase their confidence when traveling.
- Train all transit personnel to help all riders, regardless of whether they appear to have a disability.
- Provide transit travel assistance cards to help riders request appropriate assistance.
- Offer information about transportation stops through multiple means, including communication boards, audio, and text displays.
- Provide audio and visual information about the route, final destination, and next stop on all buses and trains.
- Use display signs on all transit, encouraging other riders to offer their seats to people in need and empower people with invisible disabilities to request seats when needed.
- Consult with riders with disabilities to develop street signage around transit stops to improve navigation and accessibility.
- Introduce safe places and use "Help, I'm lost" cards to enable people with invisible disabilities to obtain appropriate support when traveling.
- Include maps with quiet routes for walking through noisy urban areas to assist people who find noise stressful.

Developing and evaluating comprehensive programs is a critical step. Transit agencies can work with researchers to conduct focus groups and collect data to evaluate what techniques work so that lessons learned can be documented and, ultimately, guidance and regulations can be drafted to ensure that everyone has access to inclusive transportation.

[6] Learn more at https://www.invisibledisabilityireland.com/.
[7] Find out about this organization at https://www.snoopcharity.org/services/after-school-care/.
[8] Read more at https://invisibledisabilities.org/.

Opening Doors

Including People with Disabilities in the Transit Workforce

Courtesy of the National Academies

JUDY SHANLEY, SHAYNA GLEASON, AND PATRICIA GREENFIELD

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With beverage at hand and headset in place, a person in a wheelchair is set for a productive workday. In the transit sector, people with disabilities have typically been viewed as those to *be* served as riders rather than *to* serve as members of the transit workforce. That perspective is changing, as agencies engage with people with disabilities about accessibility needs that will help them thrive in the workplace.

The transit workforce is expected to grow substantially in coming years and already, more than 90 percent of public transit agencies are struggling to hire individuals for frontline positions (*1*, *2*). In 2022, only 21.3 percent of people with a disability were employed nationally, while 65.4 percent of people without a disability were employed (*3*). This stark employment disparity suggests that people with disabilities comprise an untapped pool of potential candidates for positions. Partnerships between transit agencies and organizations that connect with and serve people with disabilities can result in powerful and mutually beneficial relationships, as evidenced by the case examples that follow.

Cheerleaders for a diverse transit workforce, particularly those who are focused on people with disabilities—are thrilled that this topic is included in this *TR News* theme issue. It affirms the idea of "nothing about us without us," a longtime ideal of the Independent Living Movement. This principle envisions people with disabilities as being at the table in policy and strategy decisions that affect their lives. In the transportation industry, individuals with disabilities should comprise part of a diverse workforce and—using approaches discussed in this article—can be included in recruitment and retention initiatives. The authors offer an overview of strategies gleaned from a literature review, their professional experiences, and interviews with practitioners in the field.

Case Examples

METROWEST REGIONAL TRANSIT AUTHORITY, CENTRAL MASSACHUSETTS

Otoniel Orozco, who had trained in the culinary arts, was surprised to find himself working at—of all places—a transit agency. "I've always used public transportation. I could never drive," says Orozco, who is legally blind. "Somehow, I ended up here. The doors were open, the shot was given, and honestly, it's been such a great fit."

Those doors opened because the MetroWest Regional Transit Authority in Central Massachusetts has led a pioneering effort to hire people with a range of disabilities, including individuals who are blind, people who have mobility disabilities, and those with developmental disabilities. People with disabilities comprise 20 percent of MetroWest's workforce across a diverse range of roles. "It really was our benefit," affirms Eva Willens, deputy administrator of MetroWest. "We got some great employees, and we still have them to this day."

Since its inception in 2007, MetroWest has partnered with agencies that include the Massachusetts Commission for the Blind, Employment Options, MetroWest Center for Independent Living, the Perkins School for the Blind, and the Carrol Center for the Blind. Orozco, assistant manager of the MetroWest call center, connected with the transit agency through such a partnership. Agency partners also assist MetroWest in understanding what job accommodations employees with disabilities will need and provide support to these employees along the way. Liz Gulachenski, a representative from Employment Options, comments about a person the organization connected with MetroWest: "They treat her well and respect her. She actually hasn't needed us for mental health disability services in a while."

Orozco knows that he and his colleagues with disabilities bring unique qualities to MetroWest: "the real-world experience to be able to relate to the demographic we serve." Jim Nee, the agency's director, agrees that employees with disabilities bring a distinctive value, not only to the jobs they perform within transit but also to their colleagues without disabilities. "There's no amount of training that I could do or pay for that would be even close to the benefit of having a staff [member] who has that real-world experience," Nee adds.

CENTRAL OHIO TRANSIT AUTHORITY, COLUMBUS, OHIO

Similarly, Central Ohio Transit Authority (COTA) in Columbus, Ohio, has strengthened its workforce and career pipeline by recognizing the value of accommodating young people with learning disabilities who are participating in its preapprenticeship technician program. While mentoring these young people through a partnership with the Columbus City Schools, COTA realized that some of the participants had diverse ways of learning and had likely been supported in high school through individualized education programs, which focused on their specific needs.

