NATIONAL LEAGUE of CITIES | CENTER FOR CITY SOLUTIONS AND APPLIED RESEARCH

CITY OF THE FUTURE

TECHNOLOGY & MOBILITY

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ABOUT THE NATIONAL LEAGUE OF CITIES

The National League of Cities (NLC) is the nation's leading advocacy organization devoted to strengthening and promoting cities as centers of opportunity, leadership and governance. Through its membership and partnerships with state municipal leagues, NLC serves as a resource and advocate for more than 19,000 cities and towns and more than 218 million Americans. NLC's Center for City Solutions and Applied Research provides research and analysis on key topics and trends important to cities, creative solutions to improve the quality of life in communities, inspiration and ideas for local officials to use in tackling tough issues and opportunities for city leaders to connect with peers, share experiences and learn about innovative approaches in cities.

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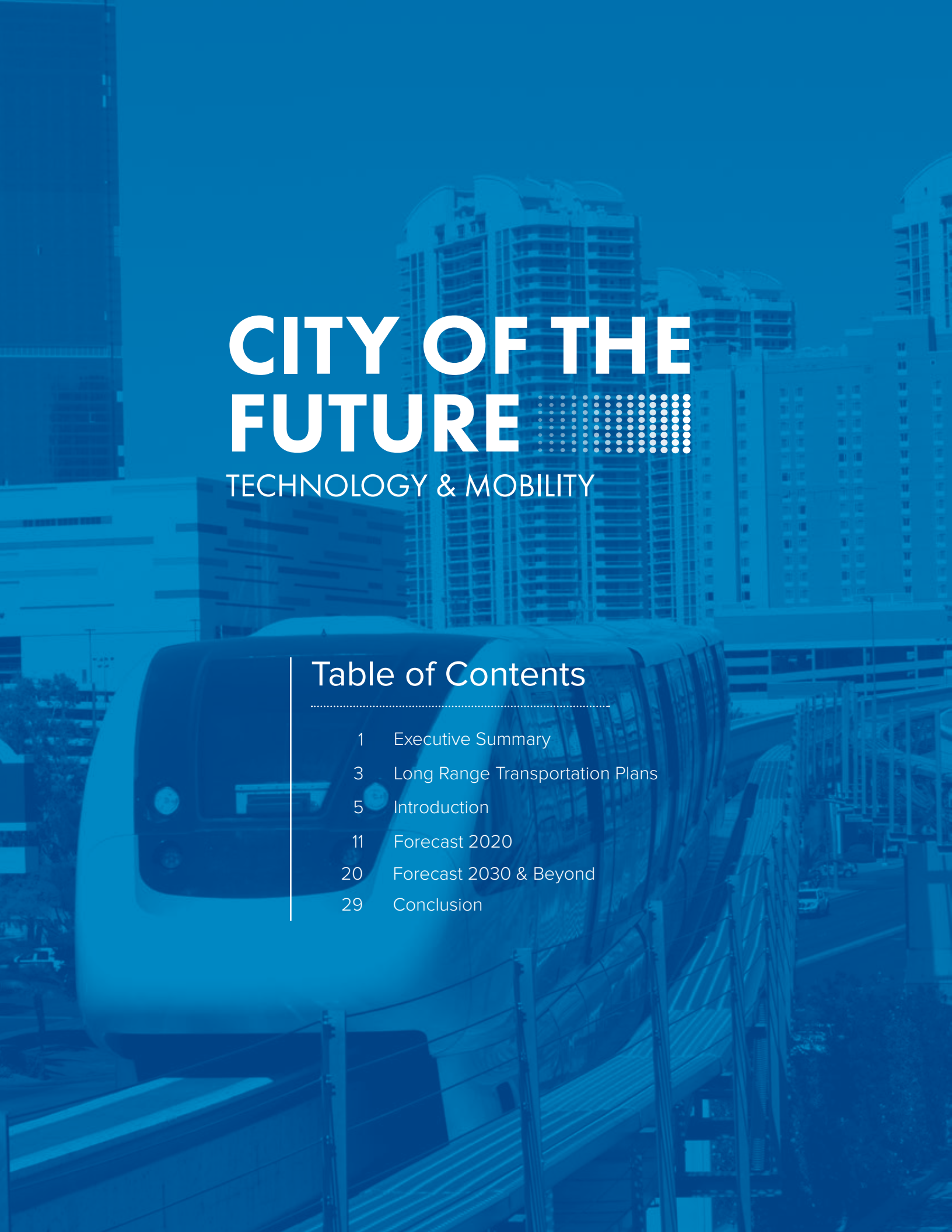

CITY OF THE FUTURE

TECHNOLOGY & MOBILITY

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EXECUTIVE SUMMARY

The seamless and efficient movement of people in cities has been a priority for government since its inception.

Mobility options are fundamental to providing a robust platform for economic activity and human interaction within the urban environment. Today, rapid technological advances coupled with shifts in demographics and public preferences are dramatically altering the nature of transportation in America's cities. Technology's ever-growing impact has profound and far-reaching implications for the future of urban mobility.

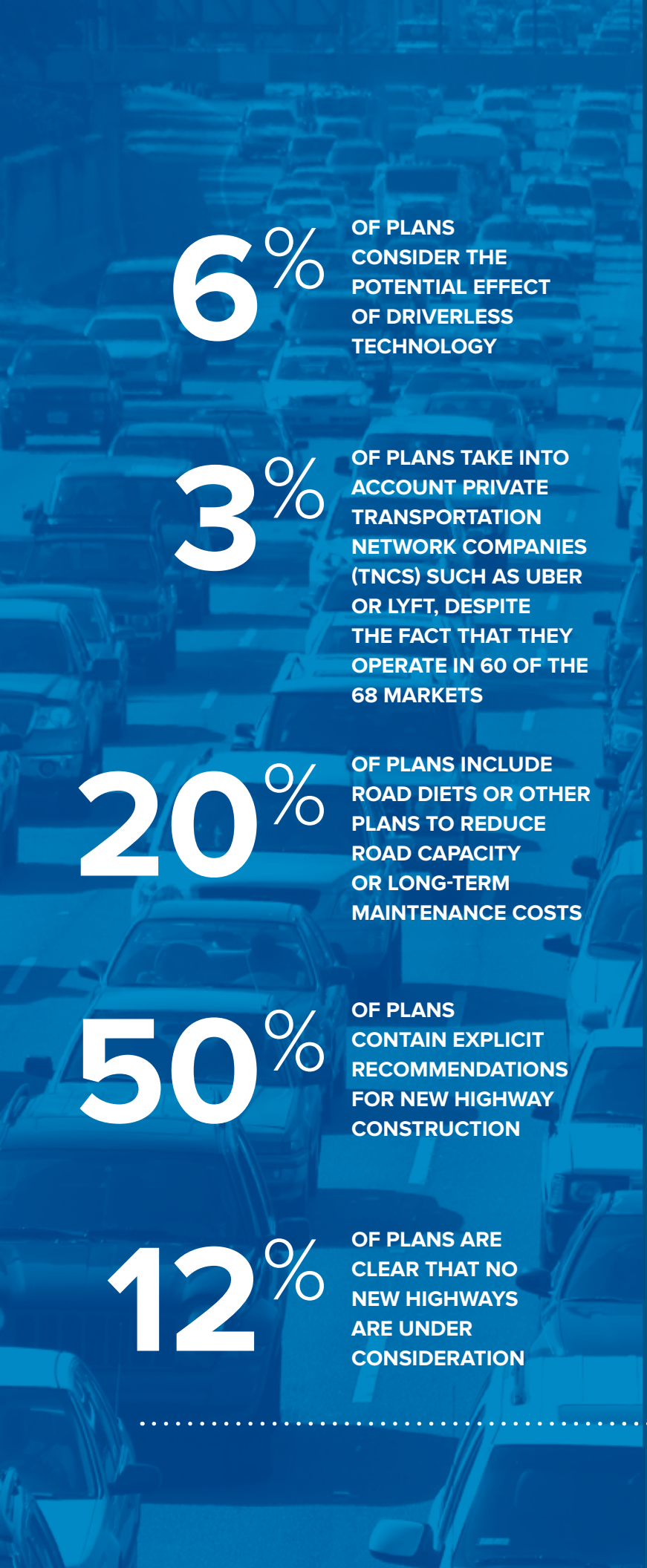
The topic of mobility and technology is a key consideration for cities as they plan for the future of their communities. The National League of Cities' (NLC) *City of the Future* initiative explores existing trends and predicts future developments so that cities can anticipate changes in the urban landscape and prepare accordingly. This multi-year research project focuses on five different factors that affect cities: technology, economics, climate, culture and demographics. By exploring these factors through a city-centric lens, the initiative highlights specific issues that will affect how people experience and move throughout cities for years to come.

The first report in this series focuses on the nexus between mobility and technology. Creating a transportation network - a platform for commerce and human interaction - is one of the oldest and most important functions of government. Technology is leading cities to more dynamic transportation systems where people shift seamlessly between multiple modes depending on their needs. The ultimate goal of cities must be to combine different transit modes into a coherent whole, so that moving from place to place is easy, equitable and enjoyable.

This report draws conclusions from a variety of sources, including existing literature, expert interviews and transportation plans. We have discovered widening gaps between innovation in the private sector, the expressed preferences of citizens and the visions of city planners regarding transportation investment.

Many transportation plans which project outcomes decades into the future focus almost exclusively on the problem of automobile congestion and prescribe increased infrastructure in the form of new roads as the primary cure. However, experts and trends point to a future that will be increasingly multi-modal.

We conducted a content analysis of city and regional transportation planning documents from the 50 most populous US cities, as well as the largest cities in every state – a total of 68 communities. Our analysis yielded the following results:



6% OF PLANS CONSIDER THE POTENTIAL EFFECT OF DRIVERLESS TECHNOLOGY

3% OF PLANS TAKE INTO ACCOUNT PRIVATE TRANSPORTATION NETWORK COMPANIES (TNCS) SUCH AS UBER OR LYFT, DESPITE THE FACT THAT THEY OPERATE IN 60 OF THE 68 MARKETS

20% OF PLANS INCLUDE ROAD DIETS OR OTHER PLANS TO REDUCE ROAD CAPACITY OR LONG-TERM MAINTENANCE COSTS

50% OF PLANS CONTAIN EXPLICIT RECOMMENDATIONS FOR NEW HIGHWAY CONSTRUCTION

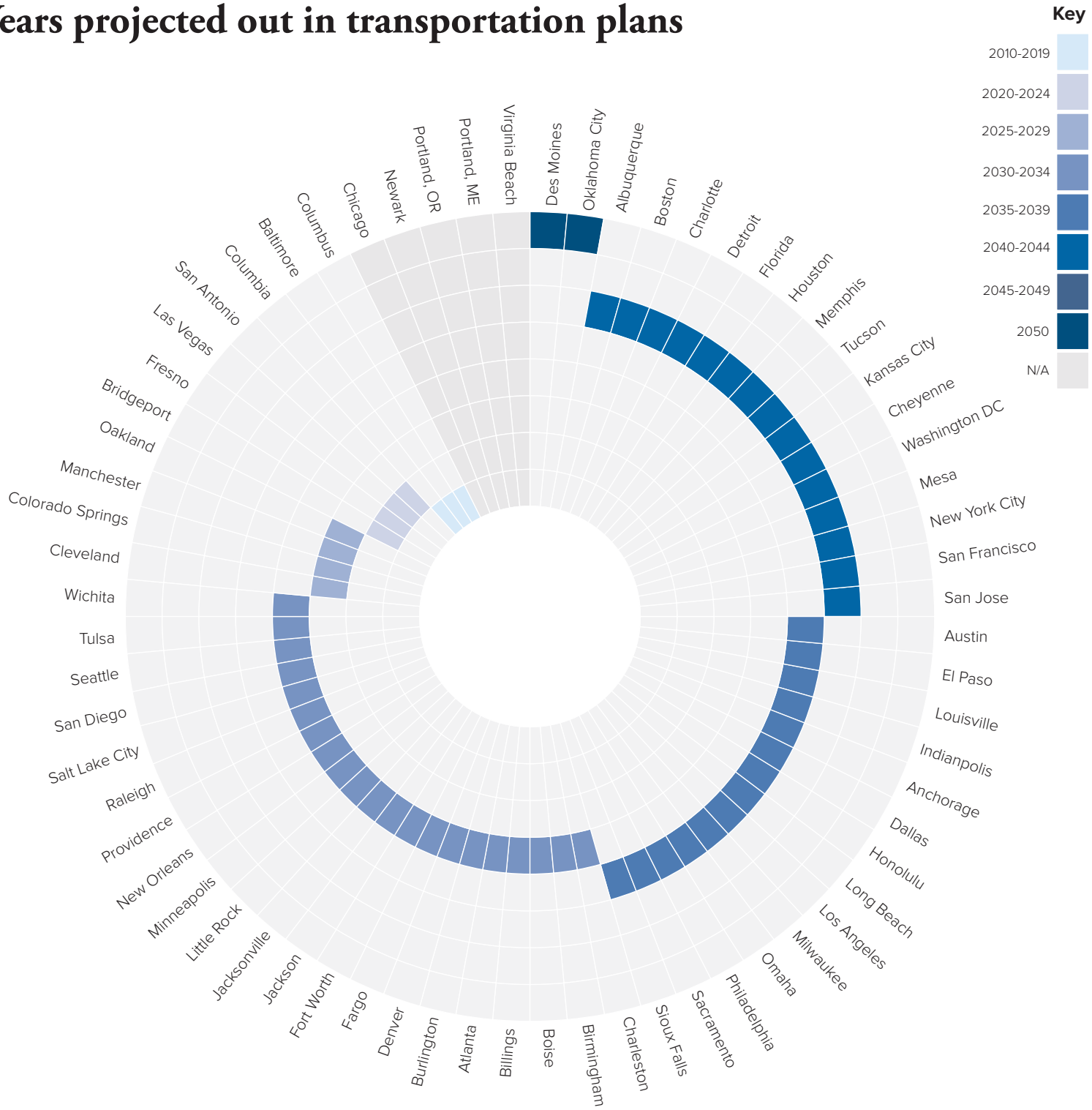
12% OF PLANS ARE CLEAR THAT NO NEW HIGHWAYS ARE UNDER CONSIDERATION

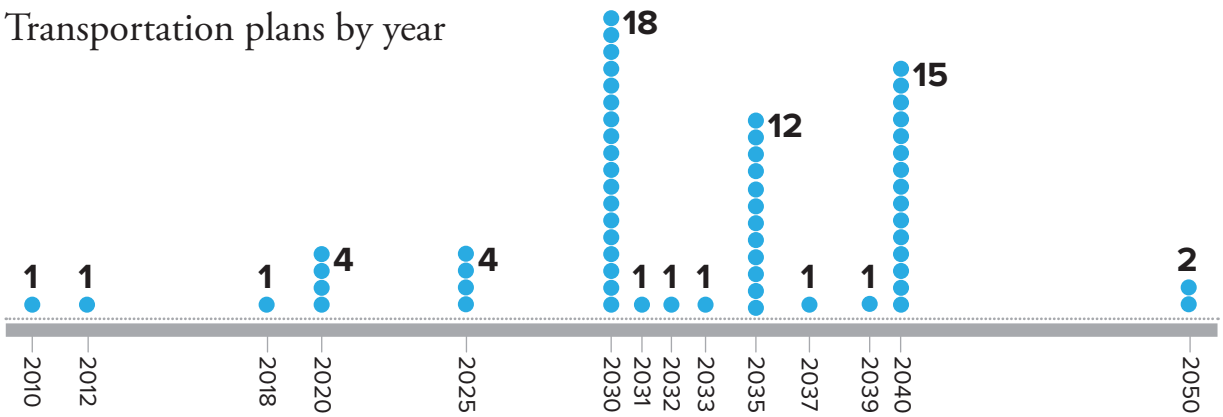
Each of these results points to its own significant trend, but their cumulative impact coupled with further advances in technology will continue to drive unprecedented and unpredictable changes in mobility. This report lays out two core scenarios focusing on the possible impacts of technology on mobility: one which centers around short-term predictions that may manifest themselves by the year 2020, and another which centers around long-term predictions that could be seen by the year 2030 or later. Within each of these scenarios we consider four key themes:

1. **Demographic and workforce trends**
2. **Infrastructure finance**
3. **The growth of public and private mobility systems**
4. **The availability of new modes of transportation**

The mobility environment is rapidly shifting, and technology serves as a critical agent of change. The lessons of the past teach us that, while we can anticipate change and make reasoned predictions as to where advances in technology may lead us, the future of mobility in cities is far from certain. We can guarantee, however, that this will be an interesting ride.

Years projected out in transportation plans

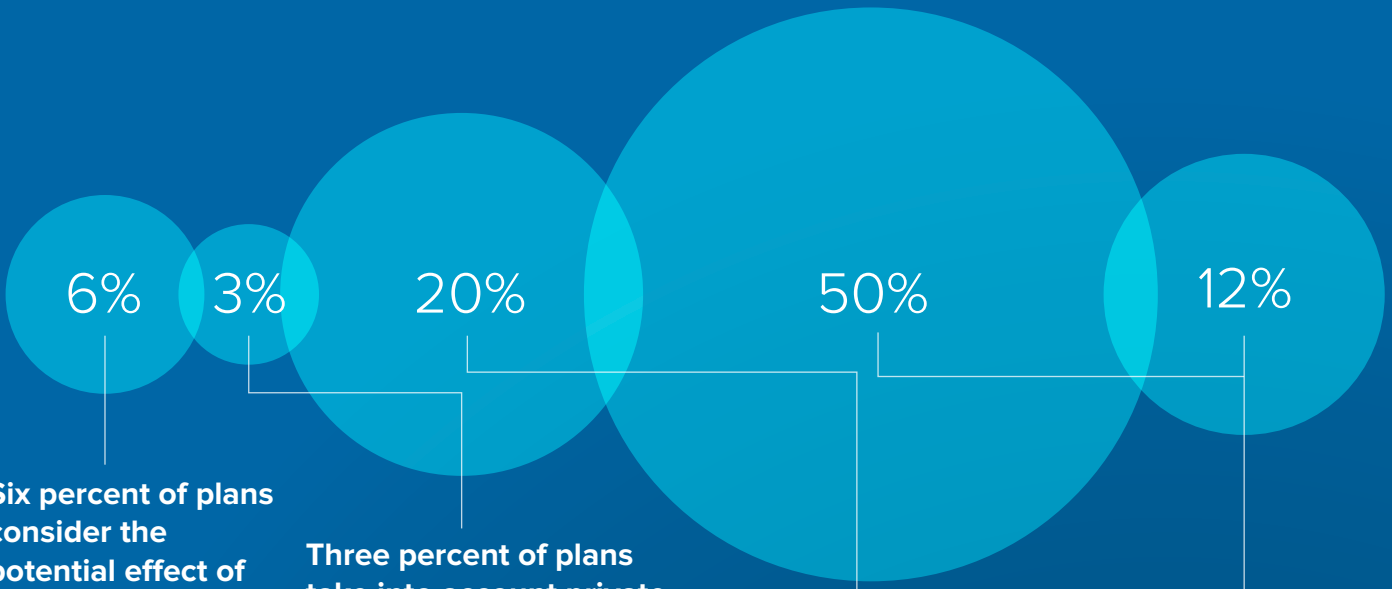




LONG RANGE TRANSPORTATION PLANS

This report draws from a variety of sources, including existing literature and interviews with elected leaders and private sector experts. Additionally, we conducted a content analysis of city and regional transportation planning documents from the 50 most populous U.S. cities, as well as the largest cities in every state – 69 communities (with one plan inaccessible) for a total of 68 plans. We found that 56 of these cities had municipal transportation plans while the remaining 13 only had transportation documents for the metropolitan region.

We have discovered widening gaps between innovation in the private sector, the expressed preferences of citizens, and the visions of city planners regarding transportation investment. Many transportation plans which project outcomes decades into the future focus almost exclusively on the problem of automobile congestion and prescribe increased infrastructure in the form of new roads as the primary cure. However experts and trends point to a future that will be increasingly multi-modal. Consider the following points:



Six percent of plans consider the potential effect of driverless technology.

California, Washington, D.C., Florida, Michigan, and Nevada have all passed legislation related to autonomous vehicles, and many more are considering bills.[1] However, the greatest threat to driverless cars are the other cars operated by humans. Cities will need to determine whether to create separate lanes or zones for driverless cars as well as what to do with acres of potentially unnecessary parking.

Three percent of plans take into account private transportation network companies (TNCs) such as Uber or Lyft, despite the fact that they operate in 60 of the 68 markets.

Many cities are dealing with the public safety concerns that surround TNC operators, but virtually none are thinking critically about the transportation implications. As TNCs grow in popularity and services like Bridj begin using buses to carry multiple passengers, these networks will be in direct competition with public transit agencies.[2]

Twenty percent of plans include road diets or other plans to reduce road capacity or long-term maintenance costs.

Some of the most successful highway-related economic development projects of the last 20 years have involved the removal of urban freeways, allowing cities to "remove crumbling infrastructure, open up land for redevelopment, [and] undo mistakes of the past when highways were allowed to carve up neighborhoods and urban centers."

percent of plans contain explicit recommendations for new highway construction, while 12 percent of plans are clear that no new highways are under consideration.

In some fast-growing areas, highway construction plans are certainly justified – but even cities that have flat or shrinking populations plan to expand their local highway system. This indicates that many cities have not yet realized the potential for new trends to reshape the way citizens travel.

INTRODUCTION

Cities are the defining political entity of this century. While cities have been centers of humanity throughout history, today we are witnessing a resurgence of cities, as populations increasingly move from rural and suburban areas into urban areas. Mobility is a critical component of humanity's growth in the urban environment, and technology is the tool that advances this growth. Technology and mobility are forever intertwined.

In working to conceptualize what will happen next in cities, it is imperative to imagine forthcoming changes that will impact the future of cities in ways that might currently be considered unimaginable. Our *City of the Future: Technology and Mobility* report is meant to help city leaders understand, imagine and plan for the coming changes in the urban environment that will affect how we all move from one place to another.

This report is a part of NLC's larger *City of the Future* initiative. This initiative seeks to highlight areas of focus that are current and recognizable, while also anticipating the game-changing trends that will define cities in the coming decades. Our initiative is focused on five factors that may have the greatest impact on cities, including technology, economics, climate, culture and demographics. By exploring these areas through a city-centric lens, NLC is able to provide cities with a usable resource that aligns directly with the long-term decision-making processes in which they are currently engaged.

Creating and sustaining a transportation network – a platform for commerce and human interaction – is one of the oldest and most important functions of government. However, as advancements in technology have occurred in concert with the development of new modes of transportation, this function has changed drastically. With current demographic shifts, generational preferences, wealth creation and other factors pointing toward the continued growth of cities, the importance of transportation and mobility is ever-growing.

CITIES ARE THE DEFINING POLITICAL ENTITY OF THIS CENTURY.

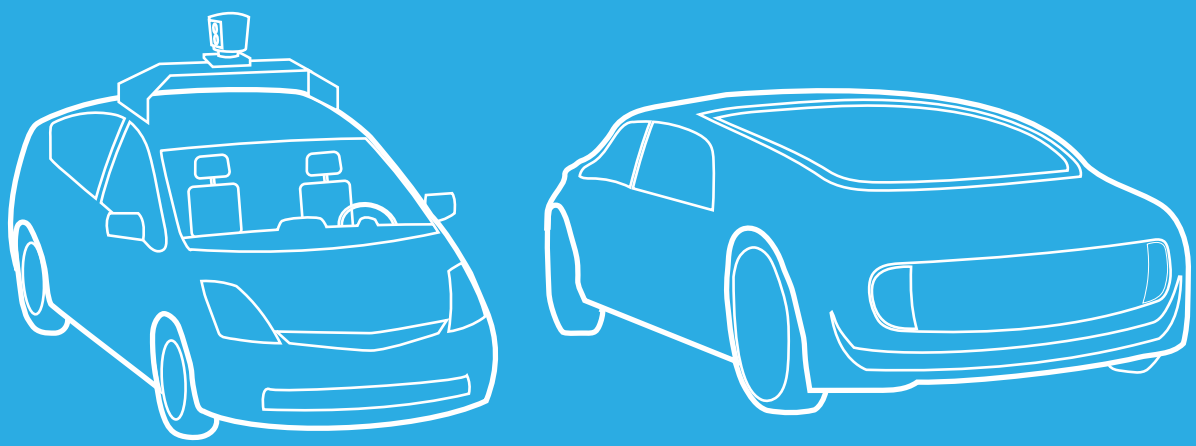
In short, we have gone from Deloreans to driverless cars in what seems like the blink of an eye.

People are driving less and getting driver's licenses at a lower rate as they seek out alternatives to traditional car ownership. Transit system usage is up, reaching the highest levels measured in 58 years, while cities are adding bicycle and pedestrian infrastructure at a rapid pace. Clearly, all of these trends point to a future where more people desire alternatives to the automobile.

Technology is leading cities to more dynamic transportation systems where people shift seamlessly between multiple modes depending on their needs. A typical day might see an individual take a bus or train to get to and from work, rent a shared car to run errands, hop on a bike to visit a friend, and even combine different modes of transportation in a single trip. The operative concepts in this scenario are availability of options and ease of use. The ultimate goal of cities must be to combine different transit modes into a coherent whole, so that moving from place to place is easy, equitable and enjoyable.

What future lies ahead, then? The disruption of traditional industries and economic development patterns will only continue to occur with greater frequency as we move forward, so thinking about and anticipating the future is an inherent part of success when it comes to city planning and economic development. The year 2030 may seem like a long time from now, but the technological advancements that will determine the future of mobility are already taking shape. Cities of all sizes have transportation plans that project at least this far into the future. It becomes evident upon an examination of the previous decades that a range of economic and social indicators provided the groundwork for where we are today.

In short, we have gone from Deloreans to driverless cars in what seems like the blink of an eye. The transportation landscape of the past is not obsolete, but it has changed considerably and will continue to evolve. The impacts of a radically changed environment are, at times, hard to comprehend – but again, we can look to the past to anticipate the future.



National League of Cities' *City of the Future: Mobility and Technology report* is about what's next, and what cities can do to move seamlessly and efficiently into the future of mobility. This report is organized around

1

DEMOGRAPHIC AND WORKFORCE TRENDS

With the coming generational shift in the workplace, the rise of contract labor, and the decrease of Vehicle-Miles Traveled (VMT) – all of which are coupled with continued population growth in cities – the mobility environment will greatly impact land-use decision making.

2

INFRASTRUCTURE FINANCE

Properly planning for infrastructure finance is key – and the financial landscape of the mobility environment is changing as VMT pilot programs successfully demonstrate paid road models, public-private partnerships continue to gain popularity, and state governments as well as the federal government look to the possibility of establishing infrastructure banks.

FOUR KEY THEMES

3

THE GROWTH OF PUBLIC AND PRIVATE MOBILITY SYSTEMS

The proliferation of modal and transit options available to citizens will positively impact cities. Bus lines are continually being optimized, public transit systems are becoming more and more seamless, and we may even see driverless bus transit within the next 10 years – a development that could have a tremendous positive impact on public safety in terms of the number of accidents involving buses. Transportation network companies will grow and shift as well, and the overall usability and availability of transportation options will replace the current scarcity of choice that plagues many U.S. cities today.

4

THE AVAILABILITY OF NEW MODES OF TRANSPORTATION

The rollout of new modes of transportation is one of the most exciting developments within the mobility and technology landscape. Driverless cars will soon start to share the roadways with traditional vehicles, and we may see a rapid expansion of autonomous transportation if fleet vehicles such as commercial trucks are the first area where driverless vehicle technology is widely deployed. Driverless public transit buses could join the world of autonomous transportation shortly thereafter. At the same time, electric cars are likely to replace hybrids as the eco-friendly transportation alternative to traditional gasoline engines, and electric assist technology will continue to make bicycle commuting more attractive and convenient for those that do not wish to use personal vehicles or public transport. Finally, futuristic mobility options ranging from folding cars and automotive pods to Elon Musk's Hyperloop transit system may impact cities in ways that are difficult to conceptualize at this point in time. One thing remains clear, however – the lessons of the past teach us that while we can anticipate change and make reasonable predictions about what may come next, the future of mobility is far from certain.

FORECAST 2020

Five years may not seem like a long time.

After all, most existing long-term transportation plans account for this time frame or longer, and most people can imagine the course of their lives between now and the year 2020. The basic transportation infrastructure of our cities will remain largely unaltered.

However, when we think about the rapid evolution of technology, five years is, comparatively, an eternity. Five years ago, the iPhone was not nearly as ubiquitous as it is today, and Uber was not a verb. Smart phones were only just starting to become a central component of everyday life, and app-based transportation models did not exist outside of major metropolitan areas. It is easy to forget that many of the transportation and technology norms we live by today are relatively recent – and it is difficult to imagine how new technology will change mobility.

Rapid technological advances coupled with demographic shifts have completely altered the nature of mobility in America's cities. Smartphones have enabled users to access transportation information and connect with providers instantaneously, and the increased access to this information is translating directly into consumer demand for the accommodation of many new and different transportation modes.

> **"The challenge is that we don't know what's coming but we know it's coming. We all have to learn to change on a dime."**
>
> - Councilwoman Pam O'Connor, Santa Monica, CA

There are metrics and policies that underscore this burgeoning sentiment: transit ridership on U.S. systems recently reached its highest level in 58 years, with 10.8 billion annual trips taken in 2014 and over 700 Complete Streets policies (and counting) that have been passed to date.[3] Likewise, demand for bicycle and pedestrian infrastructure is at an all-time high, and there have been several studies that document the value that this sort of development can bring to local economies.[4] [5] Individuals who are biking or walking tend to spend more money in local businesses than individuals in cars,[6] and bicycle infrastructure projects create more jobs than all other types of public works and road infrastructure projects.[7] Additionally, market projections predict that bikesharing will grow globally by 20 percent between now and 2020.[8]

Together, these developments have changed our assumptions and expectations around mobility. Transportation behaviors have been impacted by new technologies, and cities large and small are thinking differently about how people get from place to place. Most importantly, the single-occupancy automobile has transitioned from the centerpiece of America's transportation network to just one of many modes in a large menu of options. Drawing on existing trends, the following sections offer projections about the future of mobility and technology in America's cities over the next five years.

Demographic and Workforce Trends

More Baby Boomers will retire and Millennials will be the largest demographic in the workplace. The "baby boom generation" is commonly defined as comprised of individuals born in the U.S. between 1946 and 1964.[9] Until they all had children, they were the largest segment of the workforce. Today, they are nearing retirement and their children, known as Millennials,[10] are poised to take over that title. By 2020, all of the baby boomers will have reached pre-and early-retirement ages.[11] The pending retirement of this generation will significantly impact more than just the composition of the workplace.

Commuting choices, office locales and preferences surrounding when and how often employees work in a physical office space versus telecommuting all have a significant impact on the transportation network. As Millennials are eschewing cars and showing preferences for other modes of transportation like biking and walking, it is hard to imagine that they will suddenly feel the urge to purchase cars and start driving to work.[1213] This means that offices will need to be located in proximity to all of these transportation options, as well as to the metropolitan areas that this generation prefers in order to attract the best workers.[14] Because work impacts so many other aspects of life, including how people get around and where they spend the majority of their time, these major shifts in workplace composition and preference will undoubtedly have a subsequent impact on mobility behaviors and choices.

Traditional nine-to-five positions will increasingly be replaced by individual contract jobs, and the way that we occupy workspace will change. As the collaborative economy becomes more and more prevalent in cities large and small, the conceptualization of work is also changing significantly. Rather than working in one traditional nine-to-five position more people are working in the service economy and taking on several different contract opportunities at once. Furthermore, white-collar workforce trends toward office-sharing and telecommuting suggest that by 2020, fewer companies will feel the need to invest as much in physical office spaces. This move toward what is often referred to as the "1099 economy" increases the need for shared and temporary space. All of this will alter travel and commuting patterns as a significant proportion of the traveling that people do today is to and from their places of employment. It is likely that there will begin to be a greater distribution of demand away from rush hours, which should alter traffic patterns and have a significant impact on schedules for transit agencies nationwide.

Vehicle miles traveled (VMT) will continue to decrease. Vehicle-miles-traveled (VMT) in the United States have been steadily declining since mid-2005. This trend has been attributed to a number of factors, including the economic downturn of the Great Recession, the increasing popularity of compact, urban living, and the younger generations' disinterest in cars. According to a report released by U.S. PIRG and Frontier Group, people ages 16-34 drove 23 percent fewer miles on average in 2009 than in 2001.[15] In that same age group, only 67 percent of Americans [16] have driver's licenses. According to the 2009 National Travel Survey, one in 12 U.S. households is car-free.[17]

When adjusted for population growth, VMT is down 7.29 percent.[18] We drive significantly less as a nation than we did 10 years ago, and that number is only likely to decline more. As more working adults choose to live in high-density and walkable areas where driving is not a necessity, and more modal options enter the transportation marketplace, single-occupancy vehicles will become less central to the American dream. While this fares well for environmental and congestion prospects, less dependence on vehicles will also result in less gas tax revenue for an already struggling Highway Trust Fund. The next five years will yield less traffic congestion, but perpetuate the dire need for a paradigm shift in terms of how we think of and invest in transportation.

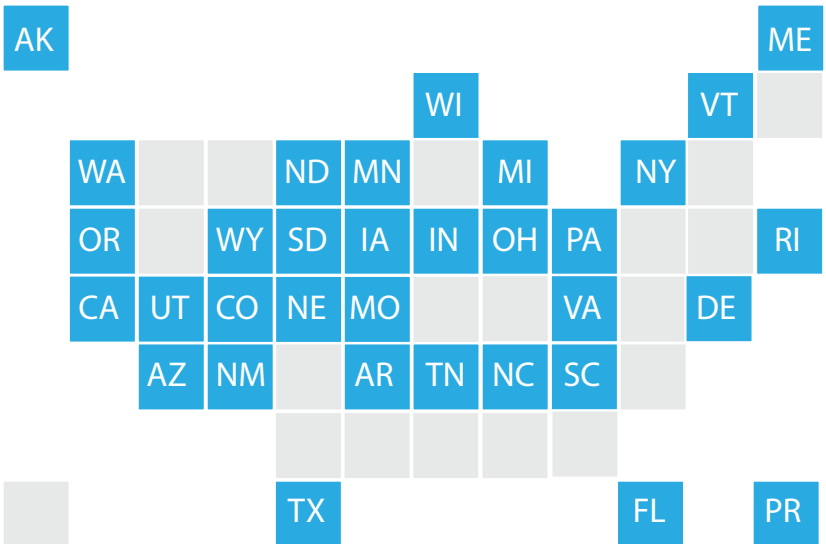
Infrastructure Finance

VMT pilot programs will successfully demonstrate the plausibility of paid road models. Given the insolvency of the nation's Highway Trust Fund, policy makers are looking to alternate methods of paying for transportation infrastructure. VMT fees, also called mileage-based-user fees, are gaining traction as a plausible mechanism to replace the struggling gas tax. Beginning in July of 2015, the state of Oregon began a pilot VMT fee program for 5,000 volunteers. This pilot is known as OreGO, and will test different methods of collection. Five years from now there will be a complete story and dataset related to this method of payment, and given the perpetually depleted nature of the Highway Trust Fund, many more states will feel pressure to consider this model. Several states – Washington, Nevada, Minnesota, and California – and university transportation centers have already initiated research and the development of policy and operational frameworks for these programs. In the year 2020 the idea of paying for road usage will be more readily accepted.

More states will establish infrastructure banks. Within the last decade, state infrastructure banks have gained support and popularity. More than half of the states in the U.S. have created state infrastructure banks, referred to as "I-banks" for short.[19] These typically consist of revolving investment funds that can provide fiscal support to different types of infrastructure projects within the state.[20] While state I-banks set aside dedicated funds for infrastructure needs, they tend to favor highway projects over other types of infrastructure.[21] The increasing needs and poor condition of our cities' roads and bridges in combination with dwindling funds and support from the federal level will forces states to set aside funds for these projects.

Because state DOTs have traditionally controlled a larger proportion of transportation dollars, these funds are typically established at the state level. Currently, 32 states and Puerto Rico have established some variation of a state I-bank, and some states that do not have them, such as Connecticut and Maryland are considering them.[22] The grant funds and low interest loans offered through these banks can do a great deal to help cities meet their infrastructure needs. While each state operates its fund a bit differently, many make a concerted effort to foster relationships with local government and partners, and base their selection of projects on regional and local economic impact analyses. By 2020, it is safe to assume that up to 40 states will have infrastructure banks. [23]

Currently, 32 states and Puerto Rico have established some variation of a state infrastructure bank.



Public-private-partnerships will become commonplace for mobility projects. Public-private partnerships (P3) constitute contractual arrangements between public agencies (federal, state or local) and private sector entities, with the overall objective of delivering a service or facility for the general public. In addition to the sharing of resources, each party shares in the risks and rewards potential in the delivery of the service and/or facility.[24] Because public dollars for transportation projects are declining, cities are turning to private and NGO partners for help with funding public works projects.

These arrangements have been most successful overseas, but they are starting to be implemented in the United States as well. The City of Chicago has successfully implemented several P3s to improve its transportation network. Beginning in 2003, the city coordinated a partnership called the Chicago Regional Environmental and Transportation Efficiency (CREATE) program. This arrangement between the U.S. Department of Transportation, the City of Chicago Department of Transportation, the Illinois Department of Transportation, Metra, Amtrak and six private freight railroads aims to address necessary infrastructure improvements, increase Chicago's freight and passenger rail capacity and ease congestion throughout the region's transportation network.[25] The city also leased its parking garage and meter systems out to private partners, and in doing so was able to pay off some of the debt acquired in building Chicago's famous Millennium Park.[26] Because they are becoming more politically palatable, U.S. cities will begin working with the private sector to jointly fund their transportation projects. There will be an uptick in the application of P3 arrangements for toll roads, parking structures, and other major infrastructure assets that fall outside the traditional purview of city management.

The Growth of Public and Private Mobility Systems

There will be more modal and transit options available to citizens. Cities across the country are feeling the seismic shift in mobility trends and developing their long term plans in ways that accommodate it. It is planning for new rail lines, streetcar systems and bike infrastructure, all while adjusting to new actors in the transportation space. Many cities are embarking on building new transit options, with bus-rapid- transit (BRT), streetcar and bikeshare systems gaining momentum and support. Currently there are more than twenty BRT lines and projects in various stages of the planning and funding process that will likely be in service within the next five years. There are also 13 streetcar lines planned that will be either well underway

> **"When I first entered this line of work, transit was seen as a large city, big metro phenomenon that you really didn't expect to have in a reliable way in a mid-size or rural area. I think what we see today is that people in communities of all sizes are looking for a range of options that can serve as alternatives to their own personally owned automobile or similar vehicle. People are looking for transit in small cities, they are looking for Complete Streets-type networks that make it possible to walk or bicycle in small cities, people are interested in shared mobility solutions."**
>
> -Chris Zeilinger, Community Transportation Association of America

Houston Metro's Better Bus Service

In 2014, Houston Metro decided that an overhaul of its bus system was long overdue. Many of the bus service's routes had not been changed since 1980, and the city of Houston has changed significantly since then. The goal of the optimization process was to revise the routes from a wide service footprint to more efficiently meeting the high ridership demands in denser transit corridors. This means that some routes were cut in order to meet the demand in high ridership areas more efficiently and reliably. By abandoning the hub-and-spoke system and eliminating infrequently used routes, Houston Metro was able to better meet the need of riders at no cost to taxpayers. [30]

or finished in this time frame.[27] These new types of transit systems will be accompanied by significantly more bike and pedestrian infrastructure. Currently 49 American cities are building or planning new bikeshare systems that will be complete and operational by 2020.

Bus lines will be optimized to provide an improved transit experience that meets growing ridership demands. With fewer dollars for transit projects and no long-term funding bill on the horizon, cities will be forced to better utilize existing assets. One way that they will do that is by reconfiguring their existing bus routes to accommodate growing transit demand in dense corridors. While many city bus routes are designed to encompass maximum land mass, migration to metropolitan areas has resulted in denser, more transit-dependent corridors with more transit dependent populations. Transit demand has spiked in downtown corridors, and transportation planners will be pressed to plan accordingly without any additional money to build out capacity. The city of Houston, TX, optimized its bus system in 2014, improving frequency and capacity in high-ridership areas.[28] [29] As cities struggle to improve service with fewer and fewer resources, they will turn to similar strategies in an attempt to do more with less.

Transportation access will be made seamless with the use of apps and the integration of fare payment systems. The way we access information about and use transit will change dramatically by 2020. There is a new demand for seamlessness in travel. For this reason, cities are starting to think regionally about transportation, and integrating their payment systems to allow riders to have one card that can be used to access all of a region's varying transportation systems. This is already a reality in the San Francisco and Seattle regions where the Clipper Card[1] and the ORCA Card, [2]respectively, allow riders to access the majority of the transportation systems in the metropolitan area. [33] [34]

In 2020, these types of fare payment systems will be more widespread. This shift will be reflective of a drastic change in peoples' preferences for taking in information. People want to know all of their options, immediately, without putting a lot of time and effort forth.

Currently there are many apps in the marketplace that help riders access information about their travel options. A handful of those are consistently reliable, and some are integrating with other non-transit options in an attempt to offer complete trip information.[35] Products like Waze and RideScout have initiated the trend toward consolidating transportation and wayfinding information. While transit has been slow to pick up

Big Innovations for the Big Blue Bus

The city of Santa Monica has big plans for the Expo Line of its Big Blue Bus (BBB). A recent proposal includes a pilot on-demand late night and weekend service that will connect riders to and from the 17th Street/Santa Monica College Station Expo light rail station. BBB seeks to work with multiple transportation vendors to operate concurrent service under its "Blue at Night" program. Similar to Uber or Bridj, the customer uses a phone or app to make a real-time reservation with a transportation service provider for a ride to or from the Expo rail station. The service would cost the customer $3.00 per ride and it will be available from 8 p.m. to 3:15 a.m. Friday and Saturday nights. Financially, the program will operate similar to a "transportation voucher" program, whereby the passenger pays a flat rate for the trip, and Big Blue Bus will pay the balance of the cost through billing from the service provider. The service costs $3.00 per ride and it will be available from 8 p.m. to 3:15 a.m. This innovative use of existing bus infrastructure will offer improved service and more seamless first and last mile connections for the residents of Santa Monica.[38]

on the trend of on-demand service and app integration, the quick rise of transportation network companies (TNCs) has rapidly changed the expectations we have for mobility services. Transit agencies around the country are beginning to integrate these technologies into their operations.[36] In the future, data will be streamlined for riders and payment methods will be integrated to make multimodal transportation more user-friendly.

Transportation Network Companies (TNCs) will be mainstream modes of personal and freight transportation in cities of all sizes, all over the world, and their business models will expand to freight and other services. Over the course of five years, Uber has spread to 58 countries and nearly 300 cities worldwide and the company gives over one million rides a day.[39] Lyft is expanding in the U.S. and growing globally as well through international partnerships.[40] These rapid expansions have changed ridesharing from a unique and privileged service at the periphery of the menu of transportation options to a mainstream means of getting from one place to the next that is fiscally and geographically accessible to all. So much so that cities are beginning to regard TNCs as significant parts of their transportation networks. By 2020, we can assume that there will have been shifts in the way transit systems and other transportation providers work with TNCs and that issues of accessibility for people with disabilities and worker rights within these companies will be further resolved. TNCs fleets will also provide not only mobility services, but delivery and freight, and they will be considering the use of autonomous vehicles for these purposes. Bridj, an on-demand bus system that currently operates in Washington, D.C., and Boston, MA, will expand their operations to larger service areas and more cities, and public transportation will begin to use similar on-demand models.

INTERNATIONAL SPOTLIGHT

City of Helsinki, Finland, Mobility on Demand Project

In July 2014, the City of Helsinki, Finland, acting through the Helsinki Region Transport Authority (HRT), embraced a vision of mobility on demand integrated across all forms of public and shared transit with a single payment system by 2025.

The intent is to provide riders with a mix of mobility options so cheap, flexible, and well-coordinated that it becomes competitive with private car ownership not merely in terms of cost, but also on accessibility and ease of use. Users would specify origin and destination points, and perhaps a few preferences. The smartphone app would then function as both journey planner and universal payment platform, knitting everything from driverless cars and micro-buses to shared bikes and ferries into a comprehensive and nuanced system of mobility. Significantly, a major focus for the initiative is on creating simple, smooth and speedy transfers between each transportation mode and node.

An example that leads in this direction is the city's Kutsuplus (Finnish for "call plus"), a fee-for-service mini-bus option from the HRT.[37] Kutsuplus lets riders specify their own desired pick-up points and destinations via smartphone; these requests are aggregated, and the app calculates an optimal route that most closely satisfies all of them. Costs are greater than those of a typical city bus but less than an expensive taxi service. The goal is to create an on-ramp for increasing public transit use, and head toward greater multi-modal transit integration.

The Availability of New Modes of Transportation

Driverless cars will exist in the consumer marketplace. What started out as excitement over Google's self-driving car experiments in the Google X lab catalyzed into a full-fledged automobile trend that will likely be right around the corner for consumers. Today, seven companies have announced that their respective autonomous models will be ready for market by 2020.[41] Tesla's recent software update turned the Model S into a Level 2 autonomous vehicle through its new autopilot function.[42] Currently, connected vehicle standards require seamless communications and interoperability capabilities between vehicles, with the vision of one day enabling a complex, multi-modal connected transportation network in which autonomous vehicles can communicate with each other and the surrounding infrastructure. [43]

By 2020, fully autonomous cars should be available and wealthy consumers will have the ability to purchase these vehicles for their personal and everyday use. We will also see companies in the transportation and freight industries considering the opportunity to purchase these vehicles as part of service fleets. This will mark the beginning of driverless fleet trends in the public and private sectors.

Electric cars will replace hybrids as the eco-friendly transportation alternative. Electric cars have become a much more viable transportation option in the last few years, with almost every major automaker releasing an electric or hybrid model.[45] Today there are a multitude of electric car options on the market, and most importantly, they are affordable, with most models ranging between $25-35,000. Tesla excited the masses with the delivery of its Model S in 2012 and the Model X in 2014. These cars are both at relatively high price points: $70,000 and $80,000, respectively. In 2016, Tesla will unveil and begin taking orders for a new, affordable electric vehicle, the Model 3. This car will have a base price of $35,000, and deliveries of the new vehicle are scheduled to start in 2017. The affordability of these vehicles will make them much more accessible to the general public, and it will also prompt investment in more electric charging infrastructure around the country. The diffusion of these new technologies should be relatively mainstream by the year 2020.[46]

VIEWPOINTS ON THE FUTURE:
Gabe Klein

"The incentives are all aligned--dense urban living, low energy usage, desires for a low carbon footprint—these are all good in every possible way including for business."

Gabe Klein has worked his entire career in the transportation business, switching between the private and public sectors. He headed both Chicago and Washington, D.C.'s Transportation Departments, and prior to that worked for several private sector companies, including Zipcar. He now works as a Special Venture Partner at a venture capital firm that funds next generation mobility companies and also advises a cadre of startups. His unique experiences in different sectors have led him to see the immense value in both public and private contributions, and even more so in cross-sector partnership. Klein has seen a change in the way cities think about land-use, public space and transportation, and also in the way they partner with businesses and NGOs to improve the quality of life of their residents. "Local governments are competing to be the most progressive, the most innovative, to lure the most Millennials and to be at the forefront of the new American 21st century city."

Cities have begun pushing the envelope more not only in terms of transportation planning but also implementation. Finally, the levers of government are being used more effectively in partnerships with the private sector and the two entities are leveraging each other's strengths. These partnerships have helped with financing, as cities can now utilize not only federal money but both private and philanthropic dollars.

"There is a great deal of innovation coming out of the private sector and government has started embracing it and applying it in ways that meets civic needs and goals."

The time is past due to rebuild existing infrastructure, and we all realize that it must be rebuilt in a much more resilient way. The price tag is mind numbing, but it is critical to the vibrancy of our cities. Today's modern mayors get the connection between land use, transportation, housing and employment. Long range plans are more coordinated, but harder to implement given the outdated and shabby state of many of our cities' infrastructure. Cities will need to rely on outside partners and embrace innovation if they want to remain at the cutting edge.

Mr. Klein notes that "there is a great deal of innovation coming out of the private sector and government has started embracing it and applying it in ways that meets civic needs and goals." He imagined a scenario in which city governments could provide the framework for the changes they want to see, ensuring service equity, job creation, safety and let the private sector fulfill the service role.

THE 5 LEVELS OF AUTONOMY

The National Highway Traffic Safety Administration outlines five levels of vehicle automation, from Level 0 (No Automation) to Level 4 (Full Self-Driving Automation). The levels are distinguished by how active the driver must be in controlling the vehicle and monitoring the roadway during operation.

LEVEL 0

No Automation. The driver is in control of all aspects of the vehicle's primary functions at all times. A vehicle at this level may have features that warn the driver of a potential collision or lane departure (if those features cannot also control speed, braking, or steering), or automated secondary systems such as headlines or turn signals.

LEVEL 1

Function-Specific Automation. The driver is still in full control of the vehicle, but may use automated features that can affect control speed, braking, or steering to assist with specific functions. Many drivers are already familiar with this level of automation, which includes features such as cruise control, automatic braking and lane keeping systems. At this level, these features may allow the driver to take his or hands off the wheel or foot off the pedal, but not both at the same time.

LEVEL 2

Combined Function Automation. An increasing level of automation allows the driver to be physically disengaged at some points — for instance, the driver may be able to take his or hands off the wheel and foot off the pedal at the same time due to a combination of cruise control and lane keeping. However, the driver must still actively monitor the vehicle and be ready to take control at any time.

LEVEL 3

Limited Self-Driving Automation. The driver is no longer expected to be constantly monitoring the roadway. The vehicle can take over all critical safety functions under certain conditions, and is able to signal to the driver if there is an upcoming obstacle or change in conditions that requires the driver to retake control.

LEVEL 4

Full Self-Driving Automation. The driver no longer has any responsibility for safe operation of the vehicle, and is not expected to monitor road conditions or take control at any point during the trip (other than specifying the destination). At this level of automation, the vehicle does not need even need a human driver to be present, and can operate unoccupied.[44]

FORECAST 2030 AND BEYOND

While our forecast for the year 2020 demonstrates that most of the mobility infrastructure in American cities will remain largely unaltered five years from now, usage will undoubtedly continue to change.

Increases in the number of citizens using bicycling, car sharing, TNC and public transit modes will begin to coalesce into a multi-modal system that functions in a much more fluid manner than does our current system. Looking ahead to 2030 and beyond, the rate of change in technology will compound to reveal more exciting and unpredictable developments. New trends in innovation, demographics, infrastructure investment and land use will alter the manner in which billions of people travel throughout communities of all sizes.

Today, many cities are just beginning to fund and construct fixed guideway transit lines, optimize bus and rapid transit systems, or pilot protected bike lane programs. However, functional mobility requires broader connectivity and a more cohesive network in order to be usable. By the year 2030, these networks will likely be more firmly established, and connectivity should improve considerably. Additional transit lines and corridors will link housing, job centers, universities and other amenities to a degree not seen today. Cityscapes will change drastically in response to these connections. The greatest determining factor in the success or failure of these public transit investments in cities will not be the lines themselves, but the land use decisions that complement them.

> **"If we try to think of it from a performance point of view and tie metrics back into civic goals, that means we have to ask different questions. What does it mean for my city to do the best possible job of being my city?"**
>
> -Chris Zeilinger, Community Transportation Association of America

Of course, one of the most transformative, exciting, and potentially disruptive technologies almost certain to be deployed by 2030 will be the driverless vehicle. Current projections indicate that level 4, fully autonomous models will be available to consumers by 2025.[47] As they come online, cities of all sizes should actively consider that driverless technology will not only challenge their transportation policy, but their existing zoning, land use and regulatory frameworks as well.

Demographic and Workforce Trends

Major urban areas will continue to grow. Over the next fifteen years, the United States population will grow by roughly 40 million people, from a current estimated population of 321 million[48] to 361 million. [49] Nationwide, this will amount to 13 percent population growth, but nearly all of this growth will occur within urbanized areas. Of the top 100 most populous urban areas in 2015, 73 are projected to grow more rapidly than the nation as a whole, and 32 are projected to grow by more than 20 percent by 2030.[50]

The repopulation and revitalization of urban centers has already begun to spread beyond cities like New York, San Francisco and Washington. There has been dramatic growth in cities that includes Knoxville, San Antonio, Raleigh and many others – these trends are expected to continue and diffuse to other cities across the country. How might these communities grow and accommodate their new residents? As a matter of practical necessity, city leaders will be pressed to provide a wide range of mobility options that can utilize road space more efficiently and mitigate congestion.

Baby boomers will retire and younger generations will dominate the workforce. In just 15 years, Millennials will be between 35-50 years of age, and will be the dominant segment of the workforce. This means there will be a significant shift in terms of workplace norms and travel preferences. Even if their preference for walkable, mixed use, urban neighborhoods wanes a bit over time, they will still prefer alternative transportation in vastly greater numbers than previous generations. By this time, they will be much more able to express these preferences with their wallets.

Commuting patterns will change, and the rush hour will be dispersed over longer time periods. As more people live in cities and fewer baby boomers remain in the workplace, commuting patterns of metro areas will change drastically. The mass retirement of baby boomers will significantly reduce the number of cars on the road, as this demographic constitutes a significant proportion of commuters who travel via single-occupancy vehicles. This decrease will be offset somewhat though, as the nation's cities see the immigrant population increase. Unlike native-born Americans, however immigrants are more apt to use alternative modes to get to work – such as biking, walking, using public transit and carpooling.[51]

In addition to shifting demographics, changes in the way people work, with more people working remotely will remove additional people from the roads. While the net outcome will still be fewer cars on the road and less congestion, the shift in commuting norms as well as new transportation modes and traffic management technologies coming on line will call for significant modifications in mobility infrastructure. We will need more carpool and HOV lanes, and there will be more networked mobility options as well as more public transit.

Infrastructure Finance

A national infrastructure bank and other public/private financing options will change the way transportation projects are evaluated. Many have hailed the promise of a national infrastructure bank or other public/private partnership models for their potential to enable private sector investment in infrastructure. Nearly every time the national transportation legislation is discussed observers cite the "billions of private dollars sitting on the sidelines"[2] while worthy projects go unfunded, and jobs go uncreated. [53] If the potential truly exists in the next several years to tap into private funding sources, it will come with private sector expectations for real economic return and reliable cash flow.

Park(ing) Day

In cities around the country, the 3rd Friday of September is Park(ing) Day. Groups of designers and other citizens organize to occupy a metered parking spaces and transform them into temporary pop-up parks, challenging people to re-imagine 80 square feet of roadway as something else. Self-driving technology could allow cities to redevelop at least 50 percent of their current street parking permanently, reclaiming space for sidewalks and dramatically expanding the public realm.

Today, nearly all transportation infrastructure is paid for by some combination of federal, state and local government dollars. Transportation projects, therefore, are given broad leeway to include indirect, public goods such as 'travel time saved' as a benefit in their project justifications. If a new project can slightly ease congestion or shorten a route, seconds saved by individuals are compounded by thousands of commuters a day over several years. Once proponents monetize these time savings it appears that nearly any new bridge or bypass will be an economic boon, but these benefits may never result in actual revenue.

The Growth of Public and Private Mobility Systems

Public transit will begin to go driverless. Although it is relatively easy to envision a small fleet of driverless cars that are always on call, mingling with traditional traffic, the potential of autonomous vehicle technology in cities will be transformative across all modes. Already, cities in Switzerland, Greece and the Netherlands are testing driverless shuttles. Most impressively, a company in China has been testing a self-driving bus along a 20 mile route in regular traffic at speeds up to 40 mph.[54] By 2030, commuters in many cities will be able to board a driverless, electric bus and travel along a route that has been recently optimized. The experience of bus transit will vastly improve, attracting additional riders and reducing operating costs.

Cities will see a reduction in single occupancy vehicles, enabling cities to redevelop more densely, or to sprawl further. By now, it should be clear how many mobility trends will support and even accelerate the current declines in auto-ownership. This is not to say people won't still own and drive cars – even in 2030 a majority of Americans will. However, even small reductions in single-occupancy vehicle use can have dramatic effects. In many U.S. cities more than 40 percent of all land is occupied by roads or parking.[55] Additionally, Norman Garrick at the University of Connecticut has found that "for each person, a car takes up 10 times more space than a bike, 15 times more than a train, and 30 times more than a pedestrian," This suggests that, nationwide, a decline in auto ownership could free vast land currently devoted to parking space for redevelopment into more productive uses.

Removing parking and redeveloping cities in a way that enables higher density is only one potential path cities could take. By traveling more closely together and improving the flow of traffic, driverless technology will also enable commuters to cover greater distances with greater comfort and reliability. Instead of continuing to flock to cities, many Americans may wish to move even further into the exurbs for cheaper land. In the end, these two options are not exclusive of one another and both will likely occur in metropolitan areas throughout the country.

Public and private companies will coordinate to create more comprehensive mobility systems in cities. Transportation network companies and app-based mobility services have become very popular in recent years, and we can only assume that technology will continue to revolutionize the way we think about transportation. Cities should embrace new actors in the transportation marketplace and figure out context sensitive solutions to make them work with existing providers. Incorporating these companies into a menu of mobility options can change the way we plan for transit station siting and other types of community development. As companies like Uber, Lyft, and Bridj become more mainstream, they will aim to work with traditional, public sector mobility services such as public transit agencies and city managed bikeshare systems to integrate service, streamline payment methods and coordinate first and last mile trips.[56] This will result in a more equitable and comprehensive mobility system that serves the travel needs of everyone in cities, in different neighborhoods and with different travel needs. These new types of complementary public/private mobility arrangements will also maximize use of existing infrastructure in getting people from Point A to Point B.

The Availability of New Modes of Transportation

Driverless technology will initially be deployed in fleet vehicles and buses. Driverless cars will likely be "widely" introduced (first) in larger urban areas by private firms operating multi-vehicle fleets. Whether it is in car for hire services such as Uber, buses from a platform like Bridj, or a new player in the mobility industry such as Google, fully autonomous technology will be deployed by companies that can operate on-demand vehicles that operate more-or-less constantly. Rather than patrolling high traffic areas for passengers, these cars can work together to distribute themselves efficiently throughout a city and loiter in less congested areas when they are not in use. Such a network has the potential to almost eliminate the need for on-street parking, and would significantly reduce the need for off-street parking.

One recent report conducted by the International Transport Forum at the OECD used actual travel data to simulate the operation of such a taxi fleet in Lisbon, Portugal.[57] In a city of roughly half a million and a greater metro area of 2.8 million, the model suggested that fewer than 26,000 'taxibots' would be needed compared to 203,000 cars today, just 13 percent. Reversing auto-oriented sprawl and redeveloping our cities to accommodate fewer cars is already becoming a top priority for cities and self-driving technology will enable this to continue.

Driverless technology will be disruptive in smaller cities as well. Fully autonomous vehicles will be deployed first in major cities, but by 2030 they will likely be more ubiquitous with everyday life. Outside of major metropolitan areas, the adoption of driverless cars will be determined largely by the private sector, requiring local leaders to anticipate and adapt as the sole means of transportation for their citizens and a significant portion of their local economy changes in the span of a few years. As we have already noted, driverless technology will work best in fleets and networks. As soon as driverless vehicles begin to hit the road, smaller communities will immediately notice two changes: a dramatically different trucking industry and declining revenues from traffic-related fines.

With the potential to drive 24-7 and dramatically reduce accident risk, the trucking industry will be among the first to rapidly deploy self-driving technology. Even before trucking becomes fully automated, single truck drivers will have the ability to lead caravans of trucks that are remotely linked to a lead driver for long-haul trips. Eventually, this will threaten the jobs of millions of professional truck drivers (between 2 and 3.5

million, depending on the source).[58] The change will ripple through countless small towns with cottage service industries that rely heavily on the middle-class incomes that truck drivers receive today.[59]

In addition, if driverless technology makes it easier and safer to commute it will also reduce speeding and other common traffic violations. For most cities, fines account for about 5 percent of city revenues, but in some communities they can be more than 30 percent.[60] It is not uncommon for smaller communities to rely on traffic fines to subsidize other governmental services, and these new advances have the potential to disrupt that.

Electric assist technology will make bike commuting more attractive. Transportation media outlets are quick to trumpet the recent boom in bike commuting. While it is estimated that biking as a primary means of transportation is up more than 60 percent since 2006, it is also true that this still represents just 1 percent of all commuters. Even in cities like Portland, Minneapolis and Washington, D.C. where bikers are seemingly 'everywhere,' the proportion only hovers around 5 percent.

There are two critical factors that limit the growth of bike commuting in the U.S.: a lack of safety and the physical effort required. Cities that provide safe, dedicated space for bikes are rapidly removing the first barrier, demonstrating that perhaps 10 – 15 percent of all commuters would actually prefer to bike as long as they do not feel physically threatened. In addition to the basic safety of painted bike lanes, it also appears that there is safety in numbers. As more people bike they tend to cluster along the best routes, and drivers are conditioned to look out for cyclists.

In the next decade, private companies offering e-bikes or electric-assist technology will dramatically reduce the second barrier and boost the appeal of bike commuting to a whole new set of riders. First, a new type of electric assist technology, the Copenhagen Wheel, involves a simple wheel attachment that can fit on most regular bikes. The device was developed at MIT and formed into start-up company, Super-pedestrian, and promises to flatten hills and shorten distances all while you ride normally. A small red disc in the center of the wheel contains an internal motor, battery, sensors, and wireless connection. Finally, electric assist bikes are particularly well suited for municipal bike sharing services. More and more cities are installing networks of bike-share stations already and both the size of the bike as well as the docking station infrastructure are ideal for electrification.

High-speed rail systems will be constructed in the east and west coast travel corridors. Currently there is a high-speed rail system under construction in the state of California that will connect the cities of Los Angeles and San Francisco, and many other major cities in the Bay Area, Central Valley and Southern California regions.[61] Phase 1 of the new rail system is scheduled to be completed by 2029, and we can assume that planning for Phase 2 of the system will be well underway by 2030. There has also been a proposal released by Amtrak for a high speed rail line in the the Northeast Corridor of the U.S. that would upgrade and replace the current Acela rail system with high-speed rail stock. This proposed line will eventually connect Washington, D.C. to Boston, and construction on the segment between New York City and Washington, D.C. will be completed by 2030. The remaining segment between New York City and Boston will see completion by 2040. [62] [63]

Several new travel modes and transit options will become more mainstream. Entrepreneurs are significantly impacting the transportation marketplace in part because they are acknowledging the changing

VIEWPOINTS ON THE FUTURE:
Peter Torrellas

"Unfortunately, planning actually hasn't changed much in the last 20-30 years."

Peter Torrellas has been working at the intersection of infrastructure and technology for almost twenty years. Today, he believes there are several critical limitations in municipal transportation planning, and in many ways these limitations are worsening. "The window of opportunity to solve problems is moving faster than the planning process. Planning, capital allocation, politics, even innovations like TIGER with the notion of 'shovel-ready projects,' are all built for a different time."

So far, these limitations haven't been too problematic. For all of the media buzz surrounding cities and the 'disruption' caused by transportation innovations, most people in most cities still only commute via car. But the true disruption may be right around the corner. "We're going to have autonomous vehicles in 10-15 years. It isn't a question."

While denser cities like San Francisco, Chicago, Washington and New York will likely continue their trends toward multi-modalism, on-demand fleets of autonomous vehicles could be much more significant for the rest of the nation. Making trips to the store for bulk purchases, getting children to events or enabling seniors to live independently can all be accomplished without actually owning multiple personal vehicles.

> **"The window of opportunity to solve problems is moving faster than the planning process."**

Mr. Torrellas notes that "In the last 10 years, independent app developers taking advantage of public data was obvious and inevitable, but the next big thing will be centered around the automation and digitization of these systems." Taking this step would be much more efficient and would remove significant amounts of traffic during peak hours. Particularly for freight and delivery services, "Data centers will begin optimizing and directing the whole transportation network. Algorithms make 60-70 percent of the trades on Wall St. and the same trend is happening in transportation."

So how can cities prepare for the future and still be responsive to these unknown changes? For most cities, it will actually be important to think small. His advice: "You can't just throw out the old way. Fixed-guideway systems will still be around, public streets and personal cars will still be around, but it will be one of many options. Now transportation planners need to learn from the software industry and be more iterative. How can we accommodate different modes, or driverless vehicles, within the old networks? San Francisco started with bike lanes and complete streets pilots, and they scaled. The city nailed pay-for-parking because they scaled and had vision."

A ROLE FOR INDUSTRY PARTNERS

All of this change provokes questions about how cities might prepare for the challenges and opportunities of the future, and furthermore, how their friends and partners in the private sector and industry side might play an important role in this collective adjustment. As many private sector firms do a significant amount of the designing, building and maintaining of city infrastructure, they should feel compelled to prepare for the near seismic shifts that behavioral changes will have on the infrastructure needs in the future. Real estate developers should consider the ways in which shifts in work patterns might impact the value of commercial real-estate. Engineering and planning firms should think about the ways in which changes in travel patterns and preferences will impact street networks, travel demand and the look and feel of city space.

Beyond the ebb and flow of traffic and changing demands on the street network, there will also be significant changes in the ways existing mobility networks operate. Driverless cars will call for new signage, sensors and signals and mobile payment infrastructure will be critical maintaining the convenience of ridehailing services. Along with this, there will likely be a need for new or adjusted procurement policies that account for all of the major technological shifts and the new equipment necessary to integrate new technologies and make innovations run smoothly and efficiently. The likely trend toward driverless car fleets will require new expertise and new data-driven industries that can help to manage, direct and maintain them.

Finally, the uncertain nature of transportation funding will require collaboration between the public, private and third sectors (NGOS). Public-private partnerships have experienced a surge in popularity in the last couple of years, and they will continue to become more common as success stories in this vein become more and more prevalent. Effective partnerships between the public and private sectors heed possibilities for improved service delivery, more effectively developed and maintained infrastructure and incorporation of new and innovative modes and technologies into the existing mobility network.

demands of users. Much of the change in transportation preferences can be attributed to a behavioral evolution. Travelers no longer think of themselves as users of a network, and instead have adopted an app-oriented mindset. They want to be able to know instantly, with the touch of their fingers or otherwise very little action on their part, how to get from Point A to Point B. Public mobility providers need to adapt to this new paradigm. It reflects a new preference for taking in information, and it is the way of the future.

We can anticipate several new modes of transportation that comport with emerging personalized mobility preferences. There is already a migration toward first class accommodations, such as high end bus services and of course the now ubiquitous Uber Black Car. Inter-city passenger rail and air travel have successfully modeled first-class accommodations, and by 2030, there will likely be first-class amenities on some public transportation services as well.

Already, consideration has been given to the viability of pod cars (also referred to as Personal Rapid Transit) which would offer nonstop, fixed guideway travel from point to point for individuals or small groups.

We can also assume that we will all have very different conceptions of what constitutes transportation in 15 years. A compeititon to build a one mile long test track for a proposed a high-speed Hyperloop system, signaling that the reality of this new system might not be as far-fetched as it initially seemed.[64]

Gondolas are currently under consideration as transportation mediums outside of ski-towns, and could likely be a reality in several cities by 2030.[65] Likewise, foldable cars have recently been launched as a possible solution to density woes, and if proven effective and safe, will likely be used by individuals and as part of car services in 2030.

CONCLUSION

All of these ideas and more will help shape the future mobility environment.

The impacts of a radically changed environment are, at times, hard to comprehend – but there must be a concerted effort to prepare for new innovations. There are few things so certain as change, and with that constant in mind, it is imperative that cities allocate time to understanding and weighing the costs and benefits of emerging technologies and developing mobility trends.

The transportation systems of the future will be highly impacted by technology, and the lessons of the past tell us that while we can anticipate and make reasoned predictions, the future is far from certain.

We can guarantee though that we should all buckle up and hold on –

because it will most definitely be an interesting ride.

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The Future of Work: The Effect of Job Automation on African-American and Latino Workers in Three Cities

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INTRODUCTION

Workers across the country are vulnerable to the effects of job automation and worker displacement. The resulting unemployment and underemployment of large swaths of the American workforce will have significant negative impacts on individuals, families, and the communities in which they reside. In anticipation of progressive job loss due to automation, local leaders and policy makers must understand the future of work, marshal resources to prepare young adults for employment, and (re)train the existing workforce to be active, productive participants in the changing labor market.

This report provides an overview of the current state of research on job automation and provides a case study of job automation in three cities: Gary, Indiana; Columbia, South Carolina; and Long Beach, California. The study focuses on the impact of projected job automation on African-American and Latino workers and assesses the education and training capacity of existing schools and programs. Finally, this report provides recommendations for the development and expansion of education and training programs to meet the requirements of the future of work.

KEY FINDINGS

State of Job Automation

- Automation, or the use of computer-controlled equipment to perform tasks, is changing the nature of work, the composition of employment, and the distribution of income.
- Forecasts predict that 9% to 47% of occupations (13 million to 68 million jobs) will be lost to automation in the upcoming decades.
- Job loss will be unequally distributed, affecting individuals with lower levels of education and African-American and Latino populations with greater severity.
- Social skills, creative intelligence, perception, and manipulation are difficult to automate. Jobs requiring these skills are less susceptible to automation and job loss.

Three City Case Study

- Gary, Indiana; Columbia, South Carolina; and Long Beach, California, are geographically and demographically diverse.
- These cities are engaging in efforts to innovate in public secondary career and technical education, but they continue to face challenges of low academic performance as well as low rates of college and career preparedness.
- African-American and Latino populations are underrepresented in local public technical colleges and universities.
- States have a variety of workforce training initiatives; however, these programs do not yet operate at a scale needed to reach all vulnerable workers.

Lessons for Local Leaders and Policy Makers

- Develop policies and practices and foster a culture promoting ongoing education and (re)training for all workers, with particular attention to communities where individuals have low levels of educational attainment.
- Support robust and equitable primary and secondary academic training as the foundation for building students' skills.
- Provide innovative and data-driven programs connecting all students to career training and college.
- Build pathways to ensure equitable transitions from secondary to post-secondary training and education.
- Develop an information dissemination platform to collect and share training and job opportunities with residents.
- Identify and make use of workforce development funding from federal and state programs.
- Support the development of a data management system to track the success of various job training programs, with attention to diversity, equity, job placement, and job longevity.
- Learn from and build on workforce development efforts that have been successful in other municipalities and states.

STATE OF JOB AUTOMATION

Debates and Developments in Projecting Job Automation

Automation is the use of computers and technology to perform tasks in substitution for human labor. Forecasts of the percentage of American jobs at risk of loss due to automation in the next few decades range from 9% to 47%.[1],[2] This variation in projections of job loss can be attributed to researchers' use of differing assumptions to model future labor needs. These assumptions include the following:

Predictions of the effects of technology substitution versus complementarity: Substitution assumes that technology will cause the displacement of human labor, leading to joblessness.[3],[4] Complementarity predicts that labor-saving technology will be balanced by economic growth and greater employment in other sectors and by the increased value of the tasks that humans uniquely supply.[5]

Skill vs. task analysis: Early analyses of the effects of automation on labor needs use the Occupational Information Network (O*NET) job classification system developed by the U.S. Department of Labor, which provides descriptions of tasks specific to occupations. Some researchers argue that this method of analysis, while informative, does not account for the considerable variation in the tasks involved in jobs having the same occupational title. More recent studies focus on cognitive and workplace skills or capacities,[6] under the argument that these metrics provide a more fine-tuned assessment of occupations.[7]

*Level of occupational classification:*The U.S. Bureau of Labor Statistics classifies jobs into 23 major occupational groups. [8] The 23 major occupational groups encompass 98 minor occupational groups, which are further divided into 459 broad occupations consisting of 867 detailed occupations. Projections vary depending on the level of occupational aggregation.

Technological factors: Projections of future labor needs are further attenuated by the general inability to predict with precision factors such as the speed of automation diffusion and the development of machine learning, data mining, mobile robotics, machine vision, and other subfields of artificial intelligence that are dedicated to the automation of non-routine cognitive tasks. [9]

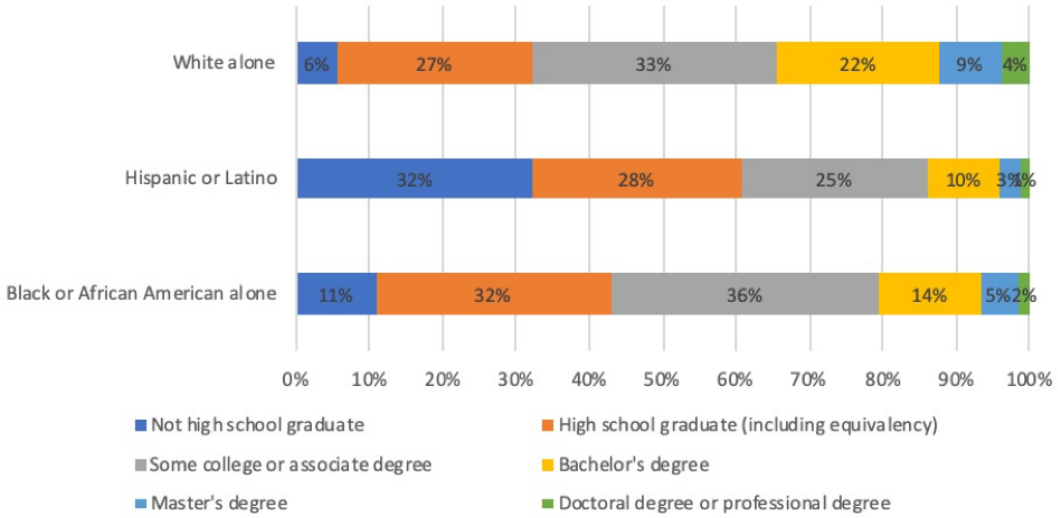
Despite variation in the projected percentage of jobs that will be lost to automation, even the moderate projection of 9% job loss translates to 13 million jobs becoming obsolete.[10] The more severe projection that 47% of jobs will be lost translates to the elimination of 68 million jobs. Such significant job loss mandates the need to provide strategic job training and support to those who will be most affected by automation.

Unequal Distribution of Job Loss Due to Automation

Studies consistently show that the distribution of job loss due to automation is and will continue to be unequal. Jobs with the highest risk of automation are those that require the least amount of education; therefore, individuals with lower levels of education will be most adversely affected by automation.[11] Further, job loss due to automation will have unequal effects across racial and ethnic groups because educational attainment as well as the occupational distribution of workers varies by race and ethnicity.

Although levels of education vary across cities and geographical areas, African-American and Latino populations attain lower levels of education when compared with white populations nationally. As depicted in Figure 1, among individuals over 20 years of age, 67% of those who identify as white (alone) have more than a high school degree, whereas only 57% of those who identify as African-American (alone) and 40% of Latinos have more than a high school degree. Policies and investments to improve the education and training of students as well as adult learners, particularly in communities with trends of low educational attainment, are necessary to mitigate the negative and unequal effects of job automation.

Figure 1. Educational Attainment of Civilian Labor Force over 20 Years of Age, by Race/Ethnicity



Source: American Community Survey, EEO 7r. Educational Attainment (6) by Younger Age Groups, Sex, and Race/Ethnicity (Part I) for Residence Geography, Total Population, Number (2006-2010).

Skills Needed by the Future Workforce

Evolving technological advances in the areas of machine learning and artificial intelligence mean that over the course of an individual's work life, the skills necessary for employment will likely change. Therefore, ongoing adult learning and workforce retraining will be a necessary feature of education and labor policies.

Identifying the skill requirements of the future labor market is an ongoing challenge because it requires continuous forecasting of the nature of future jobs. Researchers have suggested identifying the bottlenecks to automation (i.e., tasks that are difficult to automate) as a method of planning for future labor needs. Studies have identified bottlenecks such as social intelligence, or the ability to effectively negotiate complex social relationships, including caring for others and recognizing cultural sensitivities; creative intelligence; and perception and manipulation (see Table 1). Empirical evidence shows that occupations requiring these skills indeed have a lower risk of automation.[12]

Table 1. Bottlenecks to automation and corresponding skills

Bottlenecks to Automation	Skills
Social Skills	Advise, counsel, inform others Care for others Decision-making Persuade and influence others Responsibility for others Teach
Creative Intelligence	Analyze complex problems Improve processes/ new ideas Research and development
Perception and Manipulation	Dexterity Working in awkward positions

Source: BIBB/IAB and BIBB/BAuA Employment Surveys 2006 and 2012, UK Skills Surveys 1997, 2001, 2006, 2012.

The following case study assesses the impact of projected job automation on African-American and Latino workers and provides assessments of the education and training capacity of existing schools and programs in three cities: Gary, Indiana; Columbia, South Carolina; and Long Beach, California. This assessment of the labor market and education and training opportunities in geographically and demographically diverse cities offers guidance to leaders and policy makers in other cities seeking to better understand the potential impact of job automation on their local populations as well as guides by which to assess their educational and workforce training capacities.[13],[14]

Demographic Profile of Three Cities

Table 2 provides demographic profiles of the three cities. Gary, Indiana, has a population of 77,416. The majority of the population is African-American: 80% identify as African-American (alone), 12% identify as white (alone), and 6% identify as Latino of any race.[15] In Gary, 55% of the population is of standard working age, 20 to 64 years old. Median earnings for full-time, year-round workers are $32,569, ranging from $14,922 for individuals with less than a high school degree to $44,539 for those with a graduate degree.[16] The overall unemployment rate is 13%; however, rates of unemployment are higher for those with lower levels of education and higher for African-Americans (17%), compared with Latinos (12%) and whites (12%).[17]

Columbia, South Carolina, has a population of 132,236. The majority of the population is white: 48% identify as white (alone), 41% identify as African-American (alone), and 6% identify as Latino of any race.[18] In Columbia, 62% of the population is between the ages of 20 and 64 years. Median earnings for full-time, year-round workers are $40,398, ranging from $15,980 for those with less than a high school degree to $53,005 for those with a graduate degree.[19] The overall unemployment rate is 6%; however, rates of unemployment are higher for those with lower levels of education and higher for African-Americans (15%), compared with Latinos (6%) and whites (4%).[20]

Long Beach, California, has a population of 470,489. The majority of the population is Latino: 43% identify as Latino, 28% identify as white (alone), and 12% identify as African-American (alone). In Long Beach, 63% of the population is between 20 and 64 years old.

Median earnings for full-time, year-round workers are $46,054, ranging from $21,453 for those with less than a high school degree to $77,638 for those with a graduate degree.[21] The overall unemployment rate is 7%; however, rates of unemployment are higher for those with lower levels of education and higher for African-Americans (14%), compared with Latinos (8%) and whites (7%).[22]

Table 2. Demographic Profiles of the Three Cities

	Gary	Columbia	Long Beach
Total Population	77,416	132,236	470,489
Between ages 20-64 Years	55%	62%	0.63
African-American (alone)	80%	41%	12%
White (alone)	12%	48%	28%
Latino (any race)	6%	6%	43%
Below Federal Poverty Level	36%	22%	19%
Median Earnings for Full-Time Worker	$32,569	$40,398	$46,054
Less than HS	$14,922	$15,980	$21,453
HS Diploma or Equivalent	$24,461	$21,576	$29,007
Some College	$25,812	$28,399	$36,582
Bachelor's Degree	$34,786	$42,722	$57,088
Graduate or Professional Degree	$44,539	$53,005	$77,638
Unemployment (25-64 Years)	13%	6%	7%
Less than high school graduate	25%	17%	8%
High school graduate (includes equivalency)	15%	12%	9%
Some college or associate's degree	11%	9%	7%
Bachelor's degree or higher	7%	2%	4%

Source: American Community Survey, 2017

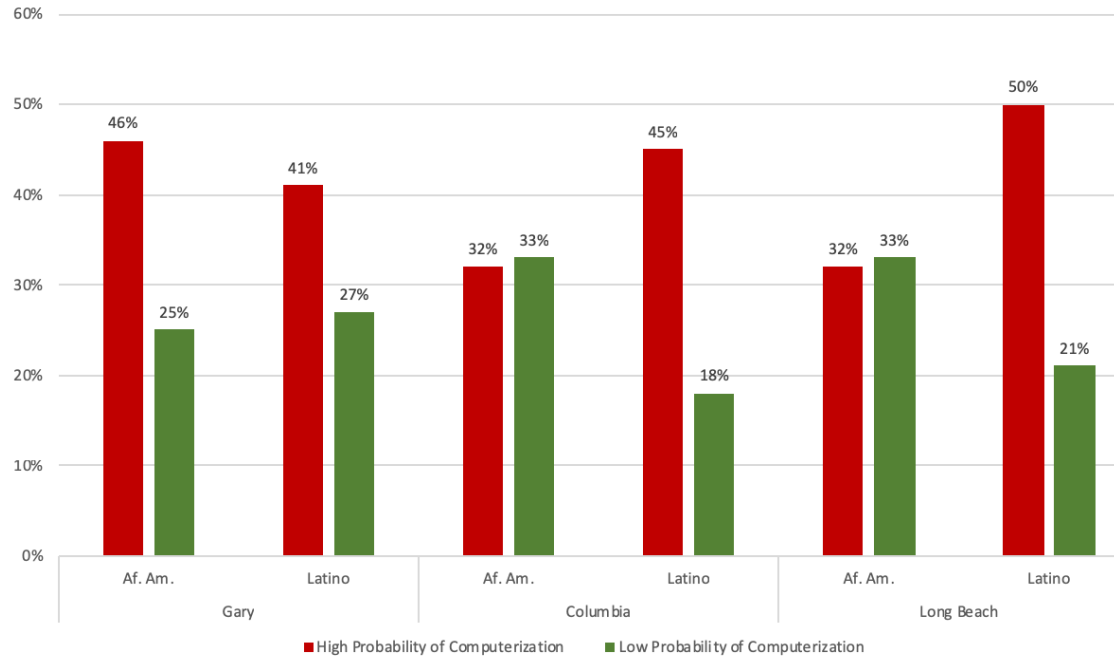
Assessing the Effect of Job Automation on African-American and Latino Workers: A Look at Two Models

Researchers have calculated the effect of automation on occupations using varying assumptions and levels of analyses. Because projection models include varying assumptions, the projections often have different names. Figures 2 and 3 present two projections: (1) the probability of automation[23] and (2) the probability of future demand,[24] focusing on the occupational distribution of African-American and Latino workers across the three cities. While the findings are slightly different, with the latter projection estimating more moderate effects of automation, the key takeaway lesson from each projection is the same: a significant proportion of African-American and Latino workers across the three cities are in occupations that have a high risk of loss due to automation.[25]

Model 1: Probability of Automation

Figure 2 presents the probability of automation of 459 broad occupational groups using a task-based assessment of occupations.[26],[27]

Figure 2. Risk of Job Automation



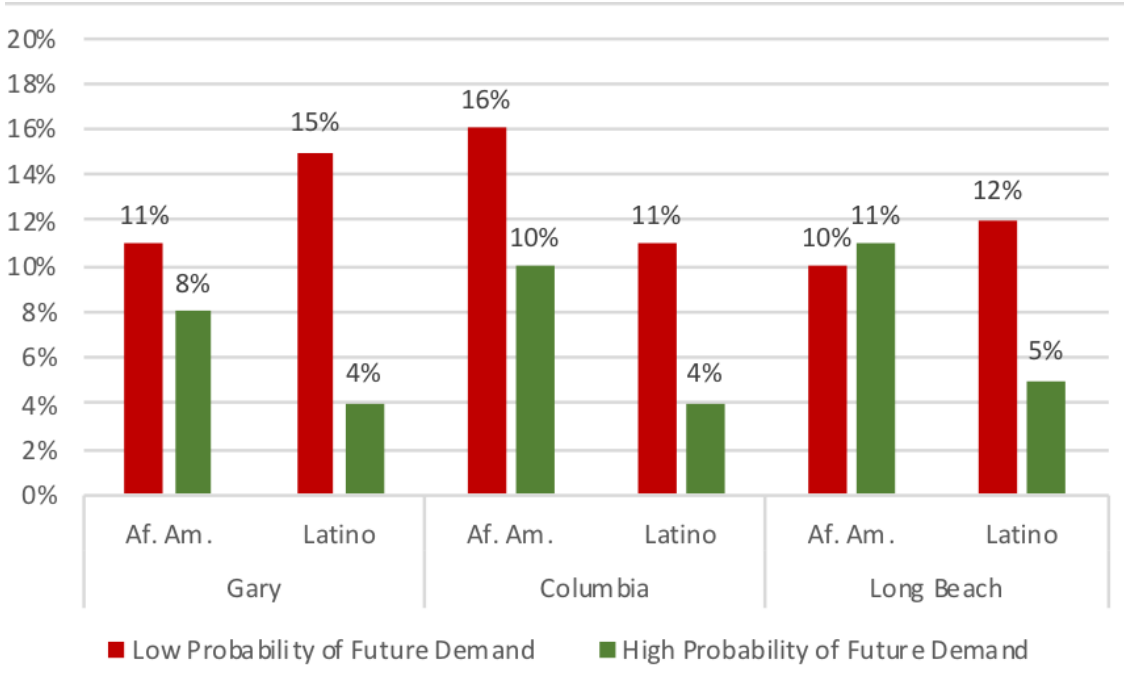
Source: African American Mayors Association, Mason, P. (2019). Automation and occupational change: assessing the impact of technological change on African American and Latino workers. Working Paper.
Note: High probability of automation is defined as >70% risk of automation. Low probability of automation is defined as <30% risk of automation.

Model 2: Probability of Future Demand

Figure 3 presents a different set of calculations showing the probability of future demand for occupations. Low probability of future demand means that an occupation will likely shrink, while a high probability of future demand means that an occupation will likely grow. This model uses calculations for the 98 minor occupational groups using a 120-point assessment of the skills, knowledge, and abilities needed for an occupation. In addition to automation, trends included in this model include urbanization, increasing inequality, political uncertainty, technological change, demographic change, globalization, and environmental stability.

Compared with the projection in Model 1 of the probability of automation, the projection of the probability of future demand in Model 2 predicts a more moderate effect of automation on occupations; however, the two projections have similar patterns for African-American and Latino workers. With evidence showing that a significant portion of the jobs held by African-American and Latino workers are likely to become obsolete, leaders and policy makers must develop education and labor policies that provide strategic and ongoing education and training to the future workforce.

Figure 3: Probability of Future Demand



Source: African American Mayors Association, Mason, P. (2019). Automation and occupational change: assessing the impact of technological change on African American and Latino workers. Working Paper.
Note: Low probability of future demand is defined as <30% probability of demand; shrinkage of this occupation is likely. High probability of future demand is defined as >70% probability of demand; growth of this occupation is likely.

Education and Training Landscape

Across the three cities, levels of educational attainment vary between racial and ethnic groups, with white populations obtaining higher levels of education when compared with African-American and Latino populations. Lower rates of educational attainment by African-American and Latino workers is a concern because occupations available to individuals with lower levels of education are at greater risk of automation.

Innovative Initiatives in Public Secondary Education

Each city's publicly provided secondary education system offers standard as well as innovative courses to high school students.

Gary

The education system in Gary serves approximately 3,526 high school students in three public high schools and four charter high schools. Gary Middle College (GMC) serves non-traditional students, offering a dual enrollment program that allows students to participate in high school classes and attend Ivy Tech Community College classes for up to 60 hours of college credit. To support the use of online learning, GMC is phasing in the use of individual computers and a Google for Education platform to allow remote sharing of course materials and assignments.[28]

Columbia

Columbia's 16 public high schools serve approximately 15,992 students. The schools offer a Career and Technical Education (CATE) program, intended to integrate career and technical instruction into courses for middle and high school students. Beginning with an Introduction to Career Clusters course offered in middle school, the CATE program introduces and trains students for careers in the 16 national career clusters adopted by the South Carolina Department of Education.[29] Among the city's 16 high schools, 3 are virtual, and some of the brick-and-mortar high schools allow students to enroll in online courses to supplement course offerings.

Long Beach

The 12 high schools in Long Beach serve approximately 25,368 students.[30] High schools in Long Beach are organized into small learning communities in which students are divided into cohorts around industry themes identified by the California Department of Education as high need and highly employable.[31] Implemented in 2009 with funding from the James Irvine Foundation, the linked learning approach offers rigorous academics, career-based learning, work-based learning, and personalized support.

Challenges with Outcomes and Program Availability and Use

Despite efforts across the cities to connect high school students with post-secondary education and career opportunities, the cities are still plagued with low performance on standard academic measures and indicators of college or career readiness.[32] For example, in Gary, rates of college and career readiness range from 30% to 75% across schools;[33] in Columbia, only 32% of high school graduates were college-ready, and only 54% were career-ready;[34] and in Long Beach, 64% of white students met the measure of college and career preparedness in 2017 whereas only 36% of Latino students and 30% of African-American students met the measure of preparedness.[35] Other challenges include unequal availability and utilization of career and technical education programs across the cities' high schools and evidence of disparate academic performance along racial and ethnic lines.

Post-secondary Education and Training

The three cities have post-secondary institutions that offer courses and credentials promoting social skills, creative intelligence, and perception and dexterity (i.e., the bottlenecks to automation). Additional institutions are located within 20 miles of each city. However, there is evidence of low and unbalanced enrollment for African-Americans in Gary and Columbia and for African-Americans and Latinos in Long Beach. For example, in Gary, African-Americans make up over 80% of the public high school population but only 21% of the student body at the local public technical college[36] and 18% of the population at the local public university.[37] Similarly, in Columbia, African-Americans make up 50% of the public high school population but only 35% of the student population at the local technical college and 9% of the population at the local public university.[38] In Long Beach public schools, where 54% of students identify as Latino and 14% as African-American, Latinos make up 59% of the student body at the local public technical school, but African-Americans are only 11% of the student body there, and at the local public university Latinos and African-Americans are only 42% and 4% of the student population, respectively.

Workforce Training

Indiana, South Carolina, and California have developed a variety of workforce development initiatives that can serve as models for other states and localities.

In these states, governmental administrative offices and bodies manage the use of public funds to support workforce training (e.g., Department of Employment and Workforce in South Carolina). Administrative offices have developed online databases and app-based platforms to share apprenticeship, training, and job opportunities available in each county. In addition, government-convened partnerships bring together educational institutions, economic development groups, workforce systems, and community organizations to align training and industry-specific workforce needs within regional markets (e.g., Indiana's Workforce Councils).[39]

States have marshaled state and federal funds to support the development of apprenticeship programs. For example, the U.S. Department of Labor awarded California's Department of Industrial Relations a $1.8 million ApprenticeshipUSA State Expansion Grant to develop and expand apprenticeship programs in the state.[40] The grant will allow the Division of Apprenticeship Standards in the state's Department of Industrial Relations to double the number of apprentices (from approximately 74,000) between 2017 and 2027, increase equity and diversity, and extend apprenticeship programs to emerging and high-growth industries.[41],[42] In addition, California requires that all public works contracts valued at $30,000 or more include an obligation to hire apprentices.[43] To further support apprenticeships, state administrative offices enforce apprenticeship standards regarding wages, hours, working conditions, and state certification.

States have procured funding for workforce (re)training programs. In Indiana, Next Level Jobs is an initiative by the governor and legislature to develop the state's workforce with a focus on high-priority industries and in-demand, high-paying jobs. Next Level Jobs provides Workforce Ready Grants to help individuals pay for training and Employer Training Grants for employers to train individuals in high-priority areas. In California, the Employment Training Panel assists employers that offer their workers training that leads to well-paying, long-term jobs.[44] In 2018, the Employment Training Panel provided approximately $5.5 million to companies to support employee training in the Los Angeles County area.[45]

States have made commendable inroads in providing various workforce development initiatives. However, there is still a need for systems of comprehensive workforce development that reflect and accommodate the need for continuous training of the workforce amid progressive job automation.

LESSONS AND OPPORTUNITIES FOR LOCAL LEADERS AND POLICY MAKERS

Local leaders have a close-up view of the needs and experiences of residents and local industries. They also have close connections to school boards and county and state government officials. Thus, local leaders are in strategic positions to marshal and coordinate resources and disseminate information about education and workforce training programs. In addition, local leaders can lobby state and federal governments to support high-quality, evidence-based programs and develop comprehensive systems of workforce development. With information about the needs and resources within their communities, local leaders can be at the forefront of efforts to prepare their workforce for the future.

Insights and Recommendations

Robust primary and secondary education and ongoing adult learning and workforce (re)training are necessary features of education and labor policies. Local leaders and policy makers should seek to develop policies and practices and foster a culture promotive of ongoing education and (re)training for all workers, with particular attention to communities where individuals have low levels of educational attainment.

Group-Specific Engagement Strategies

In addressing workforce development, leaders must focus on two distinct groups to prepare for the impact of automation: students and the workforce. Below is a list of recommendations for strategies to support each group's active and productive engagement in the changing labor market.

Students

- Support robust and equitable primary and secondary academic training as the foundation for building students' skills.
- Provide innovative and data-driven programs connecting all students to career training and college, with a focus on program enrollment and completion.
- Build pathways to ensure equitable transitions from secondary to post-secondary training and education.

Workforce

- Develop an information dissemination platform to collect and share training and job opportunities with residents.
- Identify and make use of workforce development funding from federal and state programs.
- Support the development of a data management system to track the success of various job training programs, with attention to diversity, equity, job placement, and job longevity.
- Learn from and build on workforce development efforts that have been successful in other municipalities and states.

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(L-R) Chanelle Hardy, Mayor Steve Benjamin, Zoelene Hill, Ph.D, Stephanie Mash Sykes, Esq. AAMA Future of Work Panel at the 2019 African American Mayors Association Annual Conference in Houston, Texas.

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