



Accelerating Mobility

**Optimizing transit in response to
rapid disruptions in technology and
consumer behavior**

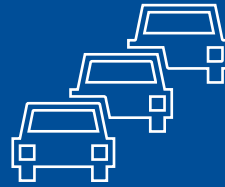
Overall transit ridership in the United States has declined by nearly 5% over the last decade, driven by a cumulative 15% decline in bus ridership over the same period. To remain relevant, cities and transit agencies need to meet the changing expectations of today's consumers. To achieve long-term success in managing congestion, providing equitable transportation options and achieving sustainability goals, we believe leaders in both the public and private sectors can embrace emerging technology and technology-driven partnerships.

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Mobility snapshot



Overall transit ridership is down 5% over the last decade, led by declining bus ridership



The rate of decline has accelerated over the last three years, reaching negative 3% in 2017



85% of Americans commute by car; of those, 90% are commuting alone



Public transit riders in major U.S. urban areas spend nearly a third of their commute time waiting for public transit, costing them 150 hours a year



90% of potential bus users live or work within a quarter mile of a bus stop in urban cores



\$90 billion backlog of unfunded infrastructure projects to keep bus and rail systems in a state of good repair



Sharing economy is anticipated to grow to \$400 billion by 2025



Only 30% of urban jobs in the U.S. are accessible within 90-minute public transportation trips

Executive summary

Technological advancements are impacting all sectors and changing the way we live, play, work and move. In this digital landscape, the consumer is literally placed in the driver's seat, requiring both private companies and public agencies to rethink how they deliver and provide consumer services.

Remaining relevant and growing shared mobility will require a reevaluation of existing business models and a deep examination of trends in consumer behaviors to gain insights into the products and services that consumers want, sometimes even before they want them. We must move from mass transit to mass mobility.

Private companies have adapted to the digital landscape, and the public sector, in particular transit providers, have the opportunity to do the same. While fixed-route bus service is still the most dominant mode of public transit, ridership has been in decline in cities across the U.S. Challenges are not monolithic and include, but are not strictly limited to: the continued dominance of the single occupancy vehicle, the rise in the sharing economy, the growing popularity of ride-hailing and ride-sharing services such as Uber, Lyft and Via, and emerging forms of active and shared transportation. Bike sharing, for example, is increasing in urban centers where over 35 million trips were taken in 2017, up 25% over 2016.¹ And, two decades of significant investment to make light and heavy rail transit more convenient have led to triple digit growth in ridership compared to a double digit decrease in bus ridership over the same period, underscoring the importance of investment in transit to boost competitiveness.² But it is our view that the biggest challenge is a change in consumer expectations where on-demand service not only proliferates, but is also now the norm.

In order to regain its standing as a valued and cost-effective transit option, and position itself for the future, now is the time for cities and civic leaders to rethink and reshape mobility. Declining transit and bus ridership is emblematic of a shifting landscape led by technology and increasing modal options. Going forward, additional challenges such connected and autonomous vehicles—as illustrated in KPMG's [Islands of Autonomy](#) white paper—will bring added pressure to the survival of the public bus. To keep transit alive and well in the digital age, transit providers have an opportunity to meet consumer needs by leveraging emerging technology and partnerships that complement and enhance bus service. This can be achieved by the following:

¹ National Association of City Transportation Officials, "Bike Share in the U.S." (2017)

² American Public Transportation Association, Ridership Report Historical Data (2018)

- Partnering with private transit providers to develop a more robust transportation service offering that caters to consumer preferences and leverages existing infrastructure.
- Utilizing traditional and nontraditional sources of data to better understand consumer behavior and the movement of people.
- Developing demand-response solutions to offer a consumer-centric transportation system.

Communities of all sizes can win by adopting these approaches. The implications are profound. For many, the bus represents the only viable form of transportation. Equitable transit is critical to achieving access – access to education, jobs and healthcare. Indeed, the benefits are broad-based. Bolstering the competitiveness of transit in an equitable way that serves low, middle, and high-income communities is a key ingredient for durable economic growth. At the end of the day, better mobility supports the local economy, connects people to each other and to jobs, and builds more attractive communities.



Introduction

“The traditional role of public transit is changing as disruptive technologies are forcing transit agencies to evolve and be more demand responsive. Agencies need to look at themselves as mobility integrators that promote convenience and connect seamlessly to other mobility options. Agencies that simply focus on providing traditional fixed-route service may become less relevant as customers demand more and better options.” - Bill Van Meter, Assistant General Manager, RTD

Public transit ridership across the U.S. has declined over the last decade, and the rate of decline is increasing. The bus is the largest mode of public transit and has led the way in driving the overall decline in public transit ridership as car- and bike-sharing services are offering consumers more choice on their terms than ever before. Increasingly, those terms include on-demand service—a challenge that is pushing transit to evolve. This white paper assesses the shifting role public transit providers can play—from organizations that build and operate transit systems to organizations that utilize data to improve service for consumers and generate new opportunities—to bring public transit systems into the digital age.

Public transportation is at a critical crossroads. In today’s digital age, consumers expect a flexible public transportation system with a mix of on-demand platforms. Many civic leaders are now rethinking the **future of mobility and are wanting to understand how technology can and should reshape transit, and in particular, public bus service** to make it more responsive, competitive and inclusive at the same time.

The explosion of data and the fragmented landscape of transportation services has prompted many cities to pursue integrated platforms that allow users to customize their trips based need, schedule, and preferred transportation mode available to them. Collecting and integrating data across a

transportation system is an important first step, but it’s just that, a first step. In order to fully optimize our transportation systems and move from integrated to smart networks, it is critical that public agencies collect nontraditional data sources that allow transit professionals to better understand and influence consumer behavior and choices.

This will require a mind shift on the part of local governments to embrace real time data to achieve greater efficiency in transportation planning. In order to better meet rapidly evolving consumer demand, public agencies can leverage nontraditional data sources such as origin and destination data collected on cellphones and navigational devices, partner with private transportation providers, and develop demand response solutions.

