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Be the leading force in advancing public transportation.

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APTA serves and leads its diverse membership through advocacy, innovation and information sharing to strengthen and expand public transportation.

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EXECUTIVE SUMMARY

New technologies, data capabilities and business platforms have disrupted transportation, rapidly changing how people move and redefining urban mobility. Ride-hailing and ridesharing companies have expanded mobility options. Autonomous vehicles will bring new opportunities for consumers as public transit agencies and other service providers integrate autonomous technology into their service offerings, potentially reducing operational costs. Technological change and generational change will make people more likely to use multi-transit options and will allow the transit industry to reach new users. For example, new technologies and travel options are expected to reduce the affinity for car ownership, particularly as younger travelers are more open to using multiple modes to commute. The changing travel patterns will not, as some critics claim, reduce the need for public transportation. In fact, these changes further underscore the role of public transportation as the backbone of new mobility.

Consumers stand to benefit from the rapid change in urban mobility by having more options potentially at less cost. However, the changes will also raise a number of important challenges. Without proper guidance from policymakers, autonomous vehicle and ride-hailing services likely will lead to more traffic congestion. However, continued reliance on, and fine tuning of public transit can help ensure a positive outcome. Public transit remains the backbone of a multi-transit lifestyle because of its space efficiency—it can move more people using less space than single occupancy vehicles. Initiatives such as dedicated bus lanes and congestion pricing are supported by the public because those measures help reduce congestion.

Public transportation agencies and transportation authorities have a powerful role to play in negotiating future mobility. They are uniquely positioned as "mobility managers" to help organize transportation options throughout an area. The role of mobility manager means shifting from simply providing traditional transit services to coordinating a diverse portfolio of services. Managing mobility will be key in a future when customers have the option to take a train, bus, bicycle, autonomous vehicle or any combination of modes to get to their destination. Through mobility management, transit agencies can be responsive to the customer while ensuring accessibility, efficiency and equity.

The paper's findings are based on recent research from the National Academy of Sciences, and new analysis by the APTA Research and Policy Development Department, including the results of APTA's 2018 Mobility Survey. For the survey, one thousand adults nationwide were polled on wide-ranging transportation topics, producing insightful results on the future of mobility. Polling questions were based on results from a qualitative focus group of millennial commuters.

KEY FINDING #1:

Seventy-Seven Percent of Americans[1] Think Public Transit is the Backbone of a Multi-Transit Lifestyle.

Advances in technology have allowed vehicles to operate with increased autonomy and efficiencies. Data capabilities have evolved and enable effortless trip planning and streamlined information sharing, and new business platforms have supported the explosion of ride-hailing and bikesharing services.

These changes have brought new partnerships and opportunities to expand and enhance mobility services. Transportation and technology industries are partnering to develop autonomous vehicles (AVs), particularly for fleet-based businesses that are expected to have fewer regulatory barriers and benefit from larger operational savings. AV fleet operations in the United States are estimated to cost 35 cents per mile compared to the $3.50 per mile cost of a taxi—a 90 percent price reduction.[2] The proliferation of on-demand sharing services has changed mobility, with consumers considering such services as a convenient alternative to car ownership. Public transit agencies have partnered with ride-hailing/carsharing companies to provide microtransit (shared transportation services with dynamic routes), paratransit (point-to-point services without a set route typically used by older and disabled travelers) or service in low-density areas. Data shows that when public transit is less frequent, ride-hailing companies (such as Uber and Lyft) can fill the gaps. That may lead to efficiency gains for public transit with AVs and future collaboration with ride-hailing companies. Other consumer-friendly tech advances -- real-time data, mobile ticketing and payment, and universal payment -- benefit travelers on multiple transit systems.

Customer preferences are also shifting to further benefit public transportation. Over the past decade, consumers' views about cars and car ownership have been changing as younger generations see car ownership less as a tool of freedom and more as part of a diverse menu of mobility choices. Many millennials favor transit-oriented living and consider public transit the backbone of a multi-transit lifestyle. These preferences will enhance the success of future transportation options as millennials become the largest category in the workforce.

In this new mobility landscape, the public transportation industry will not only be affected, but will also have a central role in shaping how new technologies are deployed and services integrated. In APTA's 2018 Mobility Survey, 77 percent of participants agreed that public transportation is the backbone of a multi-transit lifestyle. Public transit will have to bring together a wide variety of services to favor communities and their development goals.

KEY FINDING #2:

Consumers Focused on Public Transportation, Bus Lanes and Additional Funding

As disruption changes mobility and demographic shifts move us toward a multi-transit lifestyle, the public transportation industry will have a central role in addressing new technologies and services that benefit consumers, communities and urban mobility.

With an estimated 16.5 million additional commuters by 2030, U.S. roads will become even more congested. Public transit will provide a high-capacity mobility alternative, as it remains the most efficient mode of travel, transporting the most people in the smallest space. Cities and transit providers will have to strive for transportation systems designed to move the most people in the most efficient ways. The coming changes offer many

1. Percent of respondents in APTA's mobility survey
2. http://research.ark-invest.com/hubfs/1_Download_Files_ARK-Invest/White_Papers/Self-Driving-Cars_ARK-Invest-WP.pdf

opportunities to increase the efficiency and reach of bus and paratransit services, and according to APTA's 2018 Mobility Survey, Americans support strategies such as bus lanes and congestion pricing. Our current congestion could be made worse with an increase in single-occupancy ride-hailing and autonomous vehicles. Guiding change and promoting shared and active transportation modes like bicycling and walking are key ways to address the problem.

High-quality public transportation will be more important than ever to allow business districts to attract and retain high-performing workers. As public transit agencies use data, AV technologies and new business models such as ride-hailing, overall service will improve. APTA foresees a long-term increase in the percentage of public transit commuters. In fact, in APTA's 2018 Mobility Survey, 68 percent of respondents support additional funding for public transportation; 60 percent of respondents support bus lanes, even if parking is lost, and 50 percent of millennials support congestion pricing.

KEY FINDING #3:

Transit as Mobility Manager: 74 Percent of Millennials Would Use a Multi-Transit App

The various mobility services need to be organized into a network that consumers will be able to use. Public transit agencies are poised to perform the role of regional mobility manager.

As part of this role, agencies can guide regions to adopt principles and tools associated with Mobility-as-a-Service (MaaS). Current transit apps already allow consumers to view information on many shared and active transportation modes. In APTA's 2018 Mobility Survey, 74 percent of millennials said they would use a MaaS app to coordinate and pay for different types of transportation. Agencies could use current platforms to let users combine trips, centralize payment systems and get real-time travel information.

Local governments will need to work with public transit agencies to rethink how to manage curb space on public streets and design multimodal hubs to incorporate fleets of AVs. Without guidance and rules, there could be a massive increase in city traffic. Cities that integrate a strong public transit system with ride-hailing and AV services can create new public space or opportunities for business development through reduced land requirements for parking.

Establishing public transit agencies as a manager for services will ensure a more equitable and customer-centered transportation experience. While mobility is constantly evolving, the mission of public transit agencies to provide transportation for all users regardless of income or ability remains the same. Public transit protects the public interest. For example, coupled with high-quality transit, AVs could lead to expanded mobility for the elderly and disabled. The public sector can also help to protect the public interest by developing standards for data privacy.

As public transportation agencies morph into mobility managers, they can help ensure that market competition benefits the consumer and improves their commutes.