The agency worked to determine what barriers to success might exist, exploring ways to train, ask questions, and build its staff's skills in aligning communication and training content to fit the individual's learning style. "This is just what you do as a good trainer: Recognize that people learn differently," explains Tracy Spikes, COTA's Workforce Development senior program manager.

She also notes that, as they made these adjustments, some of the current technicians realized that they had the same challenges and that these accommodations worked for them, too. Spikes underscored the benefits, emphasizing that, "COTA gets another good employee who—with some special attention—now has the confidence to succeed. This approach provides us with a well-rounded and diverse workforce and helps us live up to our motto: Moving Every Life Forward."

Strategies for Recruiting People with Disabilities

- Develop partnerships with human services organizations.
- Create mentoring and career ladder programs with high schools.
- Participate in disability forums, fairs, and community disability planning.

Reasonable Accommodations

Modifications to a job, work environment, or hiring process to enable access for a person with a disability make these success stories possible. However, transit agencies are not on their own in figuring out how to navigate legally required accommodations for their employees. Agencies, such as the U.S. Equal Employment Opportunity Commission and the U.S. Department of Labor's Office of Disability Employment Policy (ODEP), provide extensive guidance in this area. In particular, ODEP's Job Accommodation Network provides free, confidential guidance on job accommodations for employers and employees.

Disability accommodations will become all the more important as the transit workforce ages. Among transit and intercity bus drivers, 72 percent are age 45 or older, and the average age of such drivers is more than 10 years older than the average American worker (*4*). In the United States, about 40 percent of adults aged 65 or older have a disability, compared with only 26 percent of all adults (*5*). Evidence suggests that many people who have age-related disabilities do not think of themselves as disabled (*6*). These employees may be less likely to know their rights to reasonable accommodations or think to ask for them. Their disabilities can also be invisible and therefore go unperceived by the employer, until they are disclosed.

Cape Cod Regional Transit Authority in Massachusetts has strengthened its workforce by actively reaching out to older adults in its recruitment efforts. The agency also proactively recognizes that retaining excellent employees may require appropriate accommodations, which includes allowing time for additional medical appointments (*7*). Such awareness and anticipation of disability accommodations will benefit transit agencies in the short and long run.

Performance Measurement

It is not sufficient for an agency or organization to implement recruitment or retention strategies without measuring outcomes. Hiring administrators must continuously evaluate these practices to determine if the strategies are achieving the desired results. It is easy to count outputs related to hiring, such as the numbers of employees with disabilities in the workplace, or the number of contacts or relationships with disability-focused hiring organizations. However, it is more difficult to measure the outcomes of having a diverse workforce that includes people with disabilities. The following are examples of outputs related to people with disabilities in the workforce:

- Increase in the number of people with disabilities in the work setting;
- Increase in career advancement opportunities;
- Increase in the number of people with disabilities in work teams;
- Increase in the number of people with disabilities as decision leaders, managers, and supervisors;
- Increase in the number of meaningful relationships with recruitment sources;
- Decrease in the number of Americans with Disabilities Act (ADA)–related reports and incidents; and
- Decrease in staff turnover attributed to ADA issues.

Likewise, the following are examples of outcomes related to including people with disabilities in the workforce:

- Increase in the percentage of employees (with and without disabilities) reporting positive perceptions of the work setting and specifically referencing diversity,
- Full integration of inclusive recruitment and retention policies and practices that become common in the work setting,
- Decrease in the overall costs of turnover,[1]

[1] The return on investment is proven by calculating the cost of turnover.

Courtesy of MetroWest

A MetroWest–branded clock ticks toward the day's end for Craig Coleman (*left*), senior transportation coordinator, and Tyler Terrasi, grants support coordinator. For Coleman, who has quadriplegia, the Central Massachusetts agency provided an adjustable desk and computer trackball with a mouse. Terrasi, who is totally blind, uses screen-reader software with text-to-speech output. Such adaptations and equipment allow them to perform their jobs efficiently.

- Increase in the production of work products and services that reflect inclusive practice and regard for people with disabilities, and
- Increase in career ladder opportunities and positions of authority for employees with disabilities.

Conclusion

People with disabilities deserve to have the same career expectations as those without disabilities, including job security, interesting assignments, career advancement opportunities, and a feeling of usefulness to society. Transit jobs have all of these qualities and more. Transit can be more equitable if the industry fosters a more inclusive workplace that reflects its riders and also if strategically targeted recruitment and retention of employees with disabilities promise to ease some of the strain of deepening labor shortages.

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TRANSPORTATION INFLUENCER

Willie L. Brown, Jr. *is the vice provost for faculty affairs at the University of Maryland Eastern Shore in Princess Anne, where he is also an associate professor in the Department of Engineering and Aviation Sciences. He serves as committee communications coordinator for TRB's Standing Committee on Aviation Safety, Security, and Emergency Management.*

What is your role as communications coordinator, and what is helping you to be successful in this role?
As the committee communications coordinators council–aviation group chair, I have a target goal to create a strategic approach among the committees to examine the overall effectiveness in the dissemination of—and shared information on—activities. The committee volunteers are the success story for me. It is our desire to forge a path for a modern transportation system through research and development. This success is only possible if the community is committed to believing in that same vision. TRB has a passion for ensuring that innovation is achieved from the activities of an interdisciplinary environment.