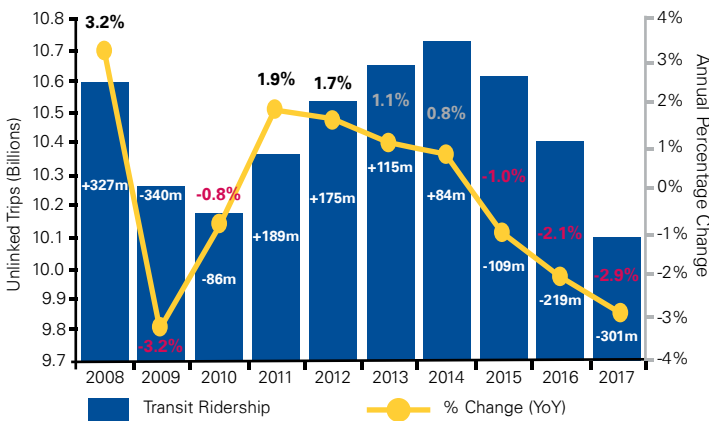
Further technology disruption is expected in the coming years, including the widespread adoption of autonomous vehicles, believed to be just around the corner, as illustrated in KPMG’s [Islands of Autonomy](#) white paper. These advancements will further catalyze the need for action. **The time for cities to align themselves to demand-oriented transportation systems that unclogs congested roads, improves safety, and reduces carbon emissions for all is now.**

Ridership in steep decline

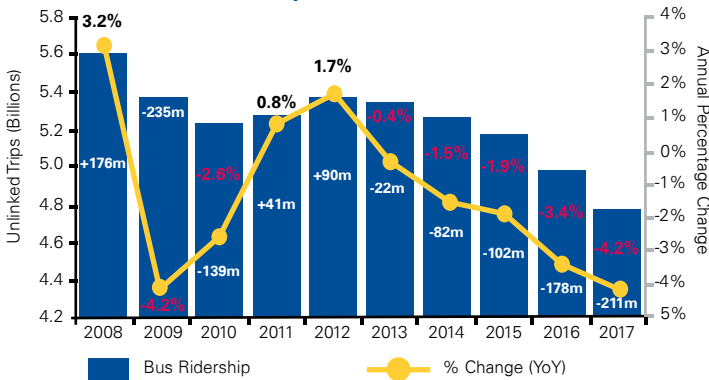
Public transit ridership has declined across the U.S. over the last decade, and in recent years the rate of decline has accelerated. Transit ridership growth has slowed down every year since 2011, turning negative over the last three years and falling to negative 3% in 2017, its largest drop in two decades (excluding the aftermath of the global financial crisis in 2009). Transit ridership is dropping at an increasing rate and has fallen 5% in the last decade, driven largely by a 15% decline in bus ridership over the same period. Other modes of transit like heavy rail or light and commuter rail have fared better, with total ridership up 8% over the same period, but most recently have also started to lose riders though not nearly at the scale of the bus.³

Figure 1 – Declining transit ridership growth has turned negative

National Public Transit Ridership, 2008-2017



National Public Bus Ridership, 2008-2017



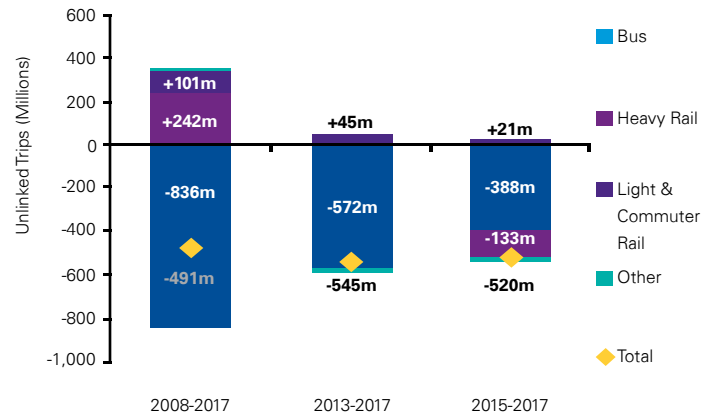
Source: KPMG Analysis using American Public Transportation Association (APTA) ridership data.

Note: Ridership measured as number of unlinked trips.

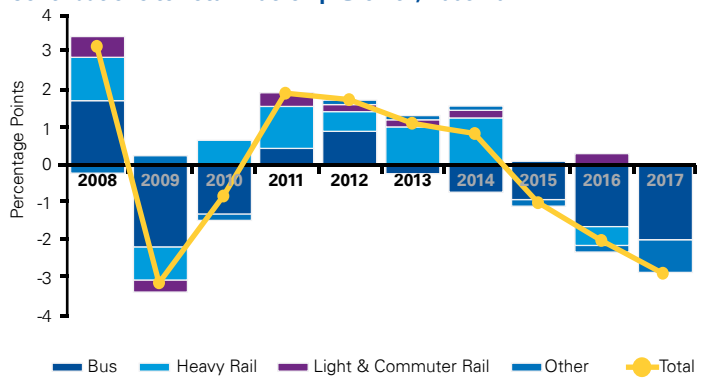
Disruptions in mobility patterns are widespread, though the impact has been strongest on the road. Consumers have always balanced the trade-off between cost and convenience to meet their travel needs, and with technology racing ahead, their options are growing. **The bus has long been a low-cost transportation option, but what will happen to the bus when other, perhaps more convenient, on-demand mobility options become cost competitive?** The steep and accelerating decline in ridership is emblematic of the challenges facing public transit in the shifting, on-demand, and technology-driven transportation landscape.

Figure 2 – The public bus is driving the decline in transit ridership

Change in Transit Ridership: last 10, 5 and 3 years



Contributions to Total Ridership Growth, 2008-2017



Source: KPMG Analysis using American Public Transportation Association (APTA) ridership data by mode.

Note: Ridership measured as number of unlinked trips.

³ KPMG analysis using data from APTA Ridership Report Historical Data (2018)