KEY TAKEAWAY

The research shows that consumers view public transportation as pivotal to the future of mobility. The reasons are clear: 1) public transportation can move more people efficiently in less space, 2) as travel options continue to grow, consumers will need a way to make the various travel choices clear and routine, and 3) as consumers recognize growing income inequality and shrinking data privacy, the need to protect the public interest and serve the vulnerable will grow as well. Therefore, public transportation will serve an even larger role in the public life of cities around the nation.

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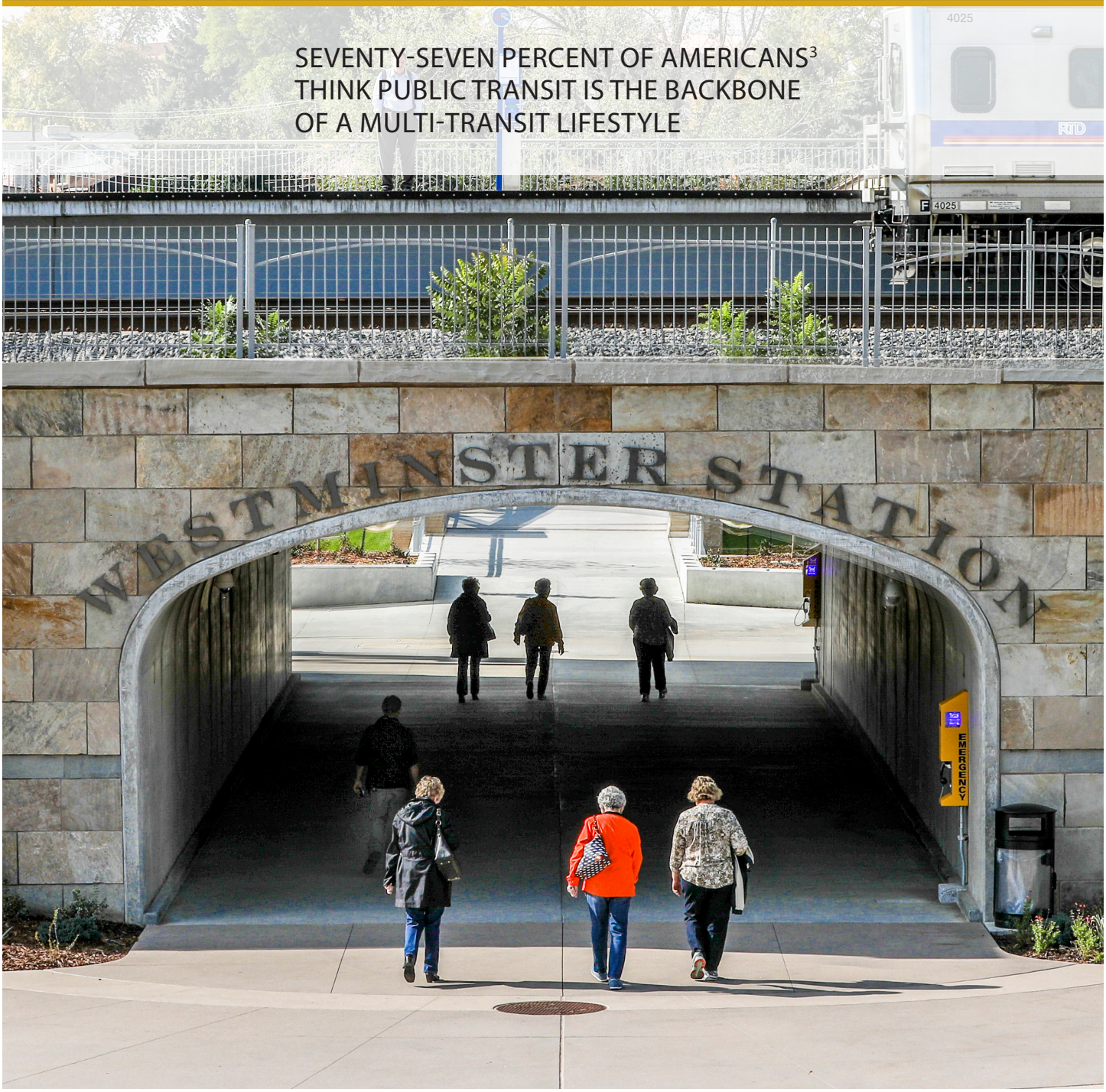
KEY FINDING 1

SEVENTY-SEVEN PERCENT OF AMERICANS[3] THINK PUBLIC TRANSIT IS THE BACKBONE OF A MULTI-TRANSIT LIFESTYLE



At the 1964 World's Fair in Queens, New York, General Motors famously debuted an exhibit titled "Futurama." It displayed a series of miniature urban models and graphics that offered a vision of how people would live and travel in the future. One prediction was that automated cars would be central to how people move around and how cities are planned and developed. Now, more than 50 years later, technology has advanced in such a way that vehicles are operating with increased autonomy (i.e. automatic parking, automatic stopping, lane control) and can operate with battery electric motors that are becoming more efficient and affordable. Data capabilities have also evolved, with new mobile and connected platforms that allow for effortless trip planning and streamlined information sharing. New business models such as ride-hailing and bikesharing are growing in coverage and popularity.

COMPETING MOBILITY AND URBAN DEVELOPMENT SCENARIOS
Figure 1 (Left): The automated vehicle, highway-centric vision presented at the 1964 World's Fair[4]
Figure 2 (Right): Transit oriented development in downtown San Diego[5]

Together, new technologies, data capabilities and business models contribute to "disruption" in the public transportation sector, which has brought more partnerships, mobility options and opportunities to expand and enhance service. Demographic shifts are also changing travel behavior and customer preferences, with the millennial generation using multiple modes to commute and less interested in car ownership.

In this new mobility landscape, the public transportation industry will not only be affected, but will have a central role in shaping how new technologies are deployed and services integrated. In APTA's 2018 Mobility Survey, 77 percent of participants agreed that public transportation is the backbone of a multi-transit lifestyle. Public transit will have to bring together a wide variety of services to favor communities and their development goals.

3. Percent of respondents in APTA's mobility survey
4. http://www.lesardevelopment.com/wp-content/uploads/2014/06/transit-oriented-development.jpg
5. http://www.lesardevelopment.com/wp-content/uploads/2014/06/transit-oriented-development.jpg

SHIFTS IN THE AUTOMOTIVE INDUSTRY AND THE IMPACT ON PUBLIC TRANSPORTATION

The development of personal automated vehicles for consumer ownership in coming decades will usher in a variety of obstacles and present legal and regulatory challenges for policymakers. For example, who is liable in a collision- owners, manufacturers or software providers? These questions, along with the challenge of operating autonomous vehicles in all conditions and geographies, may delay individual ownership of truly autonomous vehicles (Level 5 AVs).

Original Equipment Manufacturers (OEMs), sensing these challenges, are targeting fleet-based services at the initial stage of their AV rollout, as indicated through high-profile acquisitions and press releases. As a result, there will be more mobility providers, in addition to a rising number of ride-hailing/ridesharing players. The transportation and technology industries are partnering and consolidating rapidly.

Main Autonomous Vehicle Industry Players:

- Original Equipment Manufacturers
- Technology companies
- Data/software firms
- Ride-hailing/carsharing companies
- Private transportation operators
- Public transit agencies

Already, manufacturers such as Ford and General Motors are creating divisions and subsidiaries focused on shared vehicles. These manufacturers aspire to be on the cutting edge of new mobility trends and to have a designated outlet for future sales to AV fleet owners. Ride-hailing/carsharing companies are also well positioned for automation because they already are involved with managing fleets and have laid the groundwork for AV implementation. But they rely on outside manufacturers to provide the hardware to test vehicles. OEMs are inexperienced in providing a service. That is why they have either partnered with or acquired mobility companies, along with the data and software firms that will help them operate.

