



# How autonomous vehicles are making transportation more inclusive



**Author/Researcher**

Jonathan Andrews

**Partnerships Manager**

Ania Poprawka

**Digital Marketing Manager**

Folkert Leffring

**Publisher**

Willem Fast

**Director**

Richard Forster

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Cities Today  
PFD Media Group  
231-232 Strand  
London WC2R 1DA  
United Kingdom

Tel. +44 208 816 8075  
editorial@cities-today.com  
@cities\_today  
www.cities-today.com

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**O**ctober in Grand Rapids, Minnesota is not the ideal month to start an autonomous vehicle (AV) trial.

“It’s like opening a restaurant in January,” says Tom Pagel, City Administrator in Grand Rapids. “Winter typically starts mid-November and by April, if we’re lucky, the snow and cold have all gone.”

Despite the weather, the city’s goMARTI (Minnesota’s Autonomous Rural Transit Initiative) autonomous vehicle pilot has increased accessibility and transit options for its 11,500 residents across 17 square miles.

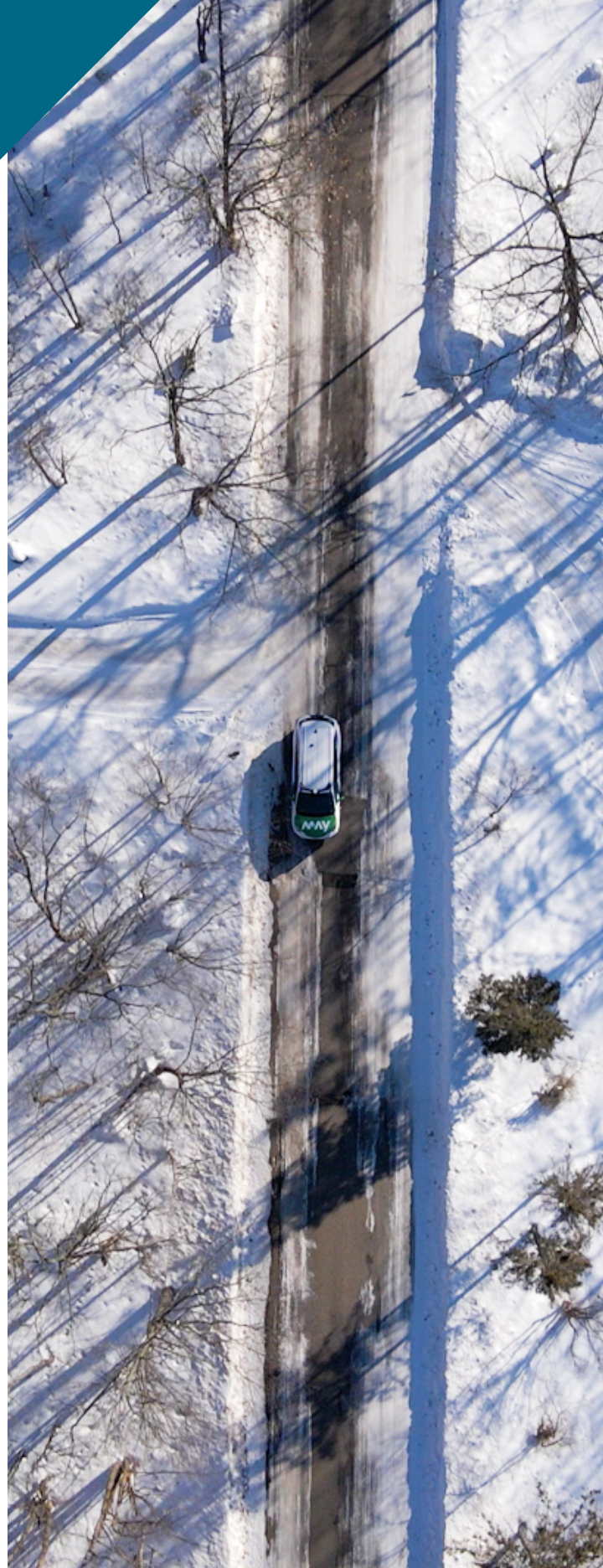
The 18-month deployment includes approximately 70 pickup and drop-off points with a fleet of five May Mobility autonomous vehicles that operate on roads up to 35 mph. Three vehicles are wheelchair accessible. The harsh winter conditions, while challenging, are essential for AVs to be fully useful in all areas. The cars, using a range of navigation tools including LiDAR technology, are able to memorize physical structures along a route.

