Urban
MOBILITY
in a Digital Age

A TRANSPORTATION TECHNOLOGY
STRATEGY FOR LOS ANGELES

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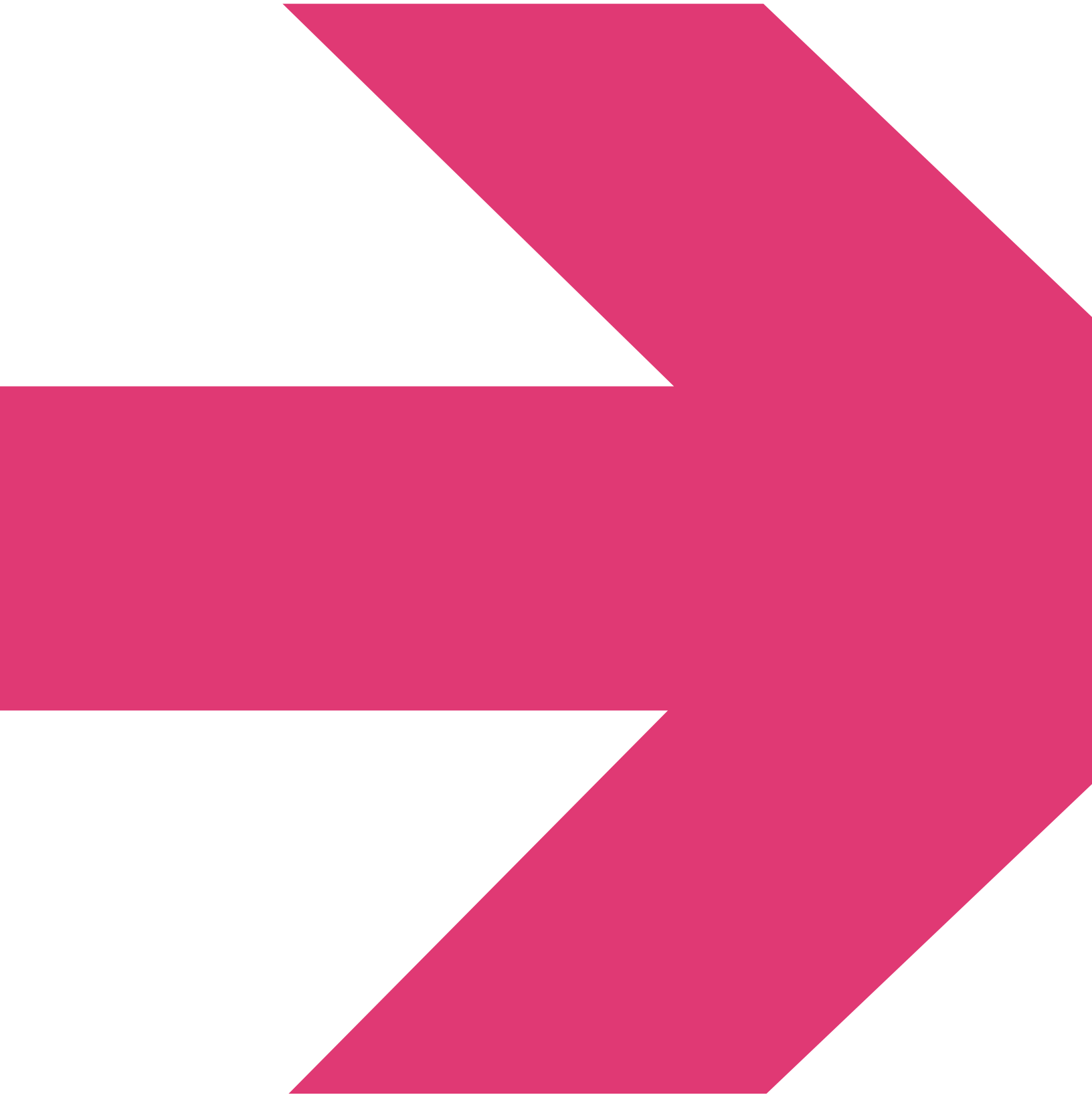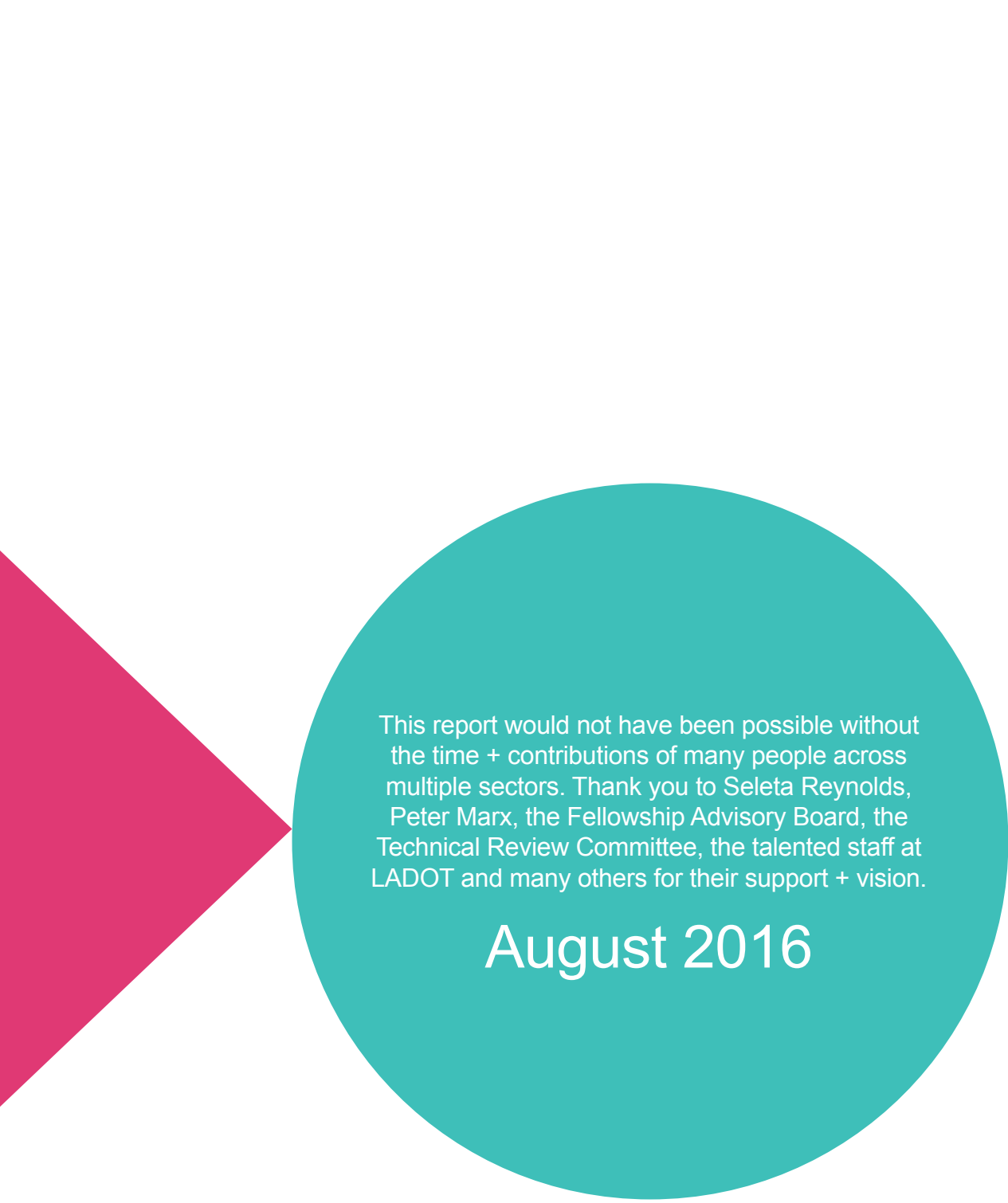A TRANSPORTATION TECHNOLOGY STRATEGY FOR LOS ANGELES