Some public transportation operators are currently testing AVs manufactured specifically for transit-specific purposes. It remains to be seen exactly how and from where public transit agencies will procure AVs (OEMs, current transit suppliers, new manufacturers).

When automation, electrification and route efficiency combine, the operating costs per mile of public transportation decrease significantly compared to alternatives. Analysts with ARK Investment Management found that an automated fleet vehicle could cost $0.35 per mile, compared to the $3.50 per mile cost of a taxi — a 90 percent price reduction.[6] Other estimates see AV prices per mile from around $0.40 to $1.00, which still could be very attractive if services are point-to-point.[7]

These estimates undercut the current high fixed costs of fully autonomous vehicle technology (including Lidar systems), though expenses will certainly decrease in the future. It has been reported that the first generation of autonomous cars could cost from $300,000 to $400,000, which will have to be borne by private investors.[8] Current ride-hailing business models are not profitable and receive significant financial support, raising questions whether they will be able to continue to keep pricing low.[9]

6. http://research.ark-invest.com/hubfs/1_Download_Files_ARK-Invest/White_Papers/Self-Driving-Cars_ARK-Invest-WP.pdf
7. http://cityobservatory.org/what-price_autonomous_vehicles/
8. http://www.thedrive.com/tech/12856/fully-autonomous-cars-will-cost-hundreds-of-thousands-of-dollars-silicon-valley-exec-says
9. https://medium.com/@parismarx/uber-is-not-price-competitive-with-transit-3ab1be13d9d5
10. https://www.rmi.org/wp-content/uploads/2017/03/Mobility_PeakCarOwnership_Report2017.pdf

The Rocky Mountain Institute notes in a 2017 study that current-model electric vehicles have lower operating costs than gasoline-powered vehicles, which result in savings of $1,000 per vehicle per year[10]. Furthermore, the costs for electric vehicles are projected to drop as battery costs are contained, battery life improves, electric vehicle supply-equipment infrastructure evolves and vehicle production scales up. This will result in definitive savings for mobility service operators, which is why APTA sees electric fleet adoption as likely soon.

For public transit, while labor would be the primary source of cost savings, the transition to electricity as a fuel source will also result in operating and maintenance cost savings in the long run. Looking at the display of transit operating costs per mile by mode (Figure 3), paratransit could gain from automation, if there is a way to ensure that riders receive the assistance they need.

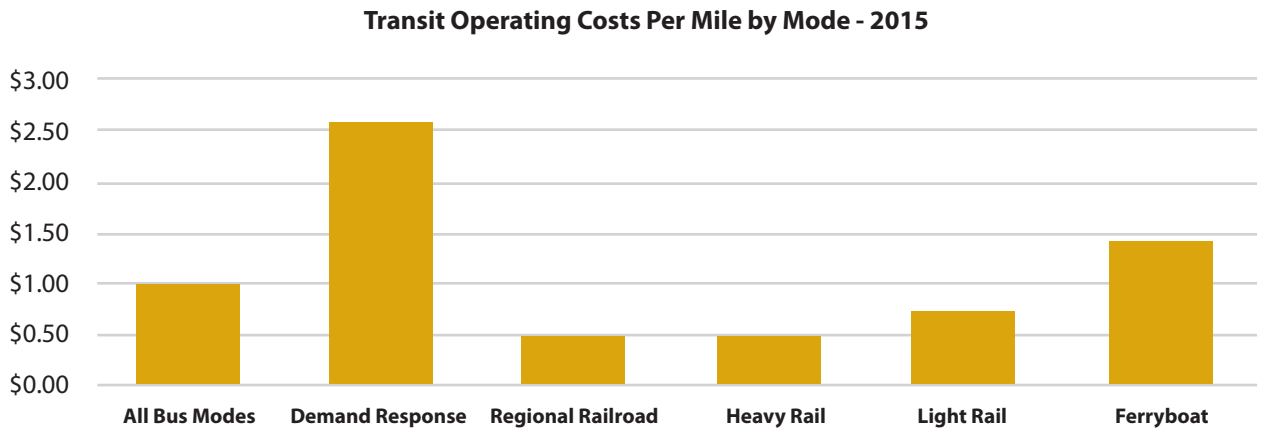


Figure 3: Transit Operating Costs Per Mile by Mode -2015 (Source: APTA Fact Book)

Public transit will need to find ways to capitalize on the per-mile cost reductions that the private taxi industry is expecting and is already working towards that through more fuel-efficient vehicle fleets and other cost-saving applications. That said, public transit's productivity per mile is still unmatched along high-density routes.

TECHNOLOGY AND NEW BUSINESS MODELS SUPPORT TRANSIT

The proliferation of ride-hailing and carsharing services and the reduced affinity for car ownership among millennials (to be explored in the next section) has changed the way people travel and has opened a door for new business models.

For example, many consumers may see shared fleets as a convenient alternative to car ownership, without the upfront fixed costs. Auto manufacturers are moving to this fleet model as a way of capturing this demand and reducing the business risk of autonomous vehicles. Currently, privately owned vehicles spend as much as 95 percent of their lives parked. Carsharing companies like Zipcar have already taken advantage of this market failure to make occasional auto use available to people in transit-rich urban environments.

The pace of development in the AV market will also influence what business models work in the future. Autonomous shared vehicles will increase convenience over current carsharing models, since the vehicles will more

quickly adapt to changes in demand and reduce travel costs such as parking fees.

While the private sector is taking the lead, public transit agencies are experimenting with new technologies and business models. Some agencies are developing their own applications, others have partnered with ride-hailing/carsharing companies to provide first- and last-mile services (connections to and from public transit stops and stations), and in some cases, directly operate paratransit service. Transit analysts expect that in an automated future, incorporating smaller vehicles along predetermined routes could allow a bus stop or train station to expand its reach to passengers who would not always be able to walk to the stop.

Many other tech advancements will help public transit improve service and attract new riders. Connected vehicle technology can enhance bus and rail efficiency through signal priority (allowing buses and rail vehicles to hold green lights). The increased availability of real-time data and mobile trip-planning apps by transit agencies helps travelers visualize their trip on public transit. This data, once analyzed, can assist with transit service planning and offer insight on consumer travel behavior, which can then lead to numerous additional applications and opportunities.

Mobile ticketing and payment also make public transit more convenient, putting it on the same level as ride-hailing. While many public transit agencies use smartcard contactless payment systems, the industry is quickly transitioning to mobile payment systems that connect directly to a traveler's bank account. Planners envision universal payment systems that will benefit travelers on multiple transit systems, using multiple modes.

DEMOGRAPHIC SHIFTS: THE MILLENNIAL GENERATION AND THE MULTI-TRANSIT LIFESTYLE

Shifting demographics are also affecting travel behaviors and consumer preferences on personal mobility and household location.

The United States and its workforce is becoming more diverse. The millennial generation, constituting more than 50 million workers, is now the largest and most diverse generation in the U.S. workforce. Forty-four percent of millennials are minorities, compared with 38 percent of Generation X and only 25 percent of Baby Boomers. This increasing diversity may impact public transportation use, as communities of color make up 60 percent of public transportation riders, according to APTA's *Who Rides Public Transportation* report.