How has TRB influenced your career?
TRB has given me new insight into research initiatives and opportunities to engage with an interdisciplinary community for advancement. This has allowed me to network and collaborate with other professionals from different sectors and to gain knowledge in my field.

What advice would you offer others, who may hesitate to take on a similar leadership role?
I am committed to service and to the critical needs of transportation research. When others give back to the research community—through volunteering and offering their expertise and perspectives—not only is this rewarding, but it also aids in everyone's professional development, including those serving in a leadership capacity.

Transportation Influencer highlights the journey of young professionals active in TRB. Have someone to nominate? Send an e-mail to TRNews@nas.edu.

MEMBERS *ON THE MOVE*

Brendan Foht is a new Cooperative Research Programs (CRP) senior editor. He comes to TRB from *The New Atlantis: A Journal of Technology and Society*, where he was an associate editor.

Chris Hedges, director of CRP, retired in May after nearly 24 years with TRB.

Cynthia Jones, a Technical Activities Division senior program officer, joined TRB from the Ohio Department of Transportation.

Sreyashi Roy has accepted a position as a technical writer–editor at the National Transportation Safety Board. She was a CRP editor for eight years.

Kristin Sawyer, previously an independent contractor with CRP, has joined the division as an editor.

Dominique Williams has joined CRP as an editor. He previously worked as a copyediting specialist at the National Quality Forum in Washington, DC.

Christopher "Kit" Mitchell

Head of Environment Division, Transport Research Laboratory, UK (retired)

Kit Mitchell is an influencer whose body of work advanced transportation practice. His career began in aeronautics at a British research organization, then known as the Royal Aircraft Establishment. In the mid-1960s, he developed a method to include unsteady aerodynamics when calculating the gust response of slender delta aircraft, such as the *Concorde*, a supersonic aircraft in development at the time. He also worked on vibration on the ground. "Before *Concorde* flew," Mitchell remembers, "we were pretty sure it would vibrate during take-off and give the pilots a rough ride."

Mitchell's groundbreaking work led him to the Road Research Laboratory (RRL) in 1973. "I was poached by RRL—which later became the Transport and Road Research Laboratory—to lead a team helping bus companies put in Dial-a-Bus systems to establish whether this was an effective way to use bus subsidies." Today, we might call this program mobility-on-demand. At the time, it was the leading edge of research on this topic."

Having made the jump from the air to the ground and from systems to microeconomics to work on personal rapid transit in 1970, Mitchell admits that it "got me hooked on transport research." He soon led the Access and Mobility Division, which he describes as "great fun with a very bright, interdisciplinary staff." Long before accessible transportation was a buzz phrase, his team examined the social effects of transportation policies and availability for groups of users, including older adults and people with disabilities. Again at the leading edge of research, he notes, "we catalogued—I think for the first time—how different types of people traveled by different modes and for different purposes."

Projects on making buses and cars easier for older adults and people with disabilities to use led to work on public buses in the UK and produced what Mitchell believes was "the first bus standard based on experimentally determined passenger's ergonomic requirements." In 1981, he moved on to the Environment Division, where he was responsible for work on noise and air pollution. This, Mitchell interjects, "was in addition to the psychological nuisance caused by traffic, planning for cycling, and the design of heavy-goods vehicle suspensions to minimize dynamic loading and road wear, as well as the operation of the road freight industry." The division completed a project to build a quiet heavy vehicle with a maximum-weight tractor that only emitted 82 decibels. Mitchell adds, "This was quieter than the laboratory car we used to carry microphones and other test equipment." When a project was launched to fund the industry to build quiet vehicles so that noise standards could be tightened, Mitchell spearheaded the effort. In 1994, at the project's conclusion, he retired after 31 years as a government scientist.

"We catalogued—I think for the first time—how different types of people traveled by different modes and for different purposes."

Although many retire to a life of quiet solitude, Mitchell spent the next year working on a voluntary basis as chair of the Scientific Committee for the Conference on Transport and Mobility for Elderly and Disabled People (TRANSED). "This was a good way to wind down from a busy job," he admits. "I was involved with the first TRANSED in Cambridge in 1978, attended all the TRANSED conferences from 1984 until 2012, and had papers at most of them."

Mitchell spent 1996 to 1997 as a visiting expert at Transport Canada's Transport Development Centre. In 1997, he became a consultant for UK-based organizations, such as the Chartered Institution of Highways and Transportation, the Road Safety Trust, and the Institute of Advanced Motorists. Spurred on by reinvolvement in the Royal Aeronautical Society, he started the *Journal of Aeronautical History* to document historic breakthroughs like the *Concorde* project that reduced the vibration in the cockpit during take-off roll. He shepherded this journal from 2010 to 2020, when he "handed the editorship to a delightful American successor."

Mitchell has been a TRB Annual Meeting attendee since 1976, a recipient of TRB's 2001 William G. Bell Award and 2022 Exceptional Service Award, and a member of TRB's Committee on Accessible Transportation and Mobility since 1998. He was co-chair from 2003 until 2009 and continues to review papers and attend online meetings as an emeritus member. He helped organize the 2022 TRANSED: Mobility, Accessibility, and Demand Response Transportation Conference, convened by TRB and held virtually. After a career full of groundbreaking research, Mitchell remains interested in seeing the results of scientific studies used to inform policy decisions—especially for older adults and all who struggle to get where they need to go.