Importantly, the vehicles are aimed at shared occupancy rather than single-occupancy and Pagel and his team were seeking to fill gaps in transportation when determining the service area for the vehicles.

“We made sure it went by most of our Housing and Redevelopment Authority complexes,” he adds. “We wanted to serve those who are more vulnerable or who lacked transportation. We then linked those areas to all of our public schools, medical facilities, and primary grocery needs.”

The city does have a public bus network but typically that only operates during daylight hours, while goMARTI operates from 2pm to 10pm. Rather than competing with public transit, the AV microtransit service offers residents a new mobility option after dark.

“It allows people who have transportation deficiencies the opportunity to go to the high school to watch a basketball game or wrestling match, or go to an arena and watch a hockey game,” says Pagel.





## Disability and inclusion

For people with disabilities, the elderly, and residents who live in underserved communities, barriers exist to accessing reliable transit. People with mobility issues may find it difficult to use public transport, and often rely on specialized services such as Paratransit. However, these services can be expensive, may require advance scheduling, and have limited availability.

According to a 2010 Census, up to 1 in 5, or 57 million people, in the US have a disability. William Riggs, Program Director and Associate Professor at the University of San Francisco and thought leader in the areas of autonomy and smart transport, believes that AV microtransit can play an important role in helping people with disabilities achieve their desired level of mobility, and reverse a currently suppressed demand for travel.

“It’s really hard from an operational standpoint for transit agencies to provide equitable service across a city and particularly to do so in a cost-effective way,” he says.

Whether it’s people with disabilities who need access to transit in a timelier way or someone who lives in an historically marginalized place that hasn’t been well served by transit, autonomous platforms offer an opportunity to serve areas where it was never cost effective from the transit operator’s standpoint.

“That’s the biggest promise from a service standards standpoint,” says Riggs. “The ability to access large parts of the city that were really untouched by transit in the past.”



**William Riggs**

Program Director and Associate Professor at the University of San Francisco



Riggs adds that historically most of the US’s transit system was designed to keep populations separate and to provide more access to certain neighborhoods than others.

“New forms of transportation [like AV microtransit] allow us to open the service capacity to these locations that have traditionally been underserved and underresourced,” he says. “Therefore, increasing access to jobs, increasing access to employment opportunities, and ultimately providing social mobility outcomes for people that have traditionally not had those ladders up.”

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# Grand Rapids, Minnesota

**L**aunched in October 2022, the free, goMARTI on-demand rides can be requested through an app and will run through spring 2024. The vehicles are considered autonomous, but there is an AV operator onboard at all times, who verifies the safe operation of the vehicle and assists passengers.

Key partners include the Minnesota Department of Transportation, City of Grand Rapids, The PLUM Catalyst, May Mobility, Department of Iron Range Resources & Rehabilitation, Itasca County, Via, University of Minnesota, Arrowhead Transit (the agency for Minnesota’s Arrowhead Region), and Mobility Mania.

“This is a pilot we’re trying to learn from and my hope is ultimately Arrowhead Transit takes this technology and starts to incorporate it into its model,” says Tom Pagel, City Administrator in Grand Rapids. “If we don’t do these pilot projects it [the technology] won’t grow and improve. My hope is that one day with this technology we can right size our public transit. Maybe we will have some buses but alongside that a small AV fleet.”

The University of Minnesota’s Humphrey Institute is undertaking research into the pilot to answer questions around business models, including the pricing and subsidy levels required.

The goals of the pilot include:

- To advance and inform the operation of automated vehicle technology in rural, winter conditions.
- To engage and educate the local community by providing real-world automated vehicle experiences.
- To provide safe, accessible mobility for residents, especially those with transportation challenges.
- To understand what economic development this innovative pilot brings while attracting future talent and technology to the area.

Within the first six months of the trial, the service has moved more than 1,500 riders over 17,000 miles. Twenty-four percent of rides have included wheelchair users and throughout the community 84 percent of all riders are repeat users.

At the end of the year Pagel will be conducting Rural Smart Seminars where local rural leaders within neighboring states will be invited to learn about the pilot.





### **Corey Clothier**

Founder and  
director of Stantec  
GenerationAV

In separate studies that focused on Boston and San Francisco, the biggest beneficiaries of ride share were for low-income minority neighborhoods that had no access to rail, and a limited after-hours bus service.

“If you work a night shift and you can’t get a ride on the bus but you can access a ride-sharing service, that’s the difference between getting fired and keeping your pay check,” comments Riggs.