For many years, car ownership has been a social norm, a routine that citizens participate in as part of the social contract. But over the past decade, views about cars and car ownership have been changing, and younger generations now see car ownership less as a tool of freedom and more as part of a pragmatic menu of mobility choices. A survey by the website NerdWallet found that "43 percent of car-owning millennials at least somewhat agreed that 'owning a vehicle is a hassle' compared with 28 percent of car owners aged 45 and older." APTA's mobility survey produced similar results, with 67 percent of millennial respondents saying they owned a car more because they need one, rather than because they enjoy owning one.

APTA'S 2018 MOBILITY SURVEY

67% **of millennials own a car more because they need one than because they enjoy owning one**

88% **of millennials say the length of their commute is important**

APTA'S 2018 MOBILITY SURVEY

56% **of millennials say access to public transportation is important**

65% **of millennials would use public transportation more if it were more convenient or accessible**

These views show how some consumers are primed to use shared modes of travel like public transportation. APTA's *Millennials and Mobility* study[11] shows that millennials tend to pick the best mode for every trip. Sixty-nine percent of millennials surveyed in the report said they used multiple modes to reach a destination several times a week or more, and 42 percent said that the trend of using multiple modes was increasing.

There is another trend likely to affect public transportation: Millennials are expected to prefer living in cities, even in future years. In previous decades, getting married, having children and starting a family was a precursor to moving to suburban, auto-oriented communities. Millennials are delaying marriage; only 20 percent of millennials aged 18 to 30 in 2014 were married, compared to 32 percent of GenX and 40 percent of Boomers at those ages.[12] Millennials are also waiting longer to have children — in 2016, the mean age of mothers at the birth of a first child was 26.6, a record high for the U.S.[13]

Millennials have already been more likely to live in cities than previous generations, and evidence so far shows that they are spending more of their adult lives living in urban environments. APTA's *Millennials and Mobility* study found that 42 percent of millennial parents agreed that "having a family doesn't mean you have to move out of the city" and 36 percent agreed that "having a family doesn't mean you have to rush out and buy a car."

The *2017 National Community and Transportation Preference Survey* by the National Association of Realtors found that 62 percent of millennials prefer walkable communities and short commutes, even if it means living in an apartment or townhouse. APTA's survey picked up on this, with 88 percent of millennial respondents saying that the length of their commute was important to them. Still, the cost of housing surpassed commute length, with 98 percent of millennials indicating its importance. That figure shows the increased need for solutions to the urban housing shortage, including additional affordable, transportation-oriented development. These preferences have the potential to lead to long-term changes in mobility for the entire country.

The combination of changing demographics and consumer preferences will drive the direction of future mobility changes. Millennials have a propensity for city living and public transit use, and those preferences will impact the success of future transportation options. Fifty-six percent of millennials in APTA's 2018 Mobility Survey said that access to public transportation was important to them, and 65 percent would use public transportation more if it were more convenient or accessible. Even millennials who live in more suburban areas may want flexible mobility options and public transportation services because of their experience living in more urban settings.

11. https://www.apta.com/resources/reportsandpublications/Documents/APTA-Millennials-and-Mobility.pdf
12. http://news.gallup.com/poll/191462/gallup-analysis-millennials-marriage-family.aspx
13. https://www.cdc.gov/nchs/data/nvsr/nvsr67/nvsr67_01.pdf page 5

KEY FINDING 2

CONSUMERS FOCUSED ON PUBLIC TRANSPORTATION, SUPPORTING BUS LANES AND ADDITIONAL FUNDING

As new technologies, data capabilities and business models change the public transportation sector, and demographic shifts reinforce the need for new services, the industry will need to work to avoid undesirable scenarios such as AVs and ride-hailing services increasing congestion.

GUIDING AND PLANNING TECH ADOPTION FOR A POSITIVE OUTCOME

Several future scenarios emerge for urban mobility. In one, AVs become popular very quickly, but they are privately owned, like current automobiles. They are operated mostly as single-occupancy vehicles, rather than as part of a shared system. AVs are likely still powered by conventional fossil fuels, rather than shifting to electric power. With a drop in the cost of driving, this scenario has the potential to create a massive increase in vehicle miles, especially miles driven by zero-occupant vehicles. That increase in vehicle miles would bring a host of negative impacts on cities, like traffic congestion, poor land use and increased pollution.

APTA's 2018 Mobility Survey shows some hesitancy about self-driving vehicles, with only 21 percent of millennial respondents saying that they would prefer a self-driving taxi to a traditional one. But that figure increases to 46 percent when respondents were told that AVs have the potential to reduce costs by 90 percent, and 31 percent indicated that they would travel by car more often. These results reinforce the need to keep not just the general public informed of new mobility technology, but policymakers and transportation planners as well.

A more positive scenario can be created if the adoption of AVs is guided. By guiding AV policy, cities can make sure that AVs are used efficiently as part of shared fleets, providing shared rides. Shared AVs result in fewer overall vehicle miles traveled and larger cost savings for users. Managers of centrally owned shared fleets will want to shift from fossil-fuels to cheaper and cleaner electric-powered vehicles due to the savings offered by electric vehicles. ¬ An increase in shared modes would mean more users would shift to public transportation. APTA's Shared Mobility and the Transformation of *Public Transit* study[14] shows that users of shared modes are more likely to use public transit than non-users. Figure 5 from the International Association of Public Transport UITP shows the different scenarios of AV adoption.