Benito Pérez

Policy Director, Transportation for America

Benito Pérez believes that making progress requires shaking things up. "Research gives us the opportunity to look at things in novel ways," he notes, quickly adding "right now, the traditional transportation paradigm is on autofocus. I challenge this with the fundamental question, Are we doing this for vehicles or for people?"

As the policy director at Transportation for America, an advocacy organization, Pérez leads their policy research, analysis, advocacy, and intergovernmental relationship building. With expertise in federal, state, regional, and local transportation policy, he describes his position as "fostering relationships and conversations among government and community stakeholders." Responsible for providing strategic policy advice and support to advocacy coalitions such as the National Campaign for Transit Justice and the National Complete Streets Coalition, he is a passionate advocate who enjoys matching practical approaches for equitable, people-centered transportation solutions with interested stakeholders.

Pérez's experience as an instructor for local and state legislator programs to improve transportation has ingrained his awareness of the importance of finding new solutions to old inadequacies. As a facilitator for events such as the Connecting Communities Mobility Workshop for the Utah Department of Transportation (DOT) and the greater Salt Lake City region, he also knows how powerful it is to involve the community.

For more than a decade, Pérez has kept a close eye on research efforts that may be ready to put into practice. As a frequent peer reviewer, he has a front-row seat to innovative research. From academics pondering general principles to practitioners reflecting on how the lessons they learn may affect the state of the practice, he looks for opportunities to move research from the lab—or the research paper—to the built environment. "I see a lot of synergies in the efforts of researchers and practitioners tackling key transportation challenges and opportunities," he explains. "I try to facilitate those conversations so folks are working together."

"Jump in, engage your curiosity, and start a conversation about the state of the practice through your research."

Pérez takes the opportunity to work with interns and students. "Their engagement into research cultivates a curiosity that launches their careers and future research endeavors," he notes, advising them to "jump in, engage your curiosity, and start a conversation about the state of the practice through your research." Frequently, Pérez has invited young professionals to collaborate with him on research projects and papers. His research efforts include topics such as impediments to walking and biking to school, big data analytics driving parking policy, and curbside freight management.

In addition to his bachelor's degree in sociology, Pérez holds two master's degrees in urban and regional planning as well as in civil engineering. He is a certified public manager whose experience from 2012 to 2021 at the District DOT in Washington, DC, included managing a team that worked with stakeholders to leverage data for policy development, resource allocation, and operations management of the District's curbside. This formative experience left Pérez with working examples of how bridging the gap between transportation planners and engineers helps them work beyond the silos and standard practice.

As a transportation engineer with the Hampton Roads Transportation Planning Organization from 2009 to 2012, Pérez dealt with passenger rail planning, as well as long-range transportation planning and its intersection with active transportation, resiliency, and land use. Previously, for the Maryland State Highway Administration, his work tapped his undergraduate sociology degree with equity and inclusion issues in transportation.

Pérez has been a member of TRB's Standing Committee on Transportation Demand Management since 2017 and has been a member of several National Cooperative Highway Research Program project panels, including "Data Management and Governance Practices," "Dynamic Curbside Management," and "Strategies for Incorporating Resilience into Transportation Networks."

There is a symbiosis here. By using data management and governance practices, Pérez has "leveraged the findings from this research to help guide policy recommendations for federal legislators on how to manage and govern railroad data between public and private railroad stakeholders." Likewise, Pérez notes that research on "Dynamic Curbside Management [set] a benchmark for municipalities to help them think about how they are evolving their practices and emerging trends—such as electric or autonomous vehicles—that can challenge curbside management."

In this way, Pérez promotes evolution through innovation backed by research and shakes things up. "We can't aspire to new heights if we don't consider innovating our practice."

Equity in Transportation

University Transportation Centers Hold National Mobility Summit

Funded by the U.S. Department of Transportation (U.S. DOT), the University Transportation Centers (UTCs) have long collaborated with TRB on initiatives that include hosting webinars, sponsoring conferences, and authoring conference summary documents. On March 16, 2023, the Fourth Annual National Mobility Summit of UTCs was held in Washington, DC. The summit was hosted by the Mobility21 UTC and led by Carnegie Mellon University in Pittsburgh, Pennsylvania.

Speakers from government, industry, and community organizations discussed challenges related to improving the mobility of people and goods. One summit session, Equity—UTC Innovations and Impacts, featured five speakers, who discussed ways to bring about greater access to transportation services and resources.

Consider Tribal Communities

Arlando Teller, assistant secretary for Tribal Government Affairs at U.S. DOT and a member of the Navajo Nation, emphasized the importance of communicating with tribal leadership—as well as tribal college and university staff—early and often when working with them. He also urged transportation policymakers not to forget about tribal communities when deploying new technologies such as alternative fuel vehicles. He explained that his home—the Navajo Nation—is 27,400 square miles, and accommodation of those vehicles on dirt roads or rough terrain would be a key implementation consideration.