Back in 2015, Corey Clothier already saw the potential of AVs in providing better mobility options for those with disabilities. As founder and director of Stantec GenerationAV, a company that enables the deployment of AVs, he was involved with an Applied Robotics for Installations and Base Operations pilot program at Fort Bragg, North Carolina, to carry soldiers between barracks and an army medical center.

“They were using a shuttle bus but many of the people couldn’t walk,” he says. “It would be a 20-minute ride to get them 200 yards.”

A new accessible AV was then trialed.

“It was a great learning experience because it had to be accessible,” Clothier adds. “And more than just wheelchair accessible. We had to try and understand how we can help people with cognitive and physical challenges get on and off a vehicle.”



## The tyranny of distance

Many low-income neighborhoods and rural areas lack reliable transportation options, which can make it difficult for residents to access jobs, healthcare, and other services.

North Carolina is considered to have the second largest rural population in the US. Seventy-eight of the state's 100 counties are considered rural and more than 1 million individuals in the state live in a household without a car.

"There are folks that have transit needs and populations that may not be able to afford to purchase and maintain a personal vehicle," explains Sarah Searcy, Deputy Director for Innovations and Data in North Carolina's Department for Transportation Integrated Mobility Division (IMD). "There are many folks with disabilities or who are elderly that may want another option to move around. We want to make sure the network serves them."

According to the IMD, in North Carolina having a car is often a pre-requisite for success. Areas of the state with higher rates of zero-vehicle households have lower average rates of labor force participation.

The state has identified that new technologies like AV microtransit can narrow the time and convenience gap between driving and public transportation, and present an opportunity to provide equitable mobility solutions for those with limited vehicle access.

Last year it received \$10.4 million in federal grants to trial, in 11 rural communities, on-demand services tailored to each community's transit needs. The aim is to increase economic opportunity and improve the quality of life for local residents.

"We want to be able to build on the microtransit work that's happening in the state by testing and evaluating AVs as a shared-mobility option," says



### Sarah Searcy

Deputy Director for Innovations and Data in North Carolina's Integrated Mobility Division (IMD)

Searcy. "Making sure those vehicles are accessible, provide a high quality of service, and complement work we've already advanced."

The state has taken a lead in AV microtransit pilots through its Connected Autonomous Shuttle Supporting Innovation program (CASSI). In 2021 the first AV to be deployed at a recreational public lands site, was launched at the Wright Brothers National Memorial, and at North Carolina A&T State University, where a two-mile test track was unveiled to simulate rural driving conditions.

The university's main focus is to develop equitable transportation solutions for low-demand rural areas by providing more efficient mobility services with flexible routing and servicing.

"CASSI started back in 2019 with a focus on shared autonomous vehicles and transit applications to prepare the state and the population for AVs while also making sure those vehicles were serving a useful purpose," explains Searcy.

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# North Carolina

**S**ince 2019, Sarah Searcy has been responsible for researching new ideas and trends related to innovative mobility within North Carolina’s Integrated Mobility Division.

“We look particularly at shared-mobility options to complement the existing transit system that we have in the state,” she says. “And then help design projects and programs.”

Searcy has been trying to expand the scope of autonomous vehicles.

“Our vision is a network of shared-mobility options,” she explains. “Ultimately, we want to set up our system so that folks can choose the mode which would offer the same benefits as a personal vehicle. To be as convenient, safe, and accessible as a personal vehicle.”

According to the department, transportation disparities are more prevalent among minority populations in the state. People of color are nearly three times more likely to live in a household without a car and make up over 60 percent of transit riders despite accounting for only 30 percent of North Carolina’s population.

One of the division’s core goals is to eliminate transport barriers to ensure all citizens have equal access to services.

**The state has identified that new technologies like AV microtransit can narrow the time and convenience gap between driving and public transport.**





## **Connected Autonomous Shuttle Supporting Innovation program (CASSI)**

North Carolina's CASSI program evaluates how autonomous vehicles can best be used by riders with different needs and in different environments. Examples include first mile/last mile solutions and connected vehicle infrastructure.

After completing three projects with a number of partners between 2020 and 2021, the department is now partnering with the Town of Cary to bring a low-speed autonomous vehicle to Bond Park.

The AV will run a four-stop route between the town's senior and community centers weekdays from 10am to 4pm until June.

A similar vehicle was piloted under the CASSI program on the Centennial Campus of North Carolina State University in Raleigh in 2020 and at the Wright Brothers National Memorial in Kill Devil Hills in 2021.