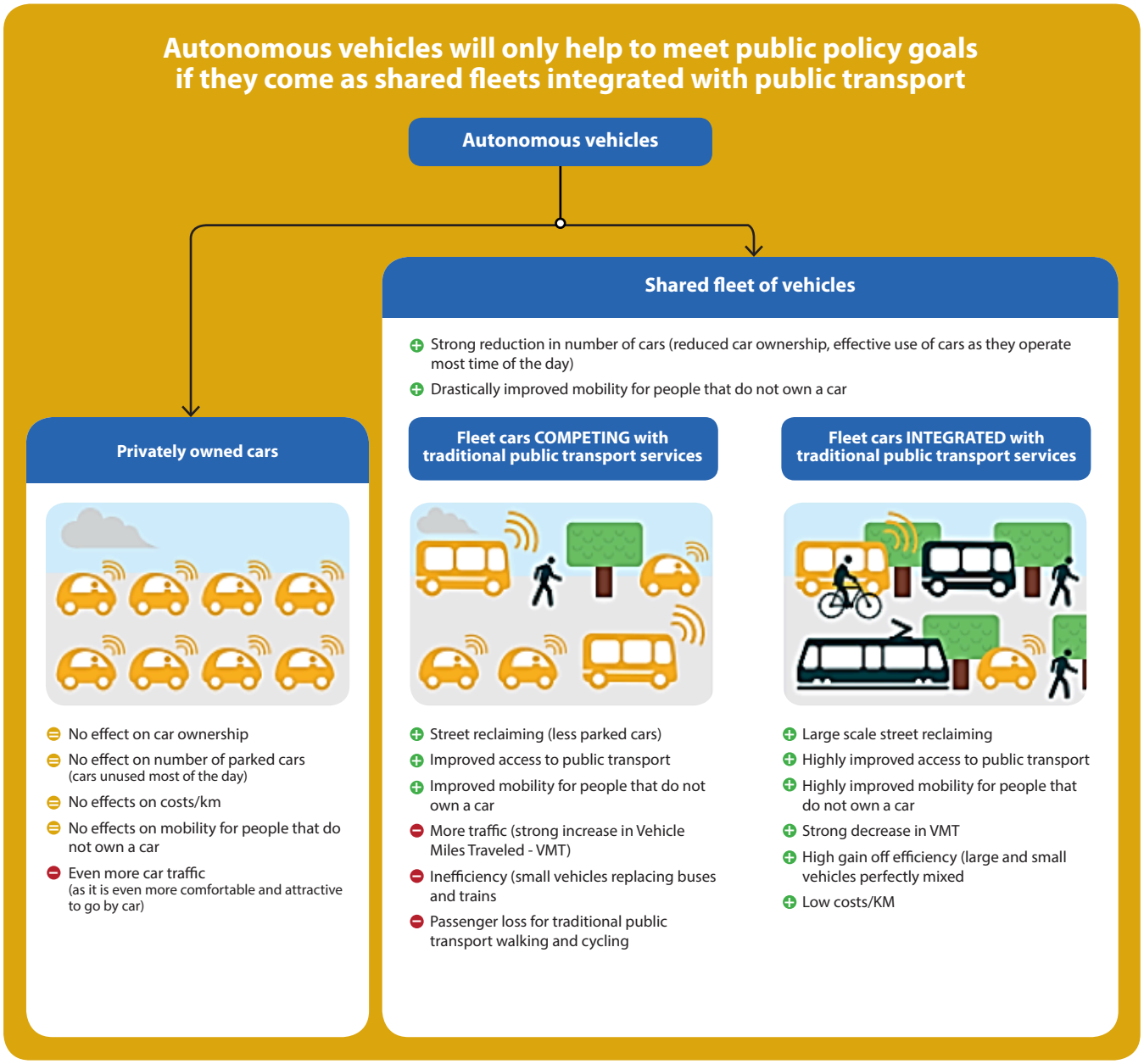
APTA'S 2018 MOBILITY SURVEY

68% **of respondents support additional funding for public transportation**

60% **of respondents support bus lanes, even if parking is lost**

50% **of millennials support congestion pricing, even before a campaign**

14. https://www.apta.com/resources/reportsandpublications/Documents/APTA-Shared-Mobility.pdf



Source: UITP/Martin Röhrleef

Figure 4: Autonomous Vehicles as shared fleets[15]

Whatever the scenario, the public transportation industry must be prepared to address the labor concerns and tensions associated with automation. As the economy moves forward, automation and robotics present a disruptive reality to the U.S. labor workforce.

15. Martin Röhrleef, Autonomous Vehicles: A Potential Game Changer for Urban Mobility, UITP Policy Brief January 2017

PUBLIC TRANSPORTATION IS MORE EFFICIENT, AND ENJOYS STRONG SUPPORT

Even when cheaper, shared AVs become available, public transportation will remain the most efficient way to move people, especially during peak periods in congested cities. On average across the entire U.S. transit industry, approximately 30 people board a bus per hour of service provided. Minimum standards at mid-size and larger public transit agencies for a route are approximately 15 per hour. Current ride-hailing service contracted by public transit agencies also does not reach this standard — well-used services provided some seven trips per hour during high-demand periods.[16] According to the National Association of City Transportation Officials, public transit moves up to 41 times more people per hour through a city than car travel.[17] A recent report on New York City congestion found that even as traditional taxi trips declined from 2013 to 2017, total passenger trips increased by 15 percent, showing the dramatic increase in vehicle miles traveled (VMT) attributable to ride-hailing.[18] Recent studies from other cities have reached similar conclusions. As a result, policy leaders know that single-occupancy travel is not a sustainable travel model.

The bus is often referred to as the "workhorse" of the public transportation system, with a wide service reach. To increase bus speed, cities around the country are investing in Bus Rapid Transit (complemented with signal priority), which tries to emulate rail with dedicated lanes or by allowing buses to run on the shoulders of freeways to avoid rush-hour traffic. Bus lanes garnered a 60 percent approval rating from millennials in APTA's 2018 Mobility Survey, even if such lanes reduce street parking. Public transit must continue to emphasize its high-capacity nature and advocate for separation from traffic as much as possible, so it is as fast as other mobility options.

The coming changes offer many opportunities to increase the efficiency and reach of road-based services, providing greater service at lower costs. Bus route redesigns are initial steps that public transit agencies have taken either to complement newly expanded rail routes or to better align with changing living and commuting patterns. Several agencies have made changes to adapt to changing mobility trends, such as buying electric buses for cleaner operation and reduced fuel costs. Transit agencies could operate self-driving fleets themselves, though the choice between higher capacity bus or microtransit remains uncertain. In January 2018, the Federal Transit Administration issued two Request for Comment notices that involve planning for automated transit buses, signaling that the industry is ready to move forward with these technologies.[19] As a regulatory framework is developed, public transit agencies will have a clearer picture to plan for automated technology research and development.

Automated systems also make it possible for vehicles to operate faster, closer together, more reliably, and with fewer attending staff.[20] According to Imperial College London, driverless trains yield significant operational savings and an estimated 10 to 15 percent rate of return on investment.[21]

Further opportunities for public transit come naturally from the future demographic makeup of America. With an estimated 34 million additional people expected by 2030 (and more than 16.5 million additional commuters), the country's roads will become even more strained. Estimates from the Federal Highway Administration point to an average growth rate in VMT of 1.07 percent annually, which could mean more than 43 trillion miles traveled in 2030.[22]

16. http://transitcenter.org/2018/05/15/adding-flexible-routes-improve-fixed-route-network/
17. https://www.nytimes.com/interactive/2018/02/27/opinion/automated-vehicles-cant-save-cities.html
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22. https://www.fhwa.dot.gov/policyinformation/tables/vmt/vmt_forecast_sum.pdf