PREPARED FOR THE CITY OF LOS ANGELES
OFFICE OF THE MAYOR AND
DEPARTMENT OF TRANSPORTATION

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This report would not have been possible without the time + contributions of many people across multiple sectors. Thank you to Seleta Reynolds, Peter Marx, the Fellowship Advisory Board, the Technical Review Committee, the talented staff at LADOT and many others for their support + vision.

August 2016

LADOT People Street

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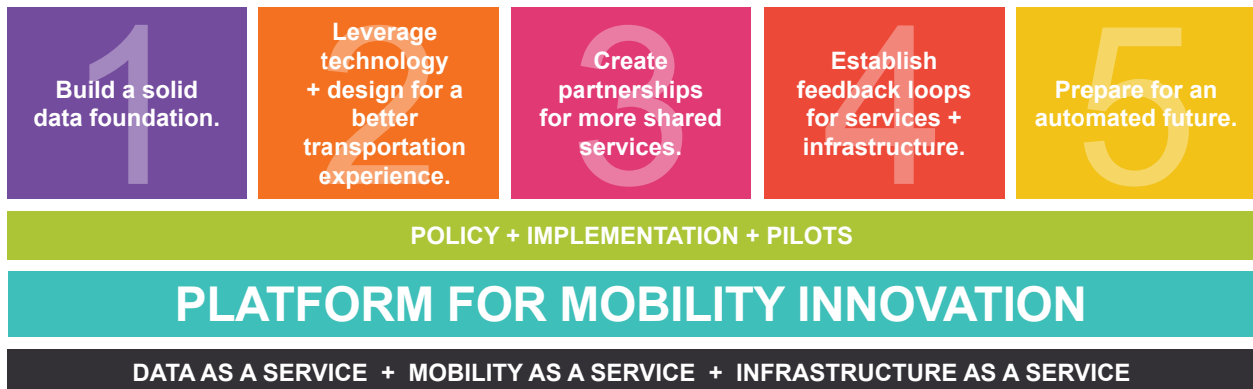
Executive Summary

Los Angeles is a culturally rich urban metropolis that has captured the imagination of millions of creative, tech-savvy and diverse populations from around the world. With the region's population projected to reach 22 million by 2040 (SCAG), Los Angeles must shed its reputation as a car culture or its roads will come to a standstill. The use of one vehicle per person to get around this vast metropolitan region is no longer viable, creating structural inequality, exerting extensive pressure on our infrastructure that outpaces funding, and leaving too many Angelenos stuck in traffic. As our greatest and most prevalent public asset, streets occupy 15% of Los Angeles' total land area and serves as our city's lifeblood (LADOT Vision Zero). There are several emerging trends in transportation technology that will help maximize limited resources to improve vehicle and roadway capacity, enhance customer experience and transportation happiness, and make our public right-of-ways safer for all Angelenos if we prepare for them now.

Urban Mobility in a Digital Age is a transportation technology strategy designed to build on the success and innovation of the City of Los Angeles and its Department of Transportation (LADOT) as regulator and transportation service provider in a complex and evolving ecosystem of public and private services. With a focus on building a solid data foundation, leveraging technology and design for a better customer experience, creating partnerships for more complimentary shared services, establish feedback loops for services and infrastructure, and preparing for an automated future, Los Angeles can refine and set the precedent for 21st Century mobility just as it did in the 20th Century. LADOT must position itself as a platform for mobility innovation that supports greater mode options by providing Data, Mobility and Infrastructure as a Service to all Angelenos.

The Vision

The City of Los Angeles, like many large cities, faces many transportation challenges. In response, our policymakers have established several transportation policy goals: increasing mobility (Mobility Plan); keeping pedestrians, bicyclists, and motorists safe (Vision Zero); and, improving air quality by decreasing congestion (Sustainability pLAn). With the rapid rise of technology in transportation, LADOT will need to deploy and support an ecosystem or mobility marketplace of advanced technologies to meet these policy objectives and create truly great streets for all Angelenos. To do so, LADOT must evolve into a platform for transportation innovation that focuses on three primary customer service delivery goals: data, mobility and infrastructure.

1 Build a solid data foundation.	2 Leverage technology + design for a better transportation experience.	3 Create partnerships for more shared services.	4 Establish feedback loops for services + infrastructure.	5 Prepare for an automated future.