There is no cost to ride the autonomous vehicles, which can transport up to eight people and an attendant. The AVs are wheelchair accessible and fully electric.

Although pilots are an excellent demonstration of the capabilities of AVs, the trials conducted in North Carolina feature very specific use-cases such as university campuses, shorter routes and a maximum speed restraint of 12.5 mph. Searcy notes the earlier, lower speed AV technology wasn't ready for "prime time".

She adds: "Testing and evaluating AVs is providing a useful service to the extent that the technology allows but at the same time it's an incredible opportunity to engage the public around what is happening in this field."

## Preparing the population

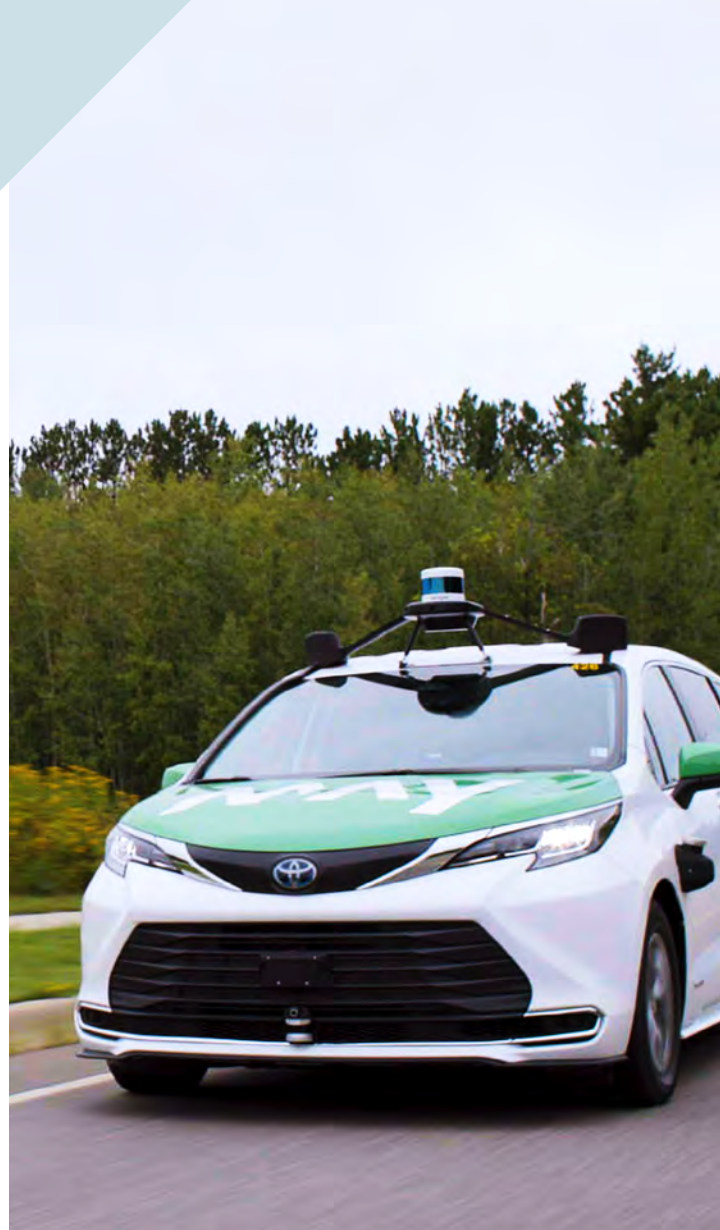
Getting the public used to seeing AVs in action and being comfortable to use them is crucial if AV microtransit is to reach its full potential in assisting underserved communities.

Yet there is a lack of public awareness of how vehicles can operate at different levels of driving automation (as outlined by the Society of Automotive Engineers and listed in the box below).

“There is a big risk in the advancement of automation right now in the public understanding of the difference between a level-two, level-three or level-four vehicle,” explains the University of San Francisco’s Riggs. “They might ultimately lose faith in these level-four vehicles. And that is a threat to many deployments that are going out that truly are safe.”

In Grand Rapids, to get the public involved and informed, schools were brought in to help design the 70 drop off and pick up signage points and a song, through a public competition, was chosen for the pilot.

“The folks I’ve talked to who have ridden it, love it,” says Pagel. “The vehicle is [a Toyota Sienna hybrid], with leather seats inside. It’s like getting into a personal passenger vehicle.”