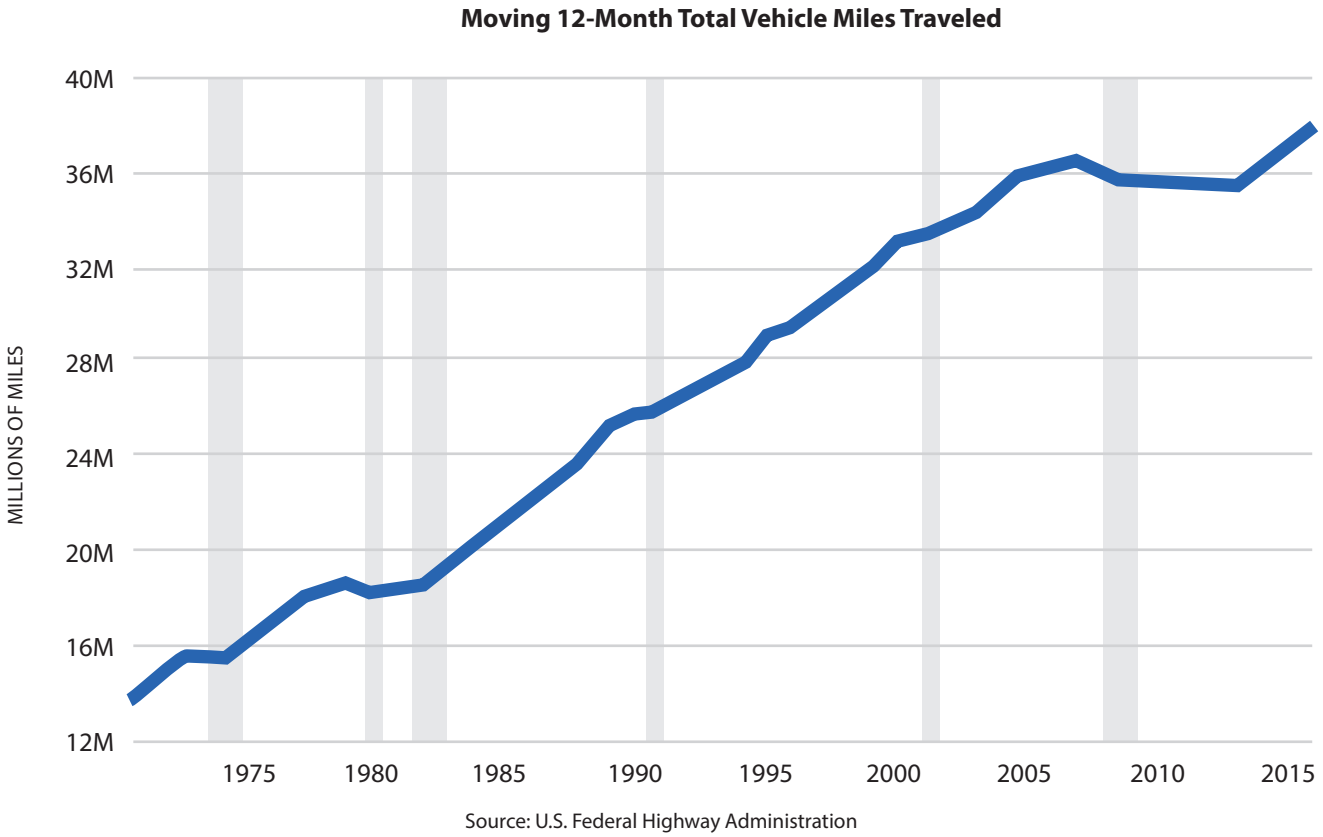

Figure 5: Total Vehicle Miles Traveled

According to the American Community Survey, 8.5 percent of commuters took public transportation, a taxi or walked/biked in 2016. The trendline suggests that by 2030 there will be more than double the number of current commuters. APTA expects that the changes outlined will only increase the percentage of commuters using public transit, taxi, biking, or walking as communities continue to invest in those modes (particularly with the dissemination of new, dockless bikesharing services).

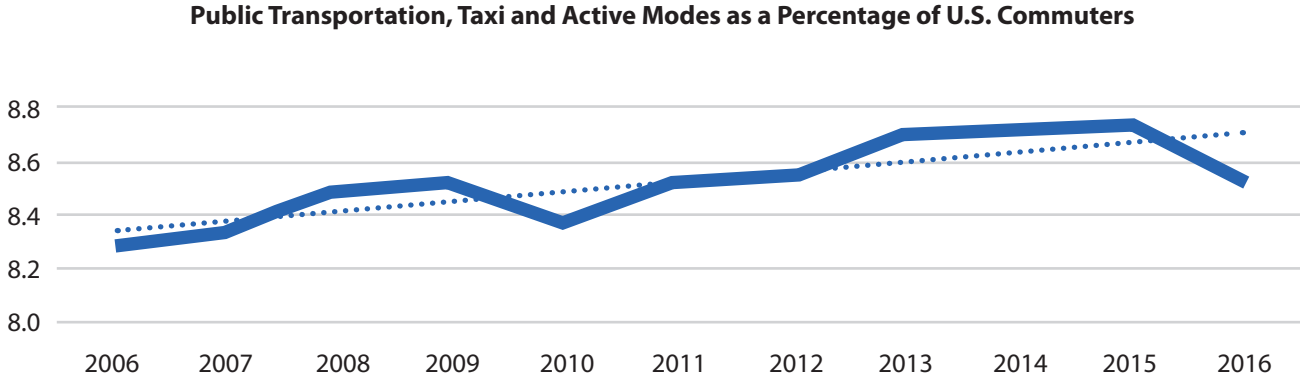

Figure 6: Percentage of U.S. Commuters taking shared/active modes (Census American Community Survey)

Ensuring funding will be essential for public transit to continue deploying new technologies and expanding shared and active modes. In APTA's 2018 Mobility Survey, 68 percent of respondents support additional local, state and federal funding for public transportation.

The future success of transit and society's ability to benefit from AVs and new mobility services depend on consumers' willingness to change how they use cars. ARK Investment Management estimates that ride-hailing is already dampening vehicle sales, preventing approximately 170,000 sales in North America in 2016.[23] APTA's *Shared Mobility and the Transformation of Public Transit* study shows that people who use ride-hailing and car-sharing in combination with public transit own half as many household cars as people who use transit alone. These numbers will only grow, leading some to estimate that peak vehicle ownership will occur in 2020.[24]

If current mobility challenges are to be solved, promoting shared/active transportation is the key to reducing single-occupancy travel. Otherwise, increased congestion and inefficient land use will be the likely consequences of continued high vehicle-ownership rates. Congestion pricing could also be used to discourage the use of vehicles in congested areas. Fifty percent of millennials in APTA's 2018 Mobility Survey support the use of congestion pricing if the money collected is used to increase funding for public transportation. Fifty percent is a good start for any campaign and shows the promise of support from a wider electorate.

Cities and public transit providers will have to work together to plan streets that are designed to move the most people in the most efficient ways. In the positive AV scenario, proliferation of different shared-vehicle sources will mean fewer people driving single-occupant vehicles into urban downtowns. This will provide an opportunity to redesign streets with fewer parking areas, which could free up more space for dedicated transit lanes.

High-quality public transportation will be needed to unlock economic benefits for employment centers. APTA's study, *Public Transportation's Role in the Knowledge Economy*, details how high-quality public transit is necessary to bring enough workers to employment centers to achieve the efficiencies sought from an urban office location.

23. http://research.ark-invest.com/hubfs/1_Download_Files_ARK-Invest/White_Papers/Self-Driving-Cars_ARK-Invest-WP.pdf
24. https://www.rmi.org/wp-content/uploads/2017/03/Mobility_PeakCarOwnership_Report2017.pdf

KEY FINDING 3

TRANSIT AS MOBILITY MANAGER: 74 PERCENT OF MILLENNIALS[25] WOULD USE A MULTI-TRANSIT APP

The fast-paced growth of new mobility services has led public transit customers to demand transportation that is flexible, quick and low-priced. The growing presence of the private sector has caused all stakeholders to rethink institutional and business models to prepare for future changes as AVs continue to develop.

In this new mobility environment, autonomous fleet owners and vehicle manufacturers will be focused on selling travel miles to consumers. Regional entities will be required to organize the wealth of options available throughout an area. Autonomous shared vehicles may provide the opportunity for cities to reconsider how they are using road space, and how they can reorganize their roads to serve efficient modes like public transportation. Public transportation agencies can guide cities on how best to prioritize efficient travel modes and cut through the hype created by proponents of one technology solution over another. They are well suited to act as regional mobility managers. Agencies have run their own service for decades and have organized disparate agencies and nonprofit providers to deliver a variety of services across entire regions.

The public transportation industry is shifting from a mindset of "we know what's best for our customer" to one that takes riders' preferences into consideration when providing and presenting service. New players like the auto industry are also repositioning themselves to provide a suite of trips and services based on consumer preferences. With the right partnerships, public transportation can act as mobility managers, demystifying the mobility options offered in a community and enumerating their societal costs and benefits.

PREPARING FOR CHANGE

To this end, local governments, in conjunction with public transportation agencies, will rethink how they manage curb space on public streets and design multimodal transportation hubs to incorporate fleets of AVs and prevent a proliferation of zombie robocars (autonomous vehicles with no passengers).[26]

Private delivery of transportation services is not new. But new mobility services could lead to increased congestion if not managed properly. Ride-hailing services currently offer shared ride services at prices competitive with public transportation.[27] And with automated technology, ride-hailing and even taxis could become even more price-competitive. These scenarios could lead to increased congestion and encourage sprawl if riders do not choose to use high-capacity public transit for any part of their trip. That means establishing public transportation agencies as regional mobility managers will become paramount to providing a more equitable and customer-centered transportation experience.