POLICY + IMPLEMENTATION + PILOTS

PLATFORM FOR MOBILITY INNOVATION

DATA AS A SERVICE + MOBILITY AS A SERVICE + INFRASTRUCTURE AS A SERVICE

Goal 1: Data as a Service

In the digital age, LADOT must be able to provide and receive real-time data from an increasingly complex marketplace of public and private transportation service providers, other jurisdictions, and connected and automated vehicles to maximize the efficiency and safety of the road and transportation networks. The San Pedro Bay Port Complex, the combined ports of Los Angeles and Long Beach, is the world's ninth largest container port (Port of LA). In 2015, more than 76 million passengers travel through LAX. As these gateways grow in the coming decade, so too does the demand for better logistics and more efficient infrastructure networks to keep people and goods moving.

Data as a Service is the rapid exchange of real-time conditions and service information between service providers, customers and the supporting infrastructure. This requires a seamless data exchange with a variety of partners and stakeholders, privacy and security protections, the capacity to analyze data from a variety of resources, and the ability to integrate this insight into a data-driven decision-making process at the level of elected officials and department management. This is a relatively cost-effective way to enhance connectivity and system efficiency and reliability without constructing new physical infrastructure. With better data, LADOT will be in a position to become more responsive to the transportation needs of Angelenos as both a service provider and regulator of transportation in Los Angeles. *Urban Mobility in a Digital Age* proposes near-term investments in data infrastructure and the public sector workforce to support this service in the future. Furthermore, Data as a Service will support the goals of Mobility and Infrastructure as a Service by tapping into critical data to best align resources to demand.

Goal 2: Mobility as a Service

Mobility as a Service centers on the customer or mobility consumer, a person who purchases and uses transportation for personal use (Shaheen). It is a single platform and payment system that offers access to a suite of transportation mode choices, often bundled together in packages. This approach requires collaboration and coordination across different transportation modes, and providers and creates a potentially competitive marketplace of services to meet the real-time and changing needs of Angelenos throughout the day, week or month, effectively transforming the single-occupant automobile owner model. While this places the burden of information exchange on public agencies and private transportation operators - both freight and passenger - Mobility as a Service can significantly improve access to jobs, education, healthcare, and other services by making it easier for Angelenos to find and utilize an increasingly complex suite of services through a single interface. This affords Angelenos more choice when determining what mode best accommodates their schedule – a key element in rider satisfaction.

LADOT has already partnered to make it easier for customers to evaluate transportation options through a trip planning application, Go LA, which compares mode options for the fastest, cheapest and/or greenest routes. Additionally, LADOT has piloted a mobile payment application for its transit services and there are plans to expand Go LA to include reservation and payment capabilities in Summer 2016. This experience with smartphone application-enabled services demonstrates the ability of LADOT in its role as a convener or advocate for regional Mobility as a Service. *Urban Mobility in a Digital Age* recommends LADOT establishes itself as a leading advocate for expanded access across the region

2015 LA Great Streets Challenge Winner, Connect the Dots, hosted three design workshops on the Van Nuys Civic Center Plaza to reimagine LA's Great Streets at their fullest potential: serving as engaging public spaces; healthy, active transit corridors in lively economic zones; and strategic groundwater assets.

LADOT PLATFORM FOR MOBILITY INNOVATION

Data as a Service	Mobility as a Service	Infrastructure as a Service

Data as a Service is the rapid exchange of real-time conditions and service information between service providers, customers and the supporting infrastructure for greater system efficiency and improved experience.

Mobility as a Service centers around the customer; it offers access to a suite of transportation mode choices through a single platform and payment to simplify access to mobility choices.

Infrastructure as a Service proposes that access to public infrastructure should be subject to pay-as-you-go fees that more closely align the costs associated with providing the infrastructure to how the infrastructure is used.

through a series of actions to better connect and integrate the existing marketplace of public and private services.

Goal 3: Infrastructure as a Service

Our physical infrastructure requires ongoing maintenance and investment, but current funding mechanisms such as the gas tax are unable to keep up with the demand of our existing roadways. Infrastructure as a Service proposes that the use of public infrastructure should be subject to pay-as-you-go user fees that more closely align the costs associated with providing the infrastructure itself to how the infrastructure is being used. Infrastructure as a Service more transparently reflects the costs for the City of Los Angeles and other agencies to build, maintain and operate public infrastructure by charging fees for this service. With a solid data baseline, this approach can also support tiered fees to ensure there is equity in access to the public right-of-way. Infrastructure as a Service can help shift behavior by incentivizing shared mobility, promoting staggered commute times and other active transportation alternatives.

As this is a fundamental rethinking of how we pay for and access our public right-of-way, Infrastructure as a Service requires a phased approach, which is already being introduced: the State of California has launched a nine-month pilot this summer to test the concept of charging drivers for vehicle miles traveled as an alternative to the gas tax; and tolling high occupancy vehicle (HOV) lanes on the 110 and 10 Interstates is currently in place. Urban Mobility in a Digital Age includes recommendations to build and grow digital infrastructure in Los Angeles to enable this service and recommends best practice policies and regional coordination to support this goal.

Transportation technologies will continue to create new opportunities for Angelenos, local government and regional stakeholders to better access existing services

while simultaneously creating a marketplace and demand for new transportation options. By becoming a universal platform for innovation and offering Data, Mobility and Infrastructure as a Service, LADOT can enhance connectivity and access across the city and greater metropolitan region.

Strategy Scope

This strategy focuses predominantly on two revolutionary transportation technologies that will reshape the mobility marketplace in Los Angeles: shared mobility and connected and automated vehicles. The introduction and growth of these technologies will require an active role by the City of Los Angeles to optimize the safety, efficiency and access benefits their proponents claim. The consequences of inaction could be detrimental to the growth and prosperity of the region.

Shared mobility - the shared use of a vehicle, bicycle or other mode - is an innovative transportation strategy that enables users to gain short-term access to transportation modes as-needed. This includes both publicly and privately operated networks for public transit, on-demand ride services, carsharing, bikesharing, etc. Depending on the jurisdiction or area, shared mobility can serve as the primary mode of transit or as a complement to fixed-route bus and rail services (Shaheen, 6). The proliferation of smartphones and seemingly ubiquitous connectivity in the digital age has created a marketplace of private mobility services that connect travelers in real-time to a variety of modes and a wealth of applications to help improve the travel experience. These services have introduced new and diverse choices for Angelenos while providing more options to connect with existing public transit services.