David Kack, director of the Western Transportation Institute in Bozeman, Montana, discussed how, when working with tribal communities, it is essential to establish trust—which only happens over time and with follow-through. Relationships with tribes must be mutually beneficial. He added that tribal members can lend great insights into discussions on climate change because they are in tune with what nature is doing and have a great deal of knowledge on sustainable hunting and fishing practices, as well as the health of rivers and other elements of the environment.

April Rai (*left*), president and chief executive officer of the Conference of Minority Transportation Officials and Arlando Teller (*right*), U.S. Department of Transportation assistant secretary for Tribal Government Affairs and a member of the Navajo Nation, spoke at the Fourth Annual National Mobility Summit of UTCs.

Put Equity First

Steven Polzin, deputy director of the Center for Teaching Old Models New Tricks UTC at Arizona State University in Tempe discussed how equity is receiving more attention and being examined from a broader perspective because there are more data and analysis tools than ever before. There are also increased opportunities to examine equity for issues such as rideshare, bike path and micromobility access, as well as deployment of hardware and software and ultimately of electric vehicles and automated vehicle services.

Carol Tyson, government affairs liaison at the Disability Rights Education and Defense Fund, commented that access issues of people with disabilities are too often addressed as an afterthought when new modes of transportation and innovations are rolled out. For instance, electric school buses reduce the amount of harmful emissions to which students are exposed; however, students with disabilities are more likely to be exposed to diesel emissions because the buses that can accommodate them often are not electric. "If you don't include us in your discussions," Tyson said, "at best you are missing something. At worst, you are causing harm."

April Rai, president and chief executive officer of the Conference of Minority Transportation Officials (COMTO), described her organization as one that includes all underrepresented groups—not only by race and ethnicity but also by ability, gender, and worldview. COMTO, she stressed, focused on equity issues long before they became buzzwords.

Rai observed a need for more curated conversations about equity through the UTC forums and other associations such as Latinos in Transit and the Women's Transportation Seminar. She highlighted that—among the most recent group of universities to which the U.S. DOT has awarded UTC grants—there are five historically Black colleges and universities, five Hispanic-serving institutions, and five tribal colleges and universities. This is the highest number of minority-serving institutions to receive grants in UTC program history.

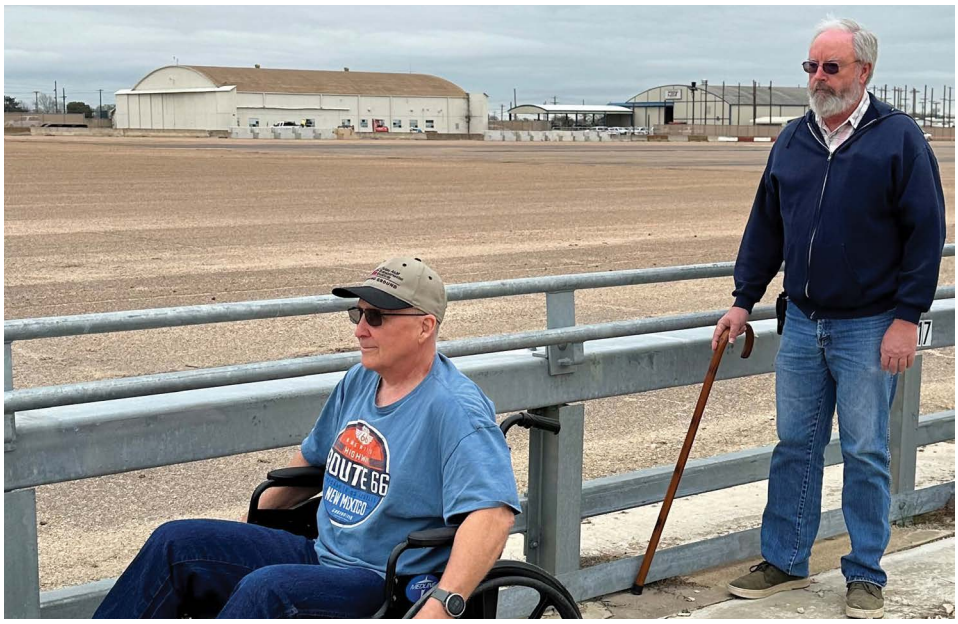
Information on this and other summit sessions may be found at https://mobility21.cmu.edu/events/the-national-mobility-summit/the-fourth-annual-national-mobility-summit-2023/.

—Karen Febey, senior report review officer, Transportation Research Board

New Roadside Barrier Design for Multimodal Corridors

ANN M. HARTELL

The author is a senior program officer with the Transportation Research Board of the National Academies of Sciences, Engineering, and Medicine in Washington, DC.



Chiara Dobrovolny, Texas A&M Transportation Institute

Staff at the Texas A&M Transportation Institute Proving Grounds in Bryan demonstrate the accessibility features of a new roadside safety barrier to protect people with disabilities. It includes graspable handrails and a flat rail near the ground that will not snag a wheelchair's front wheels and can also be detected by a cane.

Traditionally, roadside safety barriers are designed to meet the safety needs of motorists, shielding them from a steep slope or a fixed object in the clear zone—the unobstructed traversable roadside area. Roadway design speed, traffic volume, the presence of driveways, construction and maintenance costs, and aesthetics all drive barrier design selection.