Public transportation agencies are developing new institutional models to adapt to evolving technologies and growing customer expectations. Some agencies are creating offices of innovation with chief innovation officers to develop new ideas around mobility and serve as the primary liaison with new mobility partners.[28] Others are weaving innovation throughout their organizations and reorganizing them around mobility.

25. Percent of respondents in APTA's mobility survey
26. https://smartgrowthamerica.org/app/uploads/2017/09/Impact-of-Emerging-Technologies-on-Complete-Streets.pdf Presentation to National Complete Streets Coalition.
27. DRIVERLESS FUTURE: A POLICY ROADMAP FOR CITY LEADERS https://drive.google.com/file/d/0B6YBhO59Nrj_ejJMU3N1OEpHUkU/view
28. http://www.trapezegroup.com/blog-entry/how-to-know-if-youre-an-innovative-transit-agency-and-does-that-even-matter

EXAMPLE OF INNOVATIVE MOBILITY ACTION AGENDA

- **Leverage shared mobility options as a complement to existing and future services.**
- **Build an internal framework to support mobility-as-a-service.**
- **Embrace the strategic opportunities brought by electric, shared and autonomous vehicles.**
- **Integrate data management platforms and engage with other innovative mobility initiatives.**
- **Advance efforts to improve the efficiency of existing infrastructure and realize compact urban forms.**
- **Strengthen institutional capabilities to invest in and nurture a culture of innovation.**

NEW PARTNERSHIPS AND APPROACHES TO PROVIDING PUBLIC TRANSPORTATION

As part of their role as regional organizing authority, public transit agencies can guide regions to adopt principles and tools associated with Mobility-as-a-Service (MaaS). Under a MaaS scheme, customers can access transportation services through a unified service that manages their trip across modes with one payment. This type of service is already being piloted in Helsinki, Finland, where app users can book an entire trip across public transit, car share and taxi, and the provider makes sure shared vehicles and taxis are available when the rider needs them.[29]

APTA'S 2018 MOBILITY SURVEY

74% **of millennials would use a Mobility-As-A-Service app**

APTA's 2018 Mobility Survey showed that 74 percent of millennials would use a MaaS app allowing for the coordination and payment of different types of transportation, with 28 percent saying a MaaS app would make them more likely to take public transportation. Currently, 80 percent of millennials consult with either Google or Apple Maps for transportation planning, suggesting that partnerships with the two companies may be both fiscally and practically the easiest path. Optimizing existing dominant platforms should involve improved trip aggregation, centralized payment systems and real-time travel information.

29. https://nordic.businessinsider.com/this-finnish-startup-aims-to-seize-a-trillion-dollar-market-with-netflix-of-transportation--and-toyota-just-bought-into-it-with-10-million-2017-7/

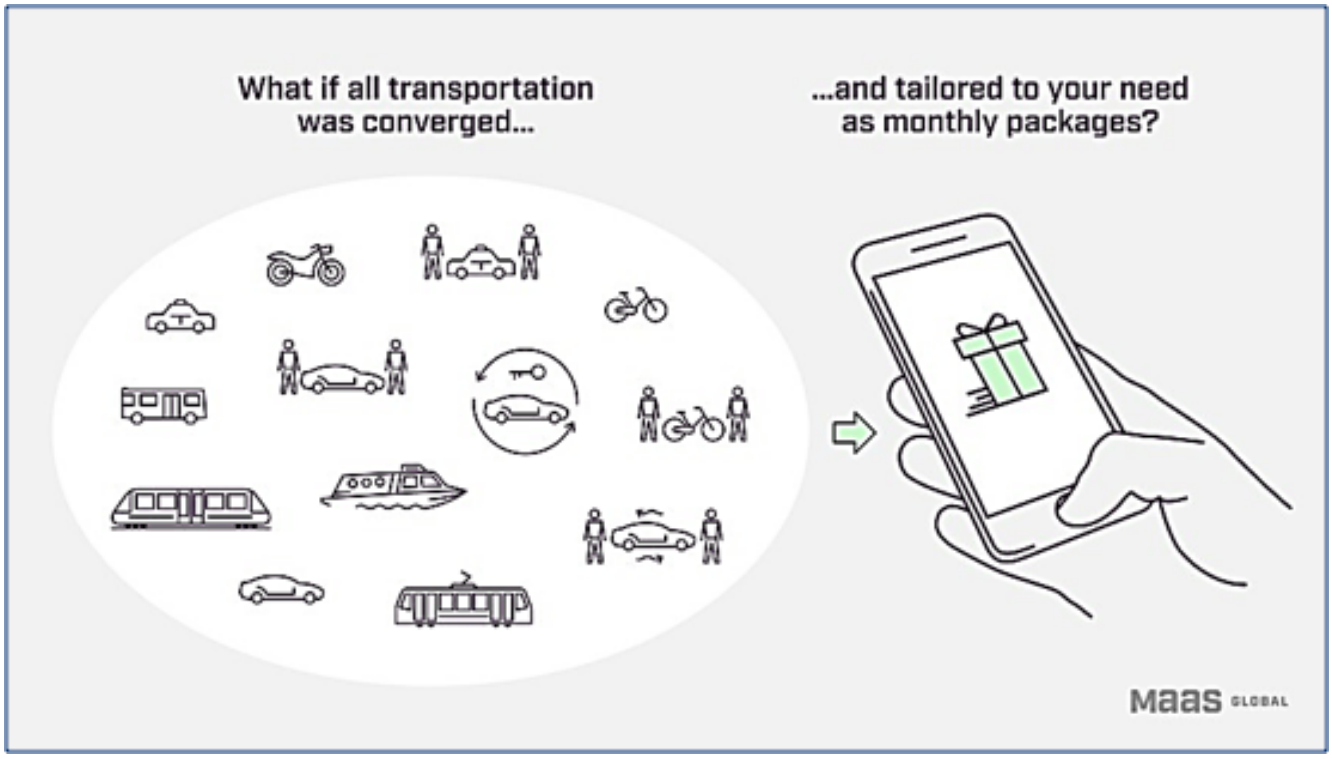

Figure 7: Transportation Options in One Service (Source: MaaS Global)

New technologies and mobility options bring further opportunities for public transportation to improve service and customer experience. In response to the increase of on-demand services, for example, some public transportation agencies are developing their own application-based microtransit programs to serve as the first- and last-mile legs of their transit networks. In APTA's mobility survey, 46 percent of millennials indicated that public transit agencies should operate ride-hailing/ridesharing services.

According to APTA's *Shared Mobility and the Transformation of Public Transit* study, partnering with the shared-mobility industry can help establish new business models that lower costs, increase service availability and improve the rider experience. Partnerships will become increasingly important for the public transportation industry, especially in areas that require new models of service, such as low-density areas and transit "deserts." Various companies have launched pilots with public transit agencies to provide on-demand service in low-density and underserved areas in cities across the country, with varying results. These partnerships between public transportation agencies and ride-hailing companies like Uber and Lyft are still evolving and could become more prevalent in the age of automation.

Coupled with high-quality transit, AVs could lead to expanded mobility among the elderly and disabled. Paratransit is often more expensive and inefficient to provide compared with other transportation modes. Between 1999 and 2012, the annual number of Americans with Disabilities Act paratransit trips increased from 68 million to 106 million, and the average cost increased from $14 to $33 per trip (a cost increase of 138 percent, compared with an increase in the unit cost of fixed-route bus service of 82 percent over that period).[30] Clearly, there is great potential for increased collaboration between public transportation agencies and private mobility providers to improve paratransit service using new technologies.