Shared mobility services also challenge transportation agencies such as LADOT to define how these services

should be regulated when their impact on existing services or the community at-large is not fully known (SCAG). While these services introduce a substantial opportunity to better connect Angelenos across the region, they require oversight for the protection of the public good and to ensure they do not undermine access for disadvantaged populations. While roughly two-thirds (68%) of the U.S. population has access to a smartphone, there remains a digital divide that without being directly addressed can leave entire communities behind. The transportation technology revolution, therefore, must be considered for both the digital and analog opportunities it can create to improve mobility universally.

The on-demand nature of new transportation services further challenges LADOT to consider how it approaches transit and infrastructure service delivery and the City will need greater flexibility to adapt as new services emerge. LADOT must support a quality customer experience that includes a seamless digital interface; comfortable and convenient connections; physical and digital infrastructure; safety; and access to information, big data, to make real-time decisions to respond to demand.

LADOT will have to strike a balance between the needs of existing ridership while attracting new customers to grow the use of shared modes (both public and private) and help mitigate future congestion. As there is no room to build more roads, Angelenos must shift their transportation behaviors to increase utilization of vehicle and mass transit capacity by filling empty seats and shared mobility can help meet these goals. This strategy highlights the importance of process improvement, communications, data-sharing and supporting a feedback loop to give a stronger voice to the customer while collecting input from smart city sensors that provide situational awareness on travel conditions. Shared mobility and other supportive amenities to make the trip easier can also help improve connectivity and trip efficiency while providing greater flexibility and choice.

The arrival of the self-driving or automated vehicles (AV) has caused a stir not just among transportation officials, but across the media and technology sector, capturing the imagination of many while raising complicated questions about ethics, liability, safety and opportunity. Technology companies and auto manufacturers are actively testing this technology on our roads today. AV has the potential to transform mobility in Los Angeles by providing new populations previously unable to drive themselves with access to vehicles; eliminating human error in traffic crashes; and creating more efficiency through connected vehicle technology. It is estimated that AV will reduce crashes by 90% and save the United States economy $190 billion annually (Schmitz). LADOT must begin planning today to optimize the safety, environmental and access benefits that could be realized by this technology; otherwise, we may unintentionally see increased vehicle miles traveled, worsened congestion and unsustainable development at the urban fringe.

Ford Motor Company estimates that there will be autonomous vehicles on the roads within four years (Ungureanu). It will take time for the entire fleet of vehicles on the road to convert to autonomous, as people replace their cars, but rapid adoption is anticipated among taxi services and ride-hailing services since almost 80 percent of the cost of a ride is the driver (Gattis). While the timeline of this technology hitting the market ranges from the aggressive predictions of five to ten years to a more realistic estimate of 25 to 30 years for full fleet conversion to AV, LADOT should begin addressing some of the core outcomes today.

Through a combination of AV, car sharing and right-sizing car ownership, it is estimated that up to 85 percent of automobiles in cities can be eliminated with a significant impact on congestion and creating a sea change for the auto industry (Weikel). By creating a culture of shared mobility today and working efficiently to adapt our digital and physical infrastructure to supported AV in the future, Los Angeles can redefine the use of our public right-of-way and alleviate pressures on the built environment that currently support single occupancy vehicles and their onerous parking requirements. This strategy proposes a series of recommendations focused on urban design, real-time data exchange, preparing our digital and physical infrastructure, and piloting AV public transit as a primary opportunity to demonstrate the potential of this technology.

Wikimedia Commons/Grendelkhan

Google X, one of the leaders in developing AV technologies, has completed millions of simulated hours and thousands of driving hours on the roadways of California and reports are that they plan to spin off the car into its own company.

StreetsBlog L.A./Joe Linton

The introduction of protect bike lanes and bikeshare in provide much-needed physical infrastructure and services to support active transportation in Los Angeles and offer Angelenos new, safer options to get where they need to go.

Approach

We are in no position to predict the future. The intent of this strategy is to establish a solid foundation that provides the flexibility to become more responsive and ultimately pro-active to changes in transportation technologies and customer preferences. This a vision for how LADOT can continue to integrate technology into service delivery, regulation, project evaluation and the advancement of meeting policy goals for the future of Los Angeles. LADOT and partner agencies in the public sector need to prepare and anticipate continuous technological change and innovation as the pace of change among emerging technologies accelerates.

Urban Mobility in a Digital Age defines five core objectives and outlines key policy and action items so LADOT will be better positioned to support this platform in the future. Some of these policies are administrative rules within the purview of LADOT and other departmental management to define and implement; other policy recommendations will require City Council action and a more public process for consideration. Following the policy recommendation for each goal, there are a series of actions that have been prioritized and sequenced for implementation. While some of these actions could be implemented concurrently, the time horizon is defined as:

TODAY (0-2 years): Some of these actions have already been initiated by LADOT and partners and may already have dedicated resources committed to their implementation. These actions are intended to help position LADOT for future funding opportunities, partnerships and collaboration with other stakeholders by offering discrete action items and entry points for engagement.

TOMORROW (3-5 years): These actions may require more resources (staff and budget) and therefore need more time to be incorporated into the LADOT strategic plan. Many of these actions build upon the TODAY recommendations.

FUTURE (6+ years): These recommendations propose actions for the future that set a broader vision for how LADOT may continue to evolve and propose future outcomes to be phased in over time.

The final component of the transportation technology strategy includes a menu of pilot projects for consideration. These projects explore partnerships and new data resources; highlight opportunities to demonstrate new technologies and service delivery methods in a real-world environment; and build on the incredible innovation already underway at LADOT. These pilots are intended to provide a starting point, a learning opportunity that can help shape future policies and actions that could be scalable across the entire city and region. Implementation can be phased as resources are available and should incorporate lessons learned and new technologies as they emerge.

1. Build a solid data foundation.

Build a solid data foundation.