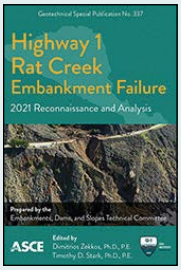
When a roadway corridor also includes a multiuse path for pedestrians, cyclists, and other nonmotorized users, additional factors must be considered. A typical guardrail, for example, may have bolts on the side facing a shared-use path that can snag a wheelchair or bicycle. Gaps between the lower part of the guardrail and the pavement, which may be intended to allow drainage from the roadway, may be more difficult to detect for a person with low vision who is using a cane. Such a person would not feel the barrier until they were nearly upon it. However, a rail placed close to the ground allows the cane to hit it while the person is still a couple of feet away. A rail placed low also allows a person with low vision to follow along the rail with the cane to navigate instead of bouncing the cane between the posts of a standard guardrail. People with better vision would be able to see the barrier itself.

An essential characteristic of safety barriers is that they are designed to absorb and redirect the energy from a crash. This energy usually causes the barrier to deflect away from the roadway—and potentially into an adjacent multiuse path—when struck by a motor vehicle. Additionally, if the barrier is damaged in a motor vehicle crash, then the damaged barrier could partially block the path—thus exposing pedestrians, cyclists, and other users to sharp edges and other hazards.

Recent National Cooperative Highway Research Program (NCHRP) research offers a new barrier design for locations where a shared-use path is close to a high-speed roadway. The barrier satisfies public right-of-way accessibility guidelines—known as PROWAG—and provides all nonmotorized users with a streamlined steel barrier. During computer simulations and full-scale crash tests at the Texas A&M University Transportation Institute Proving Grounds in Bryan, the barrier was found to be crashworthy in accordance with the *AASHTO Manual for Assessing Safety Hardware* (MASH) criteria for Test Level 3, which evaluates safety performance in full-scale crash tests using a passenger car and a pickup truck traveling at 62 miles per hour. In addition, the research team developed and tested a design for a transition that can be used to connect the new barrier to a typical steel guardrail.

The final report is anticipated for release in fall of 2023.

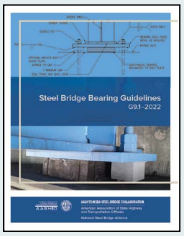
For more information about NCHRP Project 22-37, "Development of a MASH Barrier to Shield Pedestrians, Bicyclists, and Other Vulnerable Users from Motor Vehicles," visit https://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=4583.



Highway 1 Rat Creek Embankment Failure: 2021 Reconnaissance and Analysis

Dimitrios Zekkos and Timothy D. Stark, ASCE. ISBN 978-0-7844-8457-9. Purchase this e-book at https://ascelibrary.org/doi/book/10.1061/9780784484579.

This publication provides an overview of the 2021 embankment failure in Big Sur, California, and details of the investigation performed by the team mobilized by the Embankments, Dams, and Slopes Technical Committee. This e-book further expands on the team's subsequent radiocarbon dating, data analysis, and recommendations for reducing future failures.



Steel Bridge Bearing Guidelines, 2nd Edition

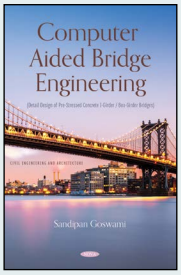
AASHTO. Download this free publication at https://store.transportation.org/Item/PublicationDetail?ID=5052.

This guideline presents steel bridge bearing design guidelines and construction details that are cost-effective, functional, and durable. It includes four major types of bridge bearings—elastomeric, high-load multirotational, steel, and seismic isolation—that are viewed as sufficient to cover most structures in the national bridge inventory. Information provided is intended to permit efficient design, fabrication, installation, and maintenance of each bridge bearing type.

Blast Protection of Buildings: Standard ASCE/SEI 59-22

ASCE. ISBN 978-0-7844-1571-9. Purchase this standard at https://sp360.asce.org/PersonifyEbusiness/Merchandise/Product-Details/productId/284581314.

This standard provides minimum requirements for planning, design, construction, and assessment of new and existing buildings subject to the effects of accidental or malicious explosions. This standard also includes principles for establishing appropriate threat parameters, levels of protection, loadings, analysis methodologies, materials, detailing, and test procedures. It provides a comprehensive presentation of current practice in the analysis and design of structures for blast resistance.



Computer Aided Bridge Engineering

Sandipan Goswami, Nova Science Publishers. ISBN 978-1-68507-413-5. Purchase this publication at https://doi.org/10.52305/YVXV1963.

This volume is the first in a series by this author on the design of prestressed concrete, I-girder, and prestressed concrete box-girder bridges. It describes project design calculations for a deck-girder superstructure, along with the design of an abutment and pier with pile foundation as the bridge substructure.

The titles in this section are not TRB publications. To order, contact the publisher listed.

TRB PUBLICATIONS

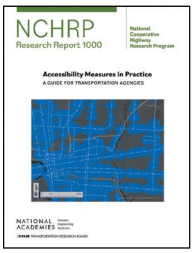
Transportation Research Record 2677, Issue 1

Topics include autonomous minibus service, nontraditional pedestrian timing treatments for coordinated signalized intersections, and debris blockage prediction in disaster-response road systems.