## SAE Automation Levels

0	1	2	3	4	5
<b>No Automation</b>	<b>Driver Assistance</b>	<b>Partial Automation</b>	<b>Conditional Automation</b>	<b>High Automation</b>	<b>Full Automation</b>
Zero autonomy; the driver performs all driving tasks.	Vehicle is controlled by the driver, but some driving assist features may be included in the vehicle design.	Vehicle has combined automated functions like acceleration and steering, but the driver must remain engaged with the driving task and monitor the environment at all times.	Driver is a necessity, but is not required to monitor the environment. The driver must be ready to take control of the vehicle at all times with notice.	The vehicle is capable of performing all driving functions under certain conditions. The driver may have the option to control the vehicle.	The vehicle is capable of performing all driving functions under all conditions. The driver may have the option to control the vehicle.

Source: SAE and US Department for Transportation



## Integrating on-demand AVs with existing services

Arlington, Texas began its third pilot AV program, RAPID, in March 2021. Ann Foss, Transportation Planning and Programming Manager at the city, says one of the two overarching goals of the project was educating and informing the public.

“One goal was to test the technology and figure out what use-cases make sense,” she says. “Our second goal has always been helping our residents understand AVs and feel comfortable with them as there will probably be more and more AVs of different types operating in our community.”

RAPID (Rideshare, Automation, and Payment Integration Demonstration) is one of the country’s first on-demand AV services, linked with an existing transit service. With grant funding from the Federal Transit Administration the city was able to partner with May Mobility, Via Transportation, and the University of Texas Arlington (UTA). The fleet includes five vehicles, one of which is wheelchair accessible.

“The location we operate the May Mobility AVs is in our downtown core and on the university campus,” Foss says. “We know there are a lot of students who don’t have access to a personal vehicle and who are low income.”

The services proved popular. In the first year, over 28,000 rides took place and at the busiest times of the year the five vehicles were averaging close to 200 rides a day. Approximately 50 percent of the rides were shared. Foss wants to see shared ridership increase as the fleet is updated to include more passenger capacity.

“We have a lot of repeat riders, with a core group of what we call super riders who rode this almost every day,” she says. “That demonstrated we were fulfilling a daily transportation need for at least a group of our riders. There is an appetite for rides that was perhaps previously being unmet.”

One differentiating factor is that Arlington does not offer any traditional fixed route public transit. Foss



**Ann Foss**

Transportation  
Planning and  
Programming  
Manager in Arlington,  
Texas

says many people figured out a way to get around, so convincing them to use a new service was also a challenge at first.

A data dashboard allows Foss and her team access to detailed information about each ride and the vehicle performance and monitoring. This data helped Foss to adjust the operating hours of the service to make it accessible to more people.

“The RAPID service area is fairly small but we do see patterns,” she explains. “We have some top destinations for pick-up and drop-off points and we can look at peak periods of demand. It initially operated between 7am and 7pm but we were getting many more rides in the late afternoon so we switched it to 8am to 8pm to improve the service.”

The pilot also allows the rider to choose between a non-autonomous or an autonomous vehicle. The majority of the time people are choosing the AV option, and acceptance of AVs is between 75 percent and 90 percent.

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# Arlington, Texas

**T**he city’s journey to deploying autonomous vehicles (AVs) began over 30 years ago. Three different city votes took place during that time on whether or not a portion of sales taxes should be used to join up with a transit authority. Each vote failed and residents were left without any public transit options.

In 2016, Arlington’s mayor and city council appointed a stakeholder committee of 31 people to focus on the transport needs of the city.

“They heard about all of the available modes that existed out there and different funding opportunities and approaches,” says Ann Foss. “That’s how we ended up with our broader on-demand rideshare service which is city-wide and is our kind of solution to public transit. Testing AV technology was part of those recommendations.”

The pilot offers shared rides in autonomous vehicles, operated by May Mobility, through Arlington’s on-demand public transit system, Via Arlington. >

**“Our broader on-demand rideshare service is city-wide and is our kind of solution to public transit.”**

**Ann Foss**

Transportation Planning and Programming Manager, City of Arlington





The standard Via fare applies to the RAPID service. Eligible University of Texas Arlington students receive a saving of \$1 off the standard fare as part of the program and a trained operator sits in the driver’s seat of all vehicles.

The fleet of autonomous vehicles, including the wheelchair-accessible vehicle, are available to riders through the Via app or by calling Via’s customer service line, and operate in city conditions on roads of up to 35 mph. During the first year of service, Arlington RAPID reported a 99 percent on-time performance and the vehicles were able to operate fully autonomously 80 percent of the time.