The challenges

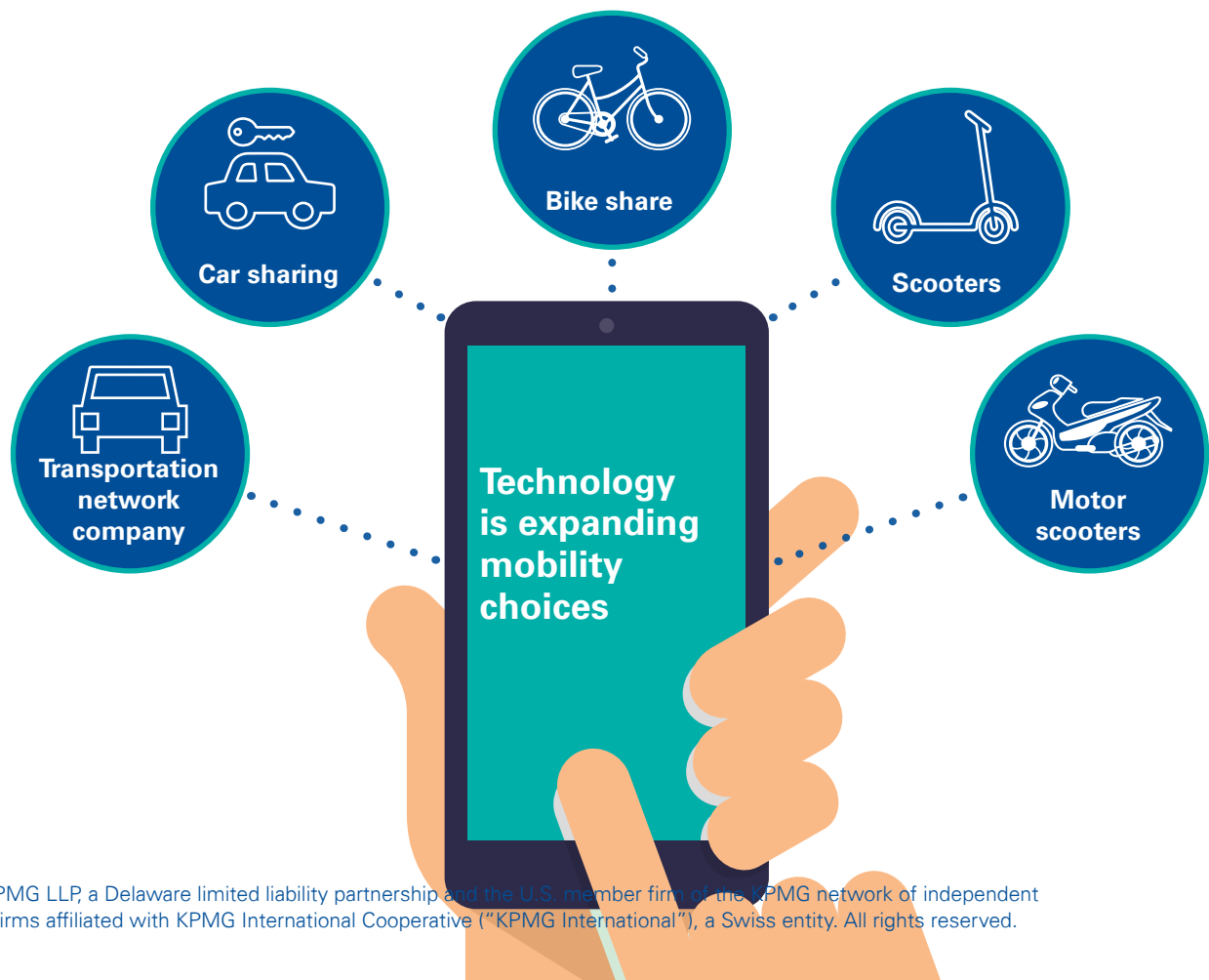
Perhaps the greatest challenges to transit ridership and particularly bus ridership are consumer behavior and expectations in the digital age. Customized service with a focus on convenience has become a hallmark of today's environment and enhanced consumer experience is a priority across industries.

The rise of the sharing economy

Over the past few years, new technologies and a wider variety of transportation options have become increasingly popular in American cities, leading to significant declines in bus ridership, lower revenues to offset operating costs, and increasing traffic congestion.

Most notably, ride-hailing and ride-sharing services, including but not limited to Uber and Lyft, have radically transformed the commuter landscape, adding 5.7 billion vehicle miles to nine major urban areas in the U.S. over the last six years. However, this alone is not the singular driver and should not be identified as the sole cause of declining transit ridership. Broader mobility services are a trillion-dollar market and past KPMG research has shown

that it is on track to be a multi-trillion-dollar market as demand continues to grow. Car sharing has grown from one million users in 2011 to 10 million in 2017, and is forecasted to grow to 36 million by 2025.⁴ Bike sharing has also increased, particularly in urban areas where over 35 million trips were taken in 2017, up 25% over 2016. Use of bike sharing is expected to grow even faster with the growing availability of dockless electric bike sharing options. Use of e-scooters is also on the rise, with options in over 100 cities providing approximately 20 million rides in just over one year.⁵ The reality is that the consumer is adopting these multiple modes of transportation and the question for civic leaders is how to leverage these options as opportunities to meet goals.



Dominance of the single occupancy vehicle

Fast fact: In the United States, 85% of people commute by car; of those, 90% are commuting alone.⁶

The private car remains the most widespread and preferred mode of choice. Within the United States, 85% of people commute by car; of those 90% are commuting alone.⁷ As our population grows, more drivers are owning cars and others are increasingly utilizing mobility services that, together, boost single occupancy vehicle (SOV) trips. This is both a competitive challenge for transit in terms of boosting ridership as well as a service challenge in terms of greater congestion and longer trip times.

The overall annual cost of traffic congestion in the U.S. is expected to rise by 50% from 2013 to 2030. The combined annual cost of traffic congestion in Europe and the U.S. will soar to \$293 billion by 2030, driven mainly by urban population growth and economic growth.⁸

Let's face it, most of our cities and their surrounding communities were designed for automobiles. Most commuters prefer to drive versus taking public transit due to convenience, reliability and

safety. Moreover, car ownership models are changing to be more accommodating to consumers. Taken together, these factors point to continued growth of single occupancy vehicle trips.

As we look at the costs associated with operating a personal vehicle versus taking public transit, it is clear that people are willing to pay for convenience. AAA reports suggest that driving a car costs roughly \$9,000 per year, a figure that includes depreciation of a new car. If one were just to consider the amount of money spent to fuel a car for 12,000 miles per year, then that cost exceeds most annual costs to take public transit.⁹

Consumers are also considering the Value of Reliability (VOR) when comparing the tradeoffs between car ownership and public transit. Even in an autonomous vehicle world, congestion will continue to rise and travel reliability will be even more critical. KPMG analysis forecasts that adoption of autonomous vehicles will lead to a 160% increase in vehicle miles travelled between 2015 and 2040, led by both personally owned autonomous vehicles and autonomous mobility services.



⁴ Frost & Sullivan, "Future of Car Sharing Market to 2025" (2016)

⁵ Bird has served over 10 million rides in more than 100 cities since 2017, Lime has served over 6 million rides since 2017, and Spin has served 1 million rides in over 19 cities since 2016.

⁶ U.S. Census (2018)

⁷ U.S. Census (2018)

⁸ Center for Economics and Business Research

Underinvestment

Currently, bus fleets in many cities are nearing the Federal Transit Administration's recommended maximum useful life of 12 years. Across larger urban cities, bus fleets are nearing 70% of their recommended useful life on average. Along with additional costs to operate these aging vehicles we must also consider the environmental impacts disinvestment has on our riders and communities. Nationwide, there is a \$90 billion backlog of unfunded infrastructure projects to keep bus and rail systems in a "state of good repair."¹⁰ At the same time, farebox recovery

ratios are declining and transit operating costs are increasing, presenting financial constraints on the ability of cities to invest in modernizing systems to provide competitive and environmentally sustainable service that meets consumer expectations (for example, the overall transportation sector accounted for 28% of total U.S. greenhouse gas emissions in 2016¹¹).

Targeted investment in transit is an important step and points to a better way forward: it can increase transit ridership, lessen our environmental footprint, and drive economic growth.

The widespread challenge of declining transit ridership across different cities suggests that it is a multidimensional issue. While the availability of alternative transportation options may be one factor in the decline, it is not the only factor. By leveraging both traditional and nontraditional data sources, the public sector can better understand the drivers affecting transit ridership and develop tailored solutions to tackle long-term transportation challenges.



⁹ AAA, "Your Driving Costs: How Much Are You Really Paying to Drive?" (2018)

¹⁰ APTA, "The Economic Cost of Failing to Modernize Public Transportation" (2018)

¹¹ EPA, "Transportation GHG Emissions" (2018)

Understanding what consumers want (and need)

New technologies and business models are disrupting standard fixed-route transit services by facilitating the move to demand-driven models. Now that consumers have a wider and growing variety of on-demand alternative solutions to public transit, it is important to understand what the 21st century rider values the most in today's shifting transportation landscape. Cities and communities will then be able to respond effectively and shepherd the evolution of mobility into the digital age.

To illustrate these ideas, we conducted an analysis on three cities—Denver, Houston and San Diego—that vary based on size, density, and rates of population and economic growth, yet are all

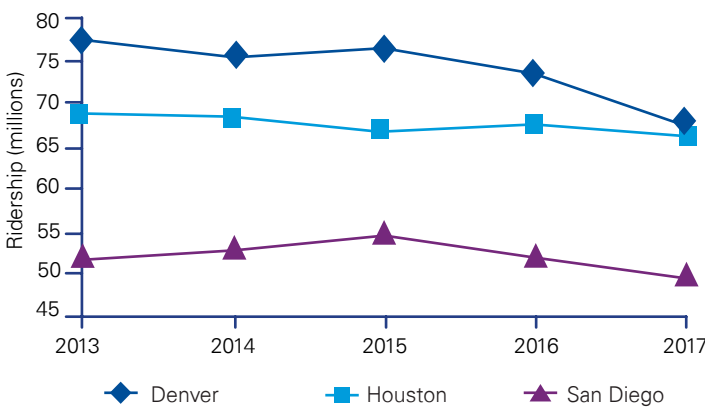
experiencing a similar decline in bus ridership and, consequently, less fare revenue to cover operating expenses.

In rapidly growing Denver, city planners have adopted a broader mobility initiative that merges efforts to boost data analytics capabilities of the city with the promotion of public transit to improve bus ridership. Meanwhile, Houston and San Diego have taken helpful steps to redraw their fixed-routes.

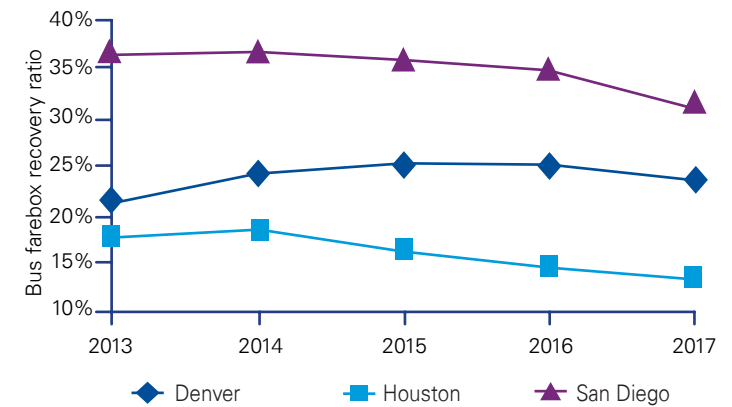
With technology racing ahead, cities need an agile approach. Now is an opportune time for cities of different sizes and needs to align their transit and mobility initiatives in a manner that is in line with technology-led shifts in consumer preferences and activity.

Figure 3: Decrease in bus ridership and farebox recovery ratio

Bus ridership



Bus farebox recovery ratio



Bus farebox recovery ratio (fare revenue as a share of operating expenses)

KPMG partnered with SafeGraph Data, a data provider, to analyze origin and destination data of consumers in Denver, Houston and San Diego, over the last five years to assess if transit access is contributing to the decrease in ridership. Our findings confirmed that in these urban centers, access to bus service is, in fact, not the issue. In these cities, 90-95% of potential customers live or work within a quarter mile of a bus stop.

What is happening is that current fixed-route bus service has not kept up with consumer preferences or been responsive to shifts in value of time perceptions. This includes the demand for faster travel times, shorter wait times, and comfort. A recent survey

shows that public transit riders in major U.S. urban areas spend nearly a third of their commute time waiting for public transit, costing them 150 hours a year.¹²

Our analysis suggests that the expansion of other transportation modes reveals that convenience and a customized experience can often trump cost when it comes to mobility and how consumers choose to travel. In other words, the value of time and money shifts for the consumer. In urban areas, the bus is accessible to nearly all potential riders and is usually the lowest cost mode of transport, yet consumers are shifting away.

¹² Moovit, "Public Transit Guide" (2015)

Coverage is not the issue

The map illustrations depict the vast coverage of bus transit access across cities. Using SafeGraph cell phone activity data, we analyzed the percentage of commuter trips that begin or end near a bus stop. Our team developed a set of assumptions around the behavioral patterns of transit commuters and found that:

- Commuters are traditionally willing to walk longer distances to public transit than to rideshare vehicles.
- Across major U.S. metros, commuters are willing to walk an average of one quarter mile to a public transit station.
- Comparatively, commuters tend to only walk about 400 feet for rideshare pick-ups.
- The tradeoffs in price, convenience and service contribute significantly to these behavioral trends.

Combining the SafeGraph data and commuter patterns, we found that over **90% of commute trips** occurred within a quarter mile of a bus stop across our study areas. With this in mind, we applied the behavioral assumption of rideshare walkability (400 feet) to bus transit access within our study areas and found that only around **30% of commuter trips** across the three cities were within this range.

These figures tell us that while transit accessibility is plentiful in downtown cores, transit cannot compete with the flexibility of on-demand service. The rise of rideshare services and their increasingly competitive prices, convenience and comfort levels have called attention to behavioral tradeoffs for commuters.

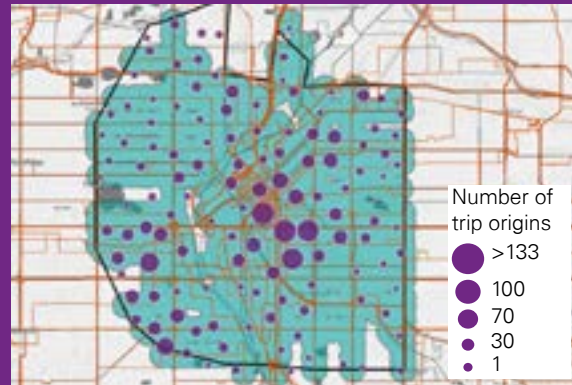
In most cities, ride sharing has emerged as the ultimate example of convenient travel, offering private, door-to-door rides available on-demand within minutes, as if a rider were in their own car, but without the headache of parking, insurance, gas, maintenance, and so on. Consequently, congestion has also increased, particularly with peak ride-sharing occurring during weekday rush hours.¹³ Bike- and scooter-sharing are also strong examples of convenient travel. Docking stations are often located at popular destinations and are filled with bikes or scooters for which availability can be monitored on a mobile application, minimizing both first- and last-mile travel as well as wait times.

While it is unreasonable to expect public buses to be able to match this exact level of convenience, civic planners and transit leaders can now employ many of these factors. For example, public transit operators can take steps to reduce total wait and travel times. Many are already offering third-party apps that allow riders to access estimated times of arrival for a given bus and some are also offering Wi-Fi and USB charging capabilities once boarded.

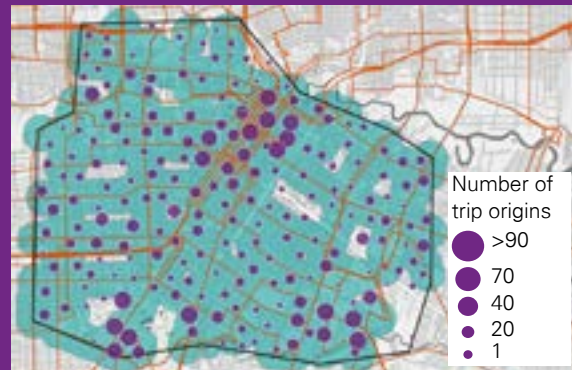
Figure 4: Morning commuters and bus transit access

Most trips in the core of downtown begin or end along a bus route. In Denver, Houston and San Diego over 90% of people live within one quarter mile of a bus stop.

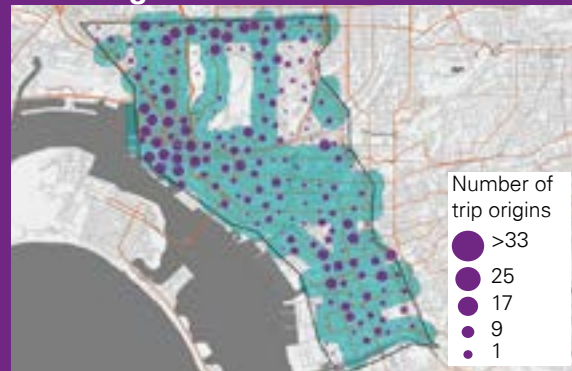
Denver 95%



Houston 94%



San Diego 91%



Source: KPMG Analysis using SafeGraph Data cell phone location data

Note: Depicts all clustered points of all commuter trips occurring within the core of downtown. Unshaded areas illustrate gaps in access to bus transit within one quarter mile of the commuter.

¹³ San Francisco County Transportation Authority “TNCs and Congestion” (2018)

The allure of microtransit

To assess the trade-off between cost and convenience, we turned our analysis to the economics of on-demand shared microtransit solutions and their viability in **complementing** bus service in the digital age. Cities around the world including Berlin, Singapore, Los Angeles, London and Sydney are actively experimenting with forms of demand responsive transit or microtransit. This technology-enabled, data-driven transit service offers dynamic routing and scheduling of mini or shuttle buses that can be summoned on your phone, **servicing as a complement** to traditional fixed route public buses to provide a more convenient option for consumers that helps alleviate traffic congestion and carbon emissions.

Among the initiatives being tested in Denver are dynamic-routing and microtransit services to better connect neighborhoods with transit options.

KPMG teamed with shared microtransit service Via, which ran microtransit simulations in the downtown cores of San Diego, Houston, and Denver to compare the convenience to consumers with private cars and the cost of providing shared microtransit service with that of public buses.

Shared microtransit can offer a viable alternative to a single-occupancy vehicle in terms of convenience for the consumer. In partnership with public transit agencies and cities, it also offers a cost-effective solution for the provider.

To assess the quality of service for consumers, we compared the time competitiveness of driving a private car versus traveling in a shared microtransit vehicle that picks up riders from “virtual” bus stops in each of our three sample cities.

The results: The simulations showed that average wait times were under eight minutes with an average walk of about 300 to 500 feet to or from requested pick-up and drop-off locations. This compares relatively well to the typical amount of time spent finding a parking space for your own car and walking to your destination, or back to your car.

The insights: Assuming comparable driving speeds and allowing time for additional stops in the shared vehicle, a trip with a shared microtransit ride took just four minutes longer than a private vehicle in Denver and San Diego and just two minutes longer in Houston. This often beats the hassle of driving in traffic and stopping for gas, and offers the added flexibility of taking one-way trips on-demand.

When compared to the fixed-route bus systems in these cities, as expected, shared microtransit was more convenient in terms of distance to bus stops. While 90-95% of people in the

downtown cores of Denver, Houston and San Diego live within the industry standard of one-fourth mile of a bus stop, only about 30% (Houston and Denver) to 50% (San Diego) of trips start or end within 300 to 500 feet of a bus stop—the average walk to or from microtransit for pick-ups or drop-offs. To be blunt, the last mile remains a problem for the fixed route bus that microtransit can potentially help solve.

To assess the cost-competitiveness of shared micro-transit, we compared the cost of providing these services with that of the public bus.

The results: Interestingly, this added convenience provided by microtransit did not increase costs for users and, in some cases, was less expensive. Based on the utilization rates of shared microtransit fleets in our simulations and estimates on hourly vehicle costs, we were able to estimate the total cost per trip of providing the service and compare it to the total cost per trip of fixed-route bus service in each of the cities. After accounting for fare revenues, which are subsidized based on city policies and cost of living, we found the cost to provide shared microtransit is roughly the same per trip as providing bus service for Denver (micro-transit was cheaper by about 2%, or 7 cents), a notable 26% (or \$1.50) cheaper in Houston, and about 15% (or just 44 cents) higher in San Diego.

The key takeaway: Shared microtransit can provide a cost-effective complement to the bus that meets consumer’s needs; but it does not replace the bus in high demand and dense areas, since a well-utilized bus carries more people per vehicle mile.

In less dense communities where access to public transit is limited and where buses are under-performing, there is room to explore solutions such as microtransit zones to help tackle first- and last-mile challenges and improve equitable access. We believe the rational application of microtransit becomes part of a full mobility solution in conjunction with high-density fixed-routes and in some cases, should replace the bus as it is quicker, more attractive and cost competitive. This is not uniform; each metropolitan region is an island unto itself (see [Islands of Autonomy](#)) and demands the proper data analysis to design the right mix of modes and service.



Inclusive ridership: Convenience within reach

All the foregoing is well and good, but we must recognize that equity (or the benefits and costs of transportation systems across population groups) is a core issue in many cities and communities. In the U.S., only 30% of urban jobs are accessible within 90-minute public transportation trips, and low-income individuals tend to have the longest commutes.¹⁴ For these groups, cost remains a challenge and convenience is out of reach. If the bus is not meeting the needs of those that depend most on it, it is missing a critical and dependable set of riders that could boost ridership for transit agencies. A number of high-profile pilot programs are underway to try to address these challenges.

On the cost front, in Columbus, the winner of the 2016 U.S. Department of Transportation's Smart City Challenge, the Central Ohio Transit Authority (COTA) is partnering with local employers to provide free bus service to 45,000 downtown workers until the end of 2020 through its C-Pass program. The program follows a successful pilot which doubled the share of bus commuters at four companies from 6.4% to 12.2%. Commuters can scan a smartphone app at the fare box, facilitating payment and transaction processing while providing valuable data on commutes within broader smart city initiatives.

However, commute time remains a challenge. Across the U.S., the average bus rider's commute to work takes about 47 minutes, more than two minutes longer than in 2007, while commute times for those who commute by car haven't risen as much.¹⁵ While transportation agencies think ahead to provide competitive and convenient transportation systems for riders, there is also an opportunity to be inclusive and, thus, drive inclusive economic growth and support stronger communities. This is not only an issue for consumers but also employers.

For illustrative purposes, we simulated a trip that connects a worker in a low-income urban neighborhood to a job-site that could have regular or irregular shifts and employs a range of low,

middle and high skilled workers—say, a downtown hospital—in Denver, Houston and San Diego. We stayed within the urban cores used in our previous analysis where coverage is plentiful in order to observe an illustrative bus trip that begins in a low-income urban neighborhood. We conducted this simulation to identify the travel times and costs for a daily commute to work for those individuals of lesser means that may be dependent on public transit, versus a private car or a ride-share service. Based on our simulations, commuting to work by bus can take up to an hour for just a 4 or 5 mile commute. Using a private car or ride-share service like Uber, on the other hand, could take just ten minutes, but can cost up to three times more per trip which is understandably cost prohibitive.

With technology racing ahead and innovative mobility options continuing to disrupt legacy transit systems, lower-cost and faster transportation modes are just around the corner. The bus is one of the lowest cost options but, as demonstrated, can struggle to meet the needs of its most dependent riders. For the bus to endure in the digital age, it must adapt to consumer needs across income groups and neighborhoods.

Making transit more competitive and inclusive will help close equity gaps, boost ridership, and, ultimately, drive stronger economic growth. New technologies can offer an opportunity to be both competitive and inclusive in a cost-effective way. The capability to reach a worker and take her to her night shift at the downtown hospital, on-demand, can provide a safer and faster option for the rider, improve economic productivity, and bolster ridership. Potential ways to ensure equity in the age of on-demand transit and a variety of modal options include providing more seamless payment and trip planning options such as pay-as-you-go arrangements, integrated mobility-as-a-service, and contactless transit cards used across platforms and modes.

“As disruptive technologies continue to enter the transportation marketplace, we need to keep the issue of equity front and center so that the transit dependent don't get left behind.”

- Bill Sirois, Senior Manager, RTD

Serving those most dependent on transit

Fixed-route transit is a crucial part of many city economies and transportation networks, providing regular and affordable mobility options for individuals to reach jobs, education, and other destinations. However, these transit networks often struggle to provide dependable access for all users, especially in lower-income areas. As a result, members of these communities lack affordable and convenient access to jobs, healthcare, education, and other opportunities.

For illustrative purposes, we simulated a trip that connects a worker in a low-income urban neighborhood to a job-site that employs a range workers—say, a downtown hospital—in Denver, Houston and San Diego. Staying within the urban cores ensures that transit coverage is not the issue, allowing us to highlight the quality of service—as indicated by the travel time and cost for a daily commute to work—of transit for those individuals of lesser means that rely on public transportation. Within the urban cores of each city, we selected commutes of about 4 to 5 miles and compared bus service to a ride-share service or private car. Based on our simulations, commuting to work by bus can take up to an hour for just a 4 or 5 mile commute. Using a private car or ride-share service like Uber, on the other hand, could take just ten minutes, but can cost up to three times more per trip which is understandably cost prohibitive.

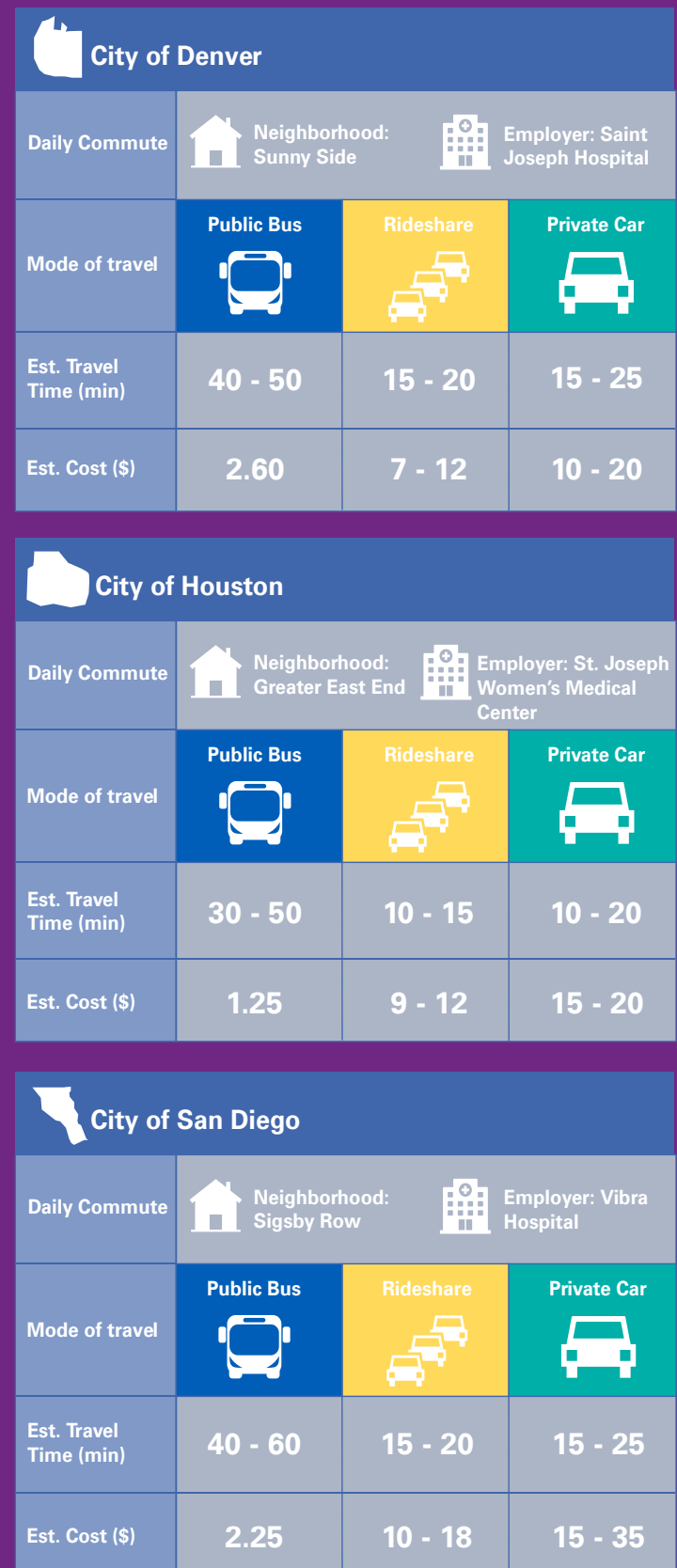
These challenges exist in all communities, regardless of their shape or size and cannot be solved efficiently or affordably through more fixed-route buses or trains. Ensuring equity requires innovative solutions that technology and partnerships can uncover, including teaming up with microtransit to create a transportation network that provides affordable and reliable access to all members of a community, regardless of their particular needs.

Methodology: Public bus cost based on average fare. Rideshare cost based on fees to rider. Private car cost based on range of daily weekday rates of nearby parking to employer location (www.spothero.com) and gasoline prices based on local price (as of mid-December 2018), commute distance and national average of vehicle fuel efficiency. Public bus travel time based includes walking time to and from bus stop during morning commute hours. Rideshare travel time based on a typical rideshare trip during morning commute hours. Private car travel time assumes an extra five minute walk from parking to employer site (industry standard) compared to a rideshare trip if parking is not immediately at destination, and assumes available parking spot.

¹⁴ Mobility Lab: Equity (2018)

¹⁵ Wall Street Journal, “America’s Buses Loses Riders, Imperiling Their Future” (2017)

Figure 5. Illustrating a typical commute to work within the urban centers where coverage is high



Adapt and be rewarded

With technology and transportation options continuing apace, there is an opportunity to bring the bus closer to consumer activity in the digital age.

Transit agencies can begin by embracing nontraditional data to enable greater insights, building partnerships with data providers, technology integrators and private transportation services to leverage existing infrastructure, and develop demand response solutions that complement the bus and plug it into the technology-based transportation ecosystem of the digital age.






With the right implementation, investments in these technologies are an economic enabler. A more competitive and inclusive mobility system will satisfy and support a broader range of consumers and keep transit agencies relevant. As disruption in mobility accelerates, the cost of alternative modes of transportation decline, the bus and public transit, and specifically the bus, will be subject to growing pressure. Making the right investments today are crucial to maintain competitiveness. The result: a more productive local economy, healthier public finances, and happier riders.

To get there, public agencies can pull on three levers:

Lever 1: Leveraging nontraditional data sources

Leveraging nontraditional sources of data generated by users is better informing transportation planners on the most efficient ways to meet rider needs. Among the key benefits of using nontraditional sources of data is an expedited planning process. In the past, it could take years for planning agencies to collect sufficient data to use in their planning methodologies. With better, more reliable, and more timely data from nontraditional sources, it is possible to more accurately predict activities and related travel choices of daily commuters. This data will pave the way to new transportation planning models that will enable forecasting tools to address travel demand, congestion, mode shift and emerging services such as autonomous vehicles, electric vehicles and mobility-as-a-service. With the right data and the right data analytics capabilities, better planning decisions can be made around quantity and frequency of service, asset allocation, real-time pricing, and land use decisions that align with overall priorities, strategies and initiatives.

Figure 6 – Examples of nontraditional data sources

 Navigation/ mapping	<i>Automakers are utilizing open source systems that allow applications</i>	Accidents, road conditions, traffic, parking
 TNC's and Rental Companies	<i>Ridesharing users are estimated to reach 539 million by 2021</i>	Traffic patterns and commuter trips
 Fitness and Recreation	<i>The wearable market is anticipated to double in growth by 2021</i>	Speed of travel, GPS, age and health of users
 E-Commerce	<i>Online sales in the United States will grow to \$603 billion by 2021</i>	Freight and logistics
 Social Media	<i>In 2020 it's estimated there will be 3 billion social network users worldwide</i>	Ridership information

Real-time data collected via cell phones, GPS trackers, and navigational devices and data collected by rideshare companies' offers an incredible wealth of information that can help local governments make better transportation decisions and improve the quality of the customer experience. This will require that both public and private companies take an altruistic approach to sharing data as it could lead to better solutions and new opportunities for all. By using nontraditional data sources (e.g., location-based data on movement and modal activity, consumer data on demographics and customizable behavior, and benchmarking data), governments and transit agencies can transform from supply-driven, low-patronage, fixed-route bus services to demand-driven, responsive services consumers want and will use.

By using nontraditional data, governments and transit agencies can transform from supply-driven, low-patronage, fixed-route bus services to demand-driven, responsive services

Sources: (From top to bottom) Reuters, "Open-Source Software" (2017); Statista, "Ridehailing" (2017); Forbes, "Smart Wearables Market to Double by 2022" (2018); Brookings Institution, "The Current and Future State of the Sharing Economy" (2017); Statista, "Social Media Users Worldwide" (2018)

For example:



The growth in anonymized location-based data on origins and destinations of trips provides opportunities for new services and improved delivery of transit commutes both in real time and with predictive capabilities. This type of data can also drastically improve the speed and capacity of traditional planning cycles that many public agencies undertake as part of their legislative mandates.



Consumer data on behavioral patterns, such as spending and demographic data, can help service providers offer an enhanced travel experience across modes of transportation that is convenient and meets consumers' needs.



Benchmarking data that combines traditional and nontraditional data sources can help transportation agencies assess their relative performance against a set of leading practices and help provide a reference point to inform policy decisions.

Lever 2: Building partnerships

Transit agencies will need partners in their efforts to bring transit service into the digital age and to better serve today's consumers in an inclusive way. This includes partnerships with nontraditional data providers as well as with microtransit or other private transportation providers. The new public-private partnership is about the access and value of data and technology between the public and private sectors. Public officials should recognize the value they bring to private partners with the public levers they control, including large scale service delivery and greater revenue opportunities. In exchange, public agencies can benefit from greater nontraditional data, enabling them to generate insights into consumer activity, enhance operational efficiencies, and create more targeted services – delivered through more effective subsidies or smarter capital deployment.

Lever 3: Developing demand-response solutions

In demand-driven transportation models, fixed routes are giving way to flexible routes created in direct response to user requests, in real time. Several US cities are already deploying demand response solutions in their communities improve transportation equity - but the scale remains small. Only 2% of national transit ridership is accounted for by public demand-response solutions. Between 2008 and 2014, ridership in public demand-response solutions grew by over 20%. However, much like public transit overall, ridership has since declined by nearly 10%.¹⁶ The key for public officials is to identify how best to design these solutions to complement existing transportation options. Developing public-private partnerships can help improve service delivery, competitiveness, and meet critical transportation equity challenges across communities of all sizes in a cost-effective manner.

¹⁶ KPMG analysis using data from APTA Ridership Report Historical Data (2018)

Shared micro transit can offer a viable alternative to single-occupancy vehicles that is comparable in convenience to having your own car

Micro-transit trips took only 2-4 minutes longer than a private vehicle trip

90% of potential bus users live or work within a quarter mile of bus stop

Shared micro-transit can be cheaper than bus service
\$0.67 cheaper per trip

Reduced congestion and time spent parking. In U.S. cities, on-street parking accounts for roughly 1,825 vehicle-miles traveled every year.*

Average micro-transit trip length 3 to 4 miles

In urban cities, only 30-50% of trips starts or end within 400 feet of a bus stop**

Simulations for San Diego, Houston and Denver

**The simulation assumes that the average maximum walking distance to a transit stop is approximately 400 feet

*Source: Donald Shoup, "Parking and the City" (2018)

Conclusion

There is no time to waste. Global companies are already racing to develop their own transportation networks. Private technology companies such as Waze and Google Maps, and rideshare companies such as Uber and Lyft, have started to collect data on the movement of goods and services in order to help individuals optimize their travel. Transit agencies need to catch up, and the use of nontraditional data on consumer activity offers an opportunity to develop insights needed to be agile in offering consumers a demand-led, efficient, and better transportation experience. Indeed, agencies must move from transit providers to mobility aggregators to meet the growing and changing needs of the consumer.

Transit providers have a big opportunity to use nontraditional data sources to learn about their customers—where they go, what they value, what they like—and to partner with on-demand disruptors to expand their transit networks. This will provide the opportunity to create an integrated platform for riders that allows them to plan their own trips based on cost, convenience, time, personal preferences, and other factors they value.

Key recommendations



Partner with disruptors



Use data to learn about customers



Develop demand-response solutions

A starting point is to understand and embrace the role data plays in enabling transit agencies to propel transit service in the digital, demand-led era. Data itself is not the solution, but it does provide the necessary insights to drive consumer behavior and to successfully integrate mobility opportunities, evaluate new applications and services, and ultimately optimize service.

Consumers moving away from public transit is a clear sign that it's time to adapt and find ways to improve their public transportation systems.



How we can help

Transportation agencies should develop and deploy holistic mobility strategies that leverage data analytics capabilities to unleash value and enable faster and more cost-efficient planning at increasingly granular levels.

This will allow for a more efficient and responsive approach to asset and capital deployment to improve customer service and increase ridership.

KPMG can help you:



Develop mobility plans that are responsive to existing and future trends and identify solutions to prepare an organization for the future



Build partnerships with private transit and data providers to leverage existing infrastructures and unlock value



Develop data analytics tools and capabilities that will allow you to manage your transportation systems and assets at a more granular level with greater speed, agility, and accuracy



Develop data governance and systems architecture and build out data governance frameworks for operational excellence in the digital, data-driven era



Design the organizational enablers that will allow you to recruit, retain, and align talent with the right opportunities



Align your transportation strategies with smart city initiatives

With technology racing ahead, riders will increasingly choose among a growing set of modal options that best meet their needs. Forward-looking cities and transportation providers recognize that data is the big enabler to better, more efficient, and more convenient transportation systems. We can help you build the capabilities and the partnerships you need to provide better, consumer-oriented services that generate value for your organizations and the public at large.

About KPMG's transportation team

KPMG works closely alongside clients across the entire lifecycle of their projects in all sectors of public transport. We can help you set the public transit strategy that is right for your city. Our professionals work with you to provide candid assessments and recommendations as well as valuable support to help in the change process. We can help you craft a vision and roadmap to move to the next level and meet the changing needs of your city.

About the authors



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