Transportation Research Record 2677, Issue 2

This issue examines how to evolve with rapidly shifting supply chains and freight systems, evaluate cost savings from truck caravanning, and enable factors and durations data analytics for dynamic freight parking limits.

SAGE is the publisher of the *Transportation Research Record: Journal of the Transportation Research Board* (TRR) series. To search for TRR articles, visit http://journals.sagepub.com/home/trr. To subscribe to the TRR, visit https://us.sagepub.com/en-us/nam/transportation-research-record/journal203503#subscribe.



Accessibility Measures in Practice: A Guide for Transportation Agencies

NCHRP Research Report 1000

This report describes measures of accessibility—defined as the ease with which travelers can reach valued destinations—and how these measures can be implemented by transportation agencies. Measures of accessibility provide important information about the transportation system's performance across all modes in meeting human needs.

2022; 148 pp.; TRB affiliates, $68.25; TRB nonaffiliates, $91. Subscriber categories: planning and forecasting, society.

Framework for Assessing Potential Safety Impacts of Automated Driving Systems

NCHRP Research Report 1001/BTSCRP Research Report 2

This joint report describes a framework meant to help state and local agencies assess the safety impacts of automated driving systems and guides agencies on adapting the framework for a variety of scenarios.

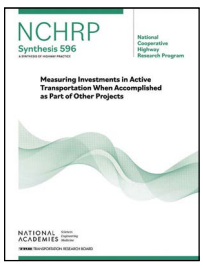
2022; 150 pp.; TRB affiliates, $68.25; TRB nonaffiliates, $91. Subscriber categories: operations and traffic management, safety and human factors, vehicles and equipment.

Watershed Approach to Mitigating Hydrologic Impacts of Transportation Projects: Guide

NCHRP Research Report 1011

This report describes a watershed-level approach to identifying strategies and techniques that can mitigate hydrologic impacts of transportation projects.

2022; 88 pp.; TRB affiliates, $57.75; TRB nonaffiliates, $77. Subscriber categories: environment.



Measuring Investments in Active Transportation When Accomplished as Part of Other Projects

NCHRP Synthesis 596

This synthesis documents the methods that state departments of transportation (DOTs) are using to track and record investments in active transportation infrastructure accomplished as part of larger infrastructure projects. State DOTs currently lack a uniform methodology for tracking investments in active transportation and may be underreporting them. Accurate investment information could help these agencies make active transportation projects more efficient and provide useful data to evaluate overall project performance.

2022; 80 pp.; TRB affiliates, $54.75; TRB nonaffiliates, $73. Subscriber categories: administration and management, pedestrians and bicycles, planning and forecasting.

Airfield Design for Large Unmanned Aircraft Systems: A Guide

ACRP Research Report 238

This report provides fundamental information on large, unmanned aircraft systems and their typical supporting infrastructure needs, which will assist airport sponsors with determining potential enhancements to support large, unmanned aircraft systems operations at their facilities.

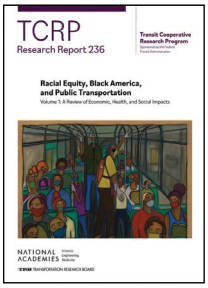
2022; 126 pp.; TRB affiliates, $64.50; TRB nonaffiliates, $86. Subscriber categories: aviation, operations and traffic management, terminals and facilities.

Guide to Evaluating Airport Governance Structures

ACRP Research Report 245

This report provides valuable tools to help communities evaluate the effectiveness of their current governance structure and consider alternative governance structures at airports.

2022; 98 pp.; TRB affiliates, $57.75; TRB nonaffiliates, $77. Subscriber categories: aviation, administration and management, policy.

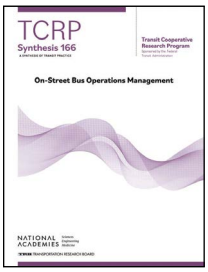


Racial Equity, Black America, and Public Transportation, Volume 1: A Review of Economic, Health, and Social Impacts

TCRP Research Report 236

This report reviews the literature and summarizes common practices of the 20th and 21st centuries that had significant economic, health, and social impacts on Black communities, as well as the racial gaps that emerged as a result of transportation inequities, deliberate actions, policies, and projects.

2022; 50 pp.; TRB affiliates, $46.50; TRB nonaffiliates, $62. Subscriber categories: policy, public transportation, society.



On-Street Bus Operations Management

TCRP Synthesis 166

This synthesis provides an overview of the current practices in real-time management of street operations at North American transit agencies.

2022; 116 pp.; TRB affiliates, $60.75; TRB nonaffiliates, $81. Subscriber categories: administration and management, operations and traffic management, public transportation.

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MEETINGS, WEBINARS, AND WORKSHOPS

August

9–13 TRB 2023 Automated Road Transportation Symposium
San Francisco, California
For more information, contact Bernardo Kleiner, TRB, 202-334-2964, BKleiner@nas.edu.

23–26 TRB Highway Capacity and Quality of Service Midyear Meeting
Orange County, California
For more information, contact Cynthia Jones, TRB, 202-334-2675, CJones@nas.edu.

23–26 TRB 13th International Conference on Low Volume Roads
Cedar Rapids, Iowa
For more information, contact Nancy Whiting, TRB, 202-334-2956, NWhiting@nas.edu.