30. https://www.apta.com/resources/reportsandpublications/Documents/APTA-Shared-Mobility.pdf

PROTECTING THE CONSUMER AND SOCIAL EQUITY

There are concerns that the rise of AVs could lead to greater inequalities in accessing these new services. Low-income and older adults and persons with disabilities could be excluded from the benefits of AVs because of technological barriers.[31] The unbanked (7 percent of households as of 2015[32]) and those with limited access to financial institutions or smartphones (23 percent as of 2017[33]) are also at risk of not benefiting from these new technologies.

The collection of large amounts of data from new sources also raises privacy concerns. Autonomous vehicles will be constantly collecting information while in service. These data, if shared, can be used to better understand travel behavior, enabling public transit agencies to better plan services. The public sector can develop standards for privacy to determine how the sector can collect and use data in the future.[34]

Mobility is continuously changing and evolving, but the mission of public transit agencies to provide transportation for all users regardless of income or ability remains the same. And while the private sector can rapidly innovate, leading to greater efficiencies, its interests can come into conflict with the public good.

PUBLIC TRANSPORTATION AGENCY'S ROLE AS A MOBILITY MANAGER

Future mobility management will require increased outreach and collaboration among all stakeholders on a variety of issues, including funding, policy, street design, and bike and pedestrian infrastructure.

Public transportation agencies are primed to be mobility managers. They have the unique ability to:

- Integrate across markets, modes, providers, resources;
- Simplify user access;
- Address equity concerns;
- Promote system efficiency and effectiveness;
- Reduce trip and service costs for customers, and
- Enhance a community or region's transportation goals.

As the public continues to embrace new mobility options and communities plan for expanded use of AVs, the public transportation industry should be prepared to consider how to work closely with new mobility providers and become the central hub of service. This will require new skills and employment models that promote collaboration, innovation, entrepreneurial thinking and flexibility.

Public transportation will also continue to provide service to people of all incomes and remain an important lifeline for many. According to APTA's Who Rides Public Transportation, 21 percent of public transit riders have household incomes under $15,000, and another 21 percent have incomes over $100,000. Such diverse communities will continue to be served as public transportation continues to be the efficient choice for serving dense communities.

31. DRIVERLESS FUTURE: A POLICY ROADMAP FOR CITY LEADERS https://drive.google.com/file/d/0B6YBhO59Nrj_ejJMU3N1OEpHUkU/view
32. https://www.fdic.gov/householdsurvey/
33. http://www.pewinternet.org/fact-sheet/mobile/
34. https://www.apta.com/resources/reportsandpublications/Documents/APTA-Shared-Mobility.pdf

CONCLUSIONS

Public transportation is poised to be the mobility manager in communities around the country. Although the mix of options and the platforms to access them will change, communities will always need a mobility manager that can make travel choices clear and routine and ensure the fair and equitable provision of access.

No other entity has the historical memory, record of stakeholder engagement and ability to ensure accessibility for all types of users as public transportation. Though maintaining the wider community goals of access, environmental sustainability and fiscal prudence will be a challenge, the best bet for policymakers is to redouble efforts to invest in public transportation.

Support for public transportation is strong. More than two-thirds of those polled support additional federal funding for public transit. This investment is vital for agencies not only to continue modernizing current services but also to succeed in a new inter-connected mobility environment.

Emerging technologies, changes in demographics and consumer preferences, and new entrepreneurial service providers are transforming the role of public transportation. As was the case during previous periods of disruption to the industry, local, state and federal government support is crucial to ensure positive outcomes for society as mobility evolves.

Some private companies have experimented effectively in the mobility space and have achieved success, impacting the lives of billions. In doing so they have benefited from strong venture capital funding and a more flexible regulatory environment. For public transportation to reap similar successes and create a positive future with equitable results, the public sector will need the necessary financial support and flexibility required to manage mobility across a diverse portfolio of services.

APPENDIX A: RECOMMENDATIONS FOR LEVERAGING DATA, NEW TECHNOLOGIES AND BUSINESS MODELS

Public Transportation will be the backbone of a multi-modal society. Understanding consumer preferences through data acquisition, the interaction of new technologies with the built environment and new business models undergird the need for mobility management. Here are some recommendations for the future:

Protect Consumer Data

- The collection and analysis of Big Data has often been described as the new oil rush. Beyond understanding travel behaviors, travel data, when combined with other data, can be invasive and can lead to negative outcomes. As mobility managers, public transit agencies and private sector partners must agree to a set of principles.

Continue Engagement with Private Sector Partners

- Many have sought to acquire the data generated by ride-hailing companies to understand consumer preferences and possible problems. The competition that drives investor expectations should be understood. Firms view data as proprietary because it informs future decisions. Uniform data requests from public transit agencies and Metropolitan Planning Organizations may be one solution to current impasses.

Embrace the Culture of Silicon Valley

- Policymakers must allow for experimentation without repercussions for failed ventures. The risk-averse culture common among public agencies must be tested. This includes moving from best practices to new models that may expand collective industry knowledge (next practices).

Establish Better Trust with Labor

- Antagonistic relationships with labor increase the risk of fallout from needed changes. Labor will need to find a role that protects workers and promotes entrepreneurial thinking, while allowing reasonable shifts in business models. Labor and management must be strong partners to accomplish this.

Demand Diversity from Private Sector Partners

- The leadership of technology and venture capital firms tends to be white and male. Firms that are not diverse should not be expected to adequately serve diverse populations. Agencies should note the diversity of top leadership and advisors when considering partnership opportunities.

Continue Investing in Public Transportation

- Strong funding for public transit from the federal, state and local levels is crucial in providing agencies the resources they need to experiment. Agencies that are not properly funded will not be able to leverage new technology and adapt their services to provide an alternative to single-occupancy-vehicle travel. APTA millennial survey respondents are overwhelmingly supportive of increased federal and local funding for public transportation (79 percent and 77 percent respectively).

Develop an Industry-Led Innovative Mobility Hub

- The authors suggest creating a new institute, the APTA Innovative Mobility Hub (IMH). By collecting models from companies around the globe, facilitating market-based solutions, and driving change with all of our partners, the institute will keep public transportation a critical part of the conversation.

GLOSSARY

These definitions are sourced from TCRP Research Report #188: Shared Mobility and the Transformation of Public Transit

BIKESHARING
Short-term bike rentals from docking stations placed throughout a community.

CARSHARING
Short-term car rentals that may involve returning to a select location or left "free floating." Zipcar, Car2Go, and Maven are examples of carsharing companies.

DOCKLESS BIKESHARING
Bikesharing that does not require docking at a station. Bikes are unlocked and paid for through mobile devices.

FIRST AND LAST MILE
The distance between a traveler's origin/destination and a transit station/stop.

FIXED-ROUTE SERVICE
Traditional public transit service operating along a prescribed route and schedule.

MICROTRANSIT
Smaller, flexible transportation services that generate routes dynamically based on demand.

MOBILITY MANAGER
An agency that has control over a diverse portfolio of transportation services, rather than just traditional transit service.

PARATRANSIT
Point-to-point services without a set route typically used by older and disabled travelers unable to use fixed-route transportation.

RIDE-HAILING
Using mobile applications to connect travelers with vehicles. Uber and Lyft are examples of ride-hailing companies.

RIDESHARING
A type of ride-hailing that allows travelers to be paired in real time with others traveling along a similar route. Uber Pool, Lyft Line, and Via are examples of this service.

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