Data will continue to be a critical tool for effective regulators and transportation service providers. LADOT must be better equipped to manage and evaluate the mobility marketplace and how it is impacting the safety and access to convenient, affordable transportation solutions. This requires better data. These recommendations focus on establishing a transparent, accountable approach to big data by defining what can be shared, how it will be used, and creating privacy principles to clearly state these goals and protections of personal data. This is intended to build upon the open data initiative well-underway at the City of Los Angeles, but also requires new data resources to be effective. These policies are intended to shape how LADOT and the City of Los Angeles will share real-time transportation data with private and public sector partners while leveraging the information, consuming new data resources, and building capacity through partnership.

LADOT must maximize analytics for a deeper understanding of how services and infrastructure address the transportation and access needs of all Angelenos; this policy framework sets the stage for both internal and external capacity development by creating a pathway to partner with outside analysts while building the professional skill set and data acumen within LADOT. Furthermore, the strategy recommends regional collaboration through participation in the recently formed Coalition for Transportation Technology, a potential mechanism for setting standards, maximizing resources, and enhancing interoperability between systems that would benefit from the perspective and leadership of LADOT. Since data collection will likely require new technologies installed in the field via smart city sensors and other infrastructure retrofits, the final policy recommendation suggests creating urban design guidelines for digital infrastructure to avoid cumulative visual blight in our public right-of-way.

The TODAY recommendations focus on the assessment of existing data resources and the prioritization of a wishlist of additional data that would contribute to better transportation planning and project evaluation in this changing mobility marketplace. With the introduction of technology-enabled private transportation providers, LADOT has an incomplete picture of what options are available, how safe they are, who they are serving and whether they are providing equitable access. LADOT needs to evaluate what data is needed to better understand this marketplace and develop a roadmap that articulates whether the City of Los Angeles will be responsible for collecting this data or if LADOT will rely on third party data resources to provide this essential information for more data-driven decision making. It will take time to transform the public sector workforce and equip it with data analytics skills, essential to the work of this and any City in the 21st Century, so it is recommended that in the interim LADOT establish a bench for contractors who can help with data analysis.

The TOMORROW recommendations focus on making it easier to access and share data within LADOT, across City departments, with regional partners and other agencies. Creating data dictionaries, for instance, will clearly articulate who owns and generates data, how it is used and updated, and what is included within a dataset. Wherever there is a data standard, LADOT should work to adopt this to make it easier to share data within the City's existing open data portal. Automating sharing for the most important and relevant datasets will help eliminate wasted time of manually sharing information and make it easier for other departments and third parties to use it. For instance, LADOT should support the automation of sharing geolocated road closure data to wayfinding applications such as Go LA and Google Waze to eliminate the need to email a pdf of permitted parade route. This will provide Angelenos with critical information while alleviating demands on LADOT staff time to support these data-sharing partnerships. The FUTURE goals will leverage this data with an empowered LADOT workforce as mobility managers that can actively consume and understand how transportation services are working (or not working) to meet the needs of the community in real-time. This will provide a solid foundation for the planning for infrastructure and transit services in the future.

POLICY
1. Define what can be shared.
2. Adopt privacy principles.
3. Develop a standard data sharing agreement.
4. Create a regional blueprint for system integration.
5. Establish design guidelines for digital infrastructure.

TODAY (0-2 years)
1. Inventory available data.
2. Create a wishlist for other data sets + prioritize.
3. Implement a data analysis bench contract + grow internal analytics capacity.
4. Develop a roadmap for new data resources.

TOMORROW (3-5 years)
1. Make the data easier to use with data dictionaries and other tools.
2. Adopt APIs + other tools to streamline sharing.

FUTURE (6+ years)
- Leverage data to manage a more flexible transportation system with public + private service providers.

Leverage tech + design for a better transportation experience. Commuting can be stressful and research shows that it affects your mental and physical health as well as how you think about other people. The most stressful mode is driving whereas walking and public transit are the top two most enjoyable ways to commute, respectively (Campbell-Dollaghan). How might LADOT leverage technology to improve the daily commute for Angelenos for a healthier, happier city?

Public transit ridership remains fairly flat in the Los Angeles region (Linton). Research indicates that the two most important indicators of rider satisfaction is service frequency and schedule (Transit Center) Many of the strategies herein address network efficiency and availability of flexible options to meet schedule demands. LADOT can further increase transit ridership through a shift in travel behaviors, incentivized by a customer experience that both attracts new users and improves on the needs of existing users. In general, government struggles to design services from the perspective of the user, but technology offers new tools to engage customers, fine-tune service offerings, and respond to the needs of Angelenos. This strategy outlines a variety of approaches that put the customer first – to ease the challenge of getting around while making it easier to access information, weigh options, and choose the best transportation mode.

These recommendations support LADOT's strategic plan to create a 21st Century traffic management system and calls for funding the proposed changes to support the integration of digital infrastructure and smart city sensors into department operations. The Automated Traffic Surveillance and Control (ATSAC) system provides signal coordination and management for more than 4,000 signalized intersections across Los Angeles; it is the technology backbone of our road network. Built in the 1980s, ATSAC requires a significant investment to upgrade and add functionality to meet policy goals and keep up with changes in the mobility marketplace. The strategy also calls for the automation of enforcement around public transit priority lanes to make the daily commute safer and more efficient for transit riders and others sharing the road. Video-as-a-sensor technology, for example, can detect and ticket violators of bus-only lanes during peak periods to keep traffic moving.

The City of Los Angeles should adopt a customer bill of rights as a commitment to providing a quality transportation experience and define metrics for transportation happiness. Additionally, these policies call for improving the built environment for pedestrians, cyclists and those opting for shared modes such as public transit or ridesharing while eliminating rules that perhaps unintentionally support the status quo - the single occupancy vehicle - by proposing changes to land use and zoning requirements. This will require a rethinking of regulations around parking and highway dedication (road widening).

The TODAY actions include a reassessment of curb rules to improve access in the age of shared mobility; creating minimum design standards for public transit access to elevate the experience; integrating data into planning decisions, supporting fleet electrification by expanding the availability of charging station information; and "greening" the transit fleet, installing more electric charging stations, and investigating the potential of new technologies such as roadway electrification. The TOMORROW recommendations include making it easier to navigate with a unified wayfinding program; testing on-demand public transit; expanding smart parking citywide; and making it easier for employers to incentivize shared modes. The FUTURE recommendation is to introduce a universal fare system by collaborating with stakeholders across the region to make it possible to use a single payment tool to access multiple services and modes of transportation. These actions are intended to enhance transportation happiness, improve connectivity and make shared mobility more appealing to an even broader audience of Angelenos and visitors to the region.