23–26 62nd Annual TRB Workshop on International Law
Richmond, Virginia
For more information, contact Robert Shea, TRB, 202-334-3209, RShea@nas.edu.

September

18–20 TRB Managed Lanes Committee Midyear Meeting
Washington, DC
For more information, contact Cynthia Jones, TRB, 202-334-2675, CJones@nas.edu.

19–21 TRB Innovations in Freight Data Workshop
Washington, DC
For more information, contact Scott Babcock, TRB, 202-334-3208, SBabcock@nas.edu.

November

13–15 TRB's Transportation Resilience 2023: 3rd International Conference on Extreme Weather and Climate Change Challenges
Washington, DC
For more information, contact Gary Jenkins, TRB, 202-334-2311, GJenkins@nas.edu or William Anderson, TRB, 202-334-2514, WBAnderson@nas.edu.

January

7–11 103rd TRB Annual Meeting
Washington, DC
For more information, contact TRBMeetings@nas.edu.

16–18 2nd U.S.–Africa Frontiers of Science, Engineering, and Medicine Symposium
Rabbat, Morocco
For more information, contact Rose Parker, 202-334-2709, RParker@nas.edu or USAfricaSTEM@nas.edu.

Please contact TRB for up-to-date information on meeting cancellations or postponements. For TRB, as well as Technical Activities Division events, visit www.nationalacademies.org/trb/events. For information on all other events or deadlines, inquire with the listed contact.

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—Source: TSA
https://www.tsa.gov/travel/passenger-support

INFORMATION FOR CONTRIBUTORS TO TR NEWS

TR News welcomes the submission of articles for possible publication in the categories listed below. All articles submitted are subject to review by the Editorial Board and other reviewers to determine suitability for *TR News*; authors will be advised of acceptance of articles with or without revision. All articles accepted for publication are subject to editing for conciseness and appropriate language and style. Authors review and approve the edited version of the article before publication. All authors are asked to review our policy to prevent discrimination, harassment, and bullying behavior, available at https://www.nationalacademies.org/about/institutional-policies-and-procedures/policy-of-harrassment.

ARTICLES

FEATURES are timely articles of interest to transportation professionals, including administrators, planners, researchers, and practitioners in government, academia, and industry. Articles are encouraged on innovations and state-of-the-art practices pertaining to transportation research and development in all modes (highways and bridges, public transit, aviation, rail, marine, and others, such as pipelines, bicycles, pedestrians, etc.) and in all subject areas (planning and administration, design, materials and construction, facility maintenance, traffic control, safety, security, logistics, geology, law, environmental concerns, energy, technology, etc.). Manuscripts should be no longer than 3,000 words. Authors also should provide tables and graphics with corresponding captions (see Submission Requirements). Prospective authors are encouraged to submit a summary or outline of a proposed article for preliminary review.

MINIFEATURES are concise feature articles, typically 1,500 words in length. These can accompany feature articles as a supporting or related topic or can address a standalone topic.

SIDEBARS generally are embedded in a feature or minifeature article, going into additional detail on a topic addressed in the main article or highlighting important additional information related to that article. Sidebars are usually up to 750 words in length.

POINT OF VIEW is an occasional series of authored opinions on current transportation issues. Articles (1,000 to 2,000 words) may be submitted with appropriate, high-quality graphics, and are subject to review and editing.

RESEARCH PAYS OFF highlights research projects, studies, demonstrations, and improved methods or processes that provide innovative, cost-effective solutions to important transportation-related problems in all modes. Research Pays Off articles should describe cases in which the application of project findings has resulted in benefits to transportation agencies or to the public, or in which substantial benefits are expected. Articles (approximately 750 to 1,000 words) should delineate the problem, research, and benefits, and be accompanied by the logo of the agency or organization submitting the article, as well as one or two photos or graphics. Research Pays Off topics must be approved by the RPO Task Force; to submit a topic for consideration, contact Nancy Whiting at 202-334-2956 or nwhiting@nas.edu.

OTHER CONTENT

TRB HIGHLIGHTS are short (500- to 750-word) articles about TRB-specific news, initiatives, deliverables, or projects. Cooperative Research Programs project announcements and write-ups are welcomed, as are news from other divisions of the National Academies of Sciences, Engineering, and Medicine.

BOOKSHELF announces publications in the transportation field. Abstracts (100 to 200 words) should include title, author, publisher, address at which publication may be obtained, number of pages, price, Web link, and DOI or ISBN. Publishers are invited to submit copies of new publications for announcement (see contact information below).

SUBMISSION REQUIREMENTS:

- **Articles** submitted for possible publication in *TR News* and any correspondence on editorial matters should be sent to the *TR News* Senior Editor, Cassandra Franklin-Barbajosa, cfranklin-barbajosa@nas.edu, 202-334-2278.
- Submit **graphic** elements—photos, illustrations, tables, and figures—to complement the text. Photos must be submitted as JPEG or TIFF files and must be at least 3 in. by 5 in. and 2 megabytes with a resolution of 300 dpi. Large photos (8 in. by 11 in. with a minimum of 4 megabytes at 300 dpi) are welcome for possible use as magazine cover images. A detailed caption must be supplied for each graphic element.

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