First year results show that more than 60 percent of riders use RAPID to access essential destinations like medical facilities, school or employment opportunities, which demonstrates the success of the service in helping to fill critical transport gaps and expand equitable access to transit across the city.

“What we want to explore next is a driverless phase, removing the trained operator from behind the wheel,” Foss says. “We want to install communication devices so vehicles can communicate with each other and if there is a first responder [police, fire, or ambulance] in the area it can communicate with the AVs to get out of the way or to detour around.”

Additional grant support from the North Central Texas Council of Governments means the service will continue to operate through to at least 2024.

## Maturing the technology

Like any developing technology there exists a wide range of attitudes and understandings. With AVs there is a perception that they are primarily for Silicon Valley and tech communities. Sarah Gryniewicz, Strategy Analyst at May Mobility, looks forward to the day when AVs become commonplace.

“AVs have amazing potential, and they’re still evolving,” she says. “Our goal is to advance the technology alongside cities so that it meets all of its true potentials. It’s exciting—initial pilots of AVs went at 12 mph. Now, May Mobility is operating in city conditions on roads up to 35mph. We’re capable of being really useful.”

She believes that once the “hype” is over, transit operators and companies like May Mobility will make positive, substantive changes in a community. Transit agencies can deploy AVs in targeted areas, coordinated in the broader transit network, instead of a transit-competing-anywhere-to-anywhere AV service. This will shift the balance and make it easier for more and more people to live without a car.



**Sarah Gryniewicz**

Strategy Analyst at May Mobility



Microtransit is an emerging tool in the mobility toolbox. On-demand AVs will further unlock the microtransit model for those travelling within a zone or connecting to a fixed-route bus or train.

“How do you make it possible to expand the transit network so people won’t have to walk a mile or two?” adds Gryniewicz.

“It’s about filling that gap so that more people can access transit in an efficient way. If AVs are coming, we’d like to do the change *with* cities rather than *to* cities.”



Nico Larco, Professor at the University of Oregon, who focuses on sustainable urban design and the impacts of emerging technology on cities, says AV technology is still behind where he was hoping it would be by now.

“We talk a lot about this idea of mobility pilots 1.0 and 2.0,” he says. “1.0 is: does the technology function? Which is where I think most pilots are right now but there needs to be a push to 2.0 where we can fully analyze what problem it is solving. Is there uptake? Are people interested? What is the business model? What are the cascading impacts?”

He believes that if a pilot works fantastically well for six months and then ends, those people who relied on that mode of transit all of a sudden have to figure out a new way to get around. He believes, as well as technology, one of the remaining challenges for AVs is the business model.

“The thing we can be doing right now is to do pilots and get a sense of where demand is and how those use cases from a consumer side make the most sense,” Larco says. “But the big unknown here is how does it work on the cost side? Is it more costly to run an AV than a bus with a driver along a fixed route? That’s still an unknown.”

Riggs believes that there is a business model that is mutually beneficial and that fills in gaps in the transportation network. He cites Arlington and Monrovia as examples. The southern California city of Monrovia embarked on a partnership with Uber and Lyft to provide subsidized, flat-fare and shared rides within the city, and to nearby medical locations and malls.

“It was a huge success in terms of increasing the number of shared rides,” says Riggs. “They had more rides for less cost. They were serving more people in a way that ultimately saves the taxpayer dollars.”

He believes there is a big opportunity for legacy transit providers as there are a lot of transport needs that they have not been able to provide. Getting people out of their own vehicle, reducing single occupancy use and getting more people



**Nico Larco**

Professor at the  
University of Oregon

into shared AVs would also provide an opportunity to capture some of the revenue.

“Say, there are certain routes that are running an 80-foot bus that is only 20 percent occupied. Instead, another platform could be deployed removing the cost of operations and folding that back into trunk lines,” he explains. “I see a huge opportunity for routes, particularly for automated travel, as feeders into transit.”

The right set of circumstances are slowly aligning, particularly in the US where low density and public transit are often not the best fit.

“AVs are a new tool that should be used to improve and evolve transit systems as opposed to being another thing on top of it,” says May Mobility’s Gryniwicz. “The more it is integrated and coordinated, the more people can use Mobility-as-a-Service as a legitimate option. We see on-demand AVs as a part of the network and helping enhance the network but not an entire network unto itself.”