POLICY
1. Create ATSAC 3.0.
2. Enforce congestion-busting rules for safety.
3. Adopt a customer bill of rights and metrics for transportation happiness.
4. Require corridor + building designs that serve multiple modes.
5. Eliminate parking minimums.
6. Rethink parking garages.
7. Stop widening roads.

TODAY (0-2 years)
1. Code the curb to optimize access.
2. Develop customer-centered requirements for public services.
3. Integrate real-time data + tech into urban design and planning processes.
4. Publish data on EV charging station locations.
5. Advance fleet conversion to greener fuel.

TOMORROW (3-5 years)
1. Create a unified wayfinding program.
2. Route transit by demand where suitable.
3. Expand ExpressPark citywide.
4. Introduce a portal for employers to manage transit benefits.

FUTURE (6+ years)
• Create a universal fare system for Los Angeles.

2. Leverage tech + design for a better transportation experience.

Create partnerships for more shared services. LADOT and the City of Los Angeles cannot address congestion by simply expanding travel lanes; this leads to induced demand and increased traffic. There are few areas in Los Angeles with the space to accommodate such expansions and little public appetite for eminent domain. And in many locations such expansions have diminished pedestrian access and safety. Shared mobility can improve the efficiency of our physically constrained roadways by increasing the capacity of vehicles, utilizing every seat in a vehicle, reducing vehicle miles traveled, and providing more choices/options that are scalable to shifting needs. With complementary land use strategies such as transit-oriented development, shared mobility could provide more Angelenos with better options and LADOT should consider ways to better deliver these services.

McKinsey identifies four major technology trends that are changing mobility. In-vehicle connectivity is creating crowdsourced information and real-time data to relieve congestion and provide new route options to drivers. The sales of plug-in and hybrid vehicles are estimated to quintuple by 2022 to 11% of the global market, reducing pollution and creating new demands on the supporting charging infrastructure. Carsharing and true ridesharing (utilizing every seat in a vehicle) will reduce the number of vehicles on the road, but increase vehicle miles traveled by 75% (in other words, fewer vehicles in constant use will make up the majority of trips). LADOT should foster new partnerships to create better access and opportunities for Angelenos willing to adopt shared mobility for even a fraction of their transportation demand.

Urban Mobility in a Digital Age includes recommendations to make it easier for new transportation services to engage with LADOT - including updating regulations (and supporting processes such as permitting) to reflect the new technology-enabled modes and services such as carsharing. In addition, LADOT should commit to reviewing existing policies and procedures to make sure they are suitable to the current mobility marketplace and open to future innovations in transportation technology. Furthermore, there needs to be a review of existing rules and regulations to ensure that the City offers a level playing field for more traditional transport services as the competition evolves. Finally, in support of an effort underway by the Department of City Planning and LADOT, the strategy recommends that the City update its transportation demand management (TDM) ordinance to reflect new transportation modes and measures to help mitigate the impact of new development on congestion.

POLICY
1. Update regulations to include new modes.
2. Make it easier to work with the City of Los Angeles + provide a level playing field.
3. Adopt a revised transportation demand management ordinance for new developments.

TODAY (0-2 years)
1. Develop a shared mobility action plan.
2. Form a multi-discipline mobility assessment team.
3. Designate an innovation pilot project manager.

TOMORROW (3-5 years)
1. Bring sharing to City Hall through carsharing, bikesharing and carpooling platforms.
2. Launch a mobility lab.

FUTURE (6+ years)
• Implement Mobility as a Service.

The actions proposed for TODAY include partnering with the National Resource Defense Council (NRDC) to develop a shared mobility action plan. This will provide LADOT with specific next steps and proven best practices to support shared mobility in Los Angeles and will complement a countywide action plan being developed by the Shared Use Mobility Center (SUMC). The strategy recommends creating an intra-departmental mobility assessment team to foster an ongoing conversation within City Hall about the impact and opportunities presented when new transportation choices emerge. To support the emphasis on partnerships, it is also recommended that LADOT assign aan innovation pilot project manager whenever a partnership or pilot is created to ensure there is a direct point of contact and someone is responsible for tracking the outcomes.

The TOMORROW actions include introducing more shared mobility platforms to City Hall by adapting existing platforms for carsharing, bikesharing and carpooling to maximize fleet efficiency and reduce vehicle miles traveled. LADOT should develop a mobility lab through public-private partnerships and expand upon its internal technology team that is currently tasked with testing and exploring new tools and software to ensure that staff remain current on evolving technologies and have the opportunity to work with them directly as appropriate. The FUTURE recommendation proposes LADOT implement a comprehensive approach to Mobility as a Service, to create or support a single platform to access transportation services and payment. LADOT should serve as both a regional advocate to advance this goal and innovative thought leader.

3. Create partnerships for more shared services.

Establish feedback loops for services + infrastructure. Cities are complex systems designed to support our daily lives. People, our priorities and needs are dynamic. LADOT must be receptive to input and feedback to enable continuous improvement and to ensure stakeholder needs are met effectively. Smart city sensors and other data can provide a dynamic view of infrastructure conditions and demand that more passively conveys the changes in our transportation system. With technology accelerating the pace of change, it will be essential for LADOT to identify new ways to ensure it understands demand and create mechanisms for integrating these shifts into its operations and management of transportation systems.

With decades of investment in public transportation services, it can be a challenge to introduce new technologies, amenities and partnerships that will disrupt these systems. Through effective performance management that involves a variety of feedback loops from customers, partners and other jurisdictions in the region, LADOT can take regular temperature checks to ensure it is on track to meet goals or pivot if there are unacceptable, unintended consequences. Private service providers have already incorporated this approach by creating reputation and ranking systems to inform the customer before a ride begins. As smartphones and social media increasingly connect people, LADOT must offer channels to receive feedback and respond to this input.

LADOT should consider policies to enable it to become a more responsive service provider to allow for shorter turnaround for data-driven decision-making. With the pace of change in technology, LADOT should not be encumbered by outmoded approaches to decision-making that might impede the department's ability to incorporate or respond to a new technology, service or tool. Linking customer feedback, for instance, to performance

management can help inform decisions to better align resources to demand. Likewise, LADOT must adopt a standard project evaluation methodology to ensure that pilots, grant-funded initiatives, and ongoing programs are evaluated by similar measures to allow for deeper analysis and understanding of their impacts. This would also provide greater consistency when LADOT publicly reports project status on the proposed project dashboard.

The TODAY actions include the formation of a working group to focus on evaluating and measuring transportation happiness and the quality of experience on public shared modes. This team would also be responsible for the ongoing evaluation of data requirements to ensure it is possible to measure the impact of services. LADOT should also investigate the deployment and optimization of technology to help assess infrastructure conditions in real-time - whether transit vehicles are equipped with sensors or smartphone apps crowdsource information on sidewalk conditions, potholes, striping, signage, etc. Providing tools to capture this information on a broad scale can help the City maintain a more routinely updated asset inventory, which will be helpful in planning maintenance and prepping infrastructure for the advent of AV. Finally, upon completion of the shared mobility action plan, LADOT should identify partners to launch a public marketing campaign to promote shared modes.

There are multiple LADOT websites that are confusing and challenging to navigate. The TOMORROW actions include streamlining online content regarding mobility services, LADOT-funded community initiatives, and other programs to a more user-friendly format. LADOT should learn from web statistics to determine what information is most useful and build on that success. As these changes are underway, LADOT must invest in developing the skills of its workforce to integrate new technology into how they work - whether in the planning or engineering processes or as part of daily field operations such as parking enforcement and transit services. LADOT should adopt a multi-modal smart fare system and advocate for the region to do the same to enable greater customization for the customer. This will provide LADOT with more detailed insight into customer behavior to adapt its services as needed.In the FUTURE, LADOT should develop a roadmap to move towards Infrastructure as a Service as outcomes of the I-110 and 10 HOV congestion pricing and California Road Charge pilot are evaluated and access to improved data continues.

4. Establish feedback loops for services + infrastructure.

POLICY
1. Become a more responsive service provider.
2. Establish a project evaluation standard.

TODAY (0-2 years)
1. Create a user experience working group.
2. Investigate new tools for the ongoing evaluation of infrastructure conditions.
3. Engage the entire community on infrastructure condition assessments.
4. Partner and support a marketing campaign on shared mobility.

TOMORROW (3-5 years)
1. Streamline LADOT online content + launch a project dashboard.
2. Prepare the workforce for changes driven by innovation in transportation technology.
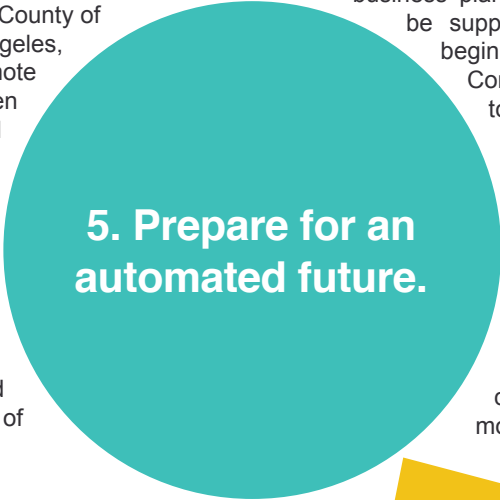3. Adopt a multi-modal smart fare system.

FUTURE (6+ years)
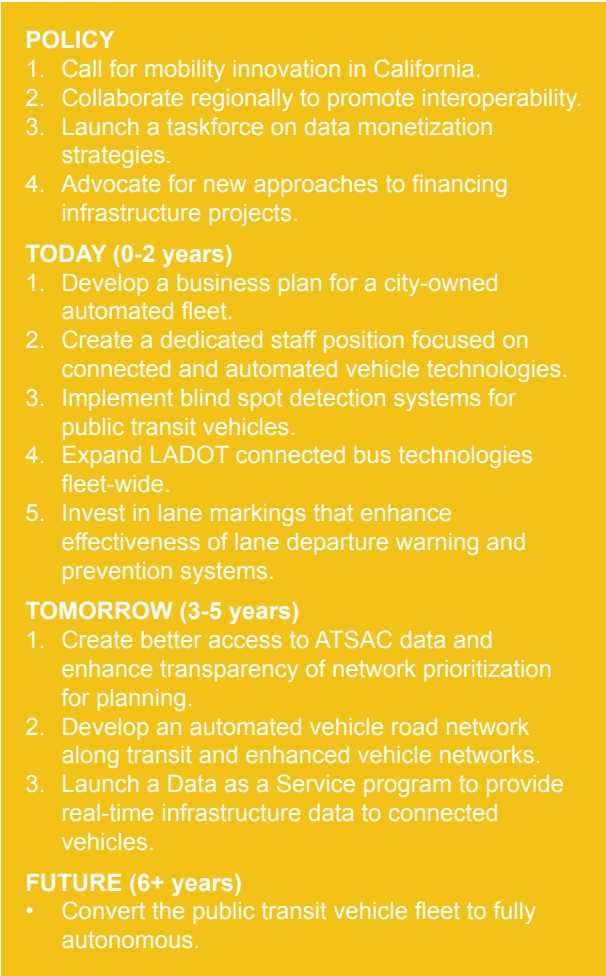• Develop a methodology to move towards Infrastructure as a Service.

Prepare for an automated future. When automobiles were introduced, entirely new systems of regulation, infrastructure and supporting services had to be created and these changes occurred very quickly. Transportation planners and engineers must be ready to anticipate how shared mobility and connected and automated vehicles will revolutionize mobility - creating incredible opportunity to impact our environment, economic development and equity in positive ways. However, if ignored, these technologies can have a devastating impact that could induce greater sprawl, inequity and other challenges for the city and region. Since infrastructure is built to last fifty to one hundred years, it is important to understand the potential impacts of these changing transportation technologies today and plan for them early. Investing in infrastructure upgrades will take a concerted effort over many years to attain the desired outcome of a safer, greener and more equitable transportation system.

Connected and automated vehicles (AV) would benefit from real-time information such as roadway conditions, traffic signal timing, pedestrian volumes, or traffic along bicycle networks. There are several potential challenges to relaying data from the infrastructure to vehicles in motion such as connectivity, latency, and standardization. Likewise, infrastructure managers would benefit from anonymized information from vehicles in the public right-of-way such as the path of travel and roadway conditions as this information would inform planning efforts. LADOT, having developed connected infrastructure through its ATSAC system, is well-positioned to lead the effort to build digital services and infrastructure to support this technological revolution.

The State of California Department of Motor Vehicles will be developing rules for AV on public streets and LADOT has already advocated for more innovative regulations. As the largest city in the state, Los Angeles must take an active role to advocate for new technologies and enabling regulations that will make our city streets safer, more accessible and sustainable. Furthermore, LADOT should work with regional stakeholders through the recently-formed Coalition for Transportation Technology, which currently includes representatives from Caltrans, Southern California Association of Governments (SCAG), Metro, County of Los Angeles and City of Los Angeles, to advance policies to promote better interoperability between jurisdictions - from data and communications to digital infrastructure and wayfinding. Technology is already able to enable communications between vehicles and infrastructure which might be an opportunity to generate new fees to support digital infrastructure; LADOT should convene a working group of

5. Prepare for an automated future.

POLICY
1. Call for mobility innovation in California.
2. Collaborate regionally to promote interoperability.
3. Launch a taskforce on data monetization strategies.
4. Advocate for new approaches to financing infrastructure projects.

TODAY (0-2 years)
1. Develop a business plan for a city-owned automated fleet.
2. Create a dedicated staff position focused on connected and automated vehicle technologies.
3. Implement blind spot detection systems for public transit vehicles.
4. Expand LADOT connected bus technologies fleet-wide.
5. Invest in lane markings that enhance effectiveness of lane departure warning and prevention systems.

TOMORROW (3-5 years)
1. Create better access to ATSAC data and enhance transparency of network prioritization for planning.
2. Develop an automated vehicle road network along transit and enhanced vehicle networks.
3. Launch a Data as a Service program to provide real-time infrastructure data to connected vehicles.

FUTURE (6+ years)
• Convert the public transit vehicle fleet to fully autonomous.

subject matter experts to explore the feasibility for a real-time data monetization strategy as a means to support the development and maintenance of connected infrastructure. Additionally, as the State of California explores the implications of a road pricing pilot, LADOT should advocate for innovation in how infrastructure is funded and move towards Infrastructure as a Service.

The TODAY actions include the development of an AV business plan for the City of Los Angeles and will be supported by a FUSE Corps Fellowship beginning in October 2016. The County of Contra Costa, California is actively working towards the deployment of an AV fleet to serve first-last mile connections from public transit centers and the City of Beverly Hills has also recently announced the intent to develop its own fleet to serve a similar purpose. LADOT will compare the business case behind an automated public transit fleet versus an automated city operations fleet and the fellowship will culminate in a specific plan as to how to move forward. Meanwhile, LADOT should

consider establishing a full-time staff position to track changes in AV technologies, provide policy guidance on an ongoing basis as new federal and state regulations develop, and work with LADOT planners and engineers to coordinate the integration of this technology into planning and operations. Additional actions for TODAY include the integration of blind-spot detection sensors onto LADOT transit vehicles and the expansion of connected vehicle technologies across the entire LADOT transit fleet to help improve safety and meet the City's Vision Zero plan. These technologies make it easier for bus operators to get real-time information, improve rider experience by providing amenities such as real-time arrival information and public WiFi, and provide a flexible communications platform for adding sensor technologies in the future. A final proposed action will require partnership with an auto company as it will leverage existing connected vehicle technologies, lane departure warning systems, to make our public right-of-way safer. As the City of Los Angeles plans to resurface 2,200 lane miles of roadway each year, LADOT should integrate lane markings that are detectable by vehicle sensors to protect cyclists in bike lanes and pedestrians

In June 2016, the National Association of City Transportation Officials (NACTO) released policy guidelines for fully-automated vehicles to:

- Promote safety for pedestrians, bicyclists, transit riders, automated vehicle passengers, and all street users within the multi-modal urban context;

- Incentivize shared, automated, electric vehicles to reduce the environmental impacts of vehicular travel and refocus planning on the principle of mobility as a service;

- Support the future vision of communities as great places to live, work, and play by using technology as a tool to change land use as well as how streets are built;

- Rebalance the use of the right-of-way with less space for cars and more space for people walking, cycling, using transit and recreating;

- Support public transit by providing first and last mile connections to major transit lines via shared, automated vehicles, and by providing cost-effective, on-demand transit in lieu of lowperforming fixed routes; and

- Improve mobility for all, contributing to a more equitable transportation system, where benefits reach all demographics and any negative effects are not unjustly concentrated (NACTO).

Urban Mobility in a Digital Age details a variety of references and best practices for reference as additional background for the recommendations.

in crosswalks wherever feasible. The standards for lane markings to support AV have not yet been determined but LADOT can work with auto manufacturers to pilot solutions that could lead to the development of these standards.

The TOMORROW actions recommend creating better access to ATSAC data, including considering policies around video retention, to make it easier to use and incorporate into transportation planning at LADOT. This will also require greater transparency on system hierarchies and signal prioritization which will be useful for service planning and scheduling as well as development review. In addition, LADOT should develop an AV network along the enhanced vehicle and transit networks, as defined in the Mobility Plan, to focus investment on connected infrastructure. LADOT should also prepare to launch a real-time data exchange services for connected infrastructure and vehicles which will require preparation and investment in data warehousing, communication capabilities and supporting policies for Data as a Service.

The FUTURE actions will build upon the work proposed and call for LADOT to convert its public transit to fully automated vehicles. As this technology evolves and AV capabilities are tested and standardized, LADOT should prepare to rethink its operations and how it will train its workforce to meet the needs of an automated fleet. This will require redefining job responsibilities and adapting the workforce to serve new functions.

Pilot Proposals

The increasingly rapid pace of change can make it difficult to identify what transportation technologies will prevail over time and the lack of standardization can make it difficult to invest public funds into new technologies, service delivery models, and partnerships. Meanwhile, there are a variety of potential funding resources now available at the federal, state and regional level that LADOT could tap moving forward and being prepared with a variety of potential initiatives will help position the City for success.

LADOT should adopt an approach to piloting new ideas to mitigate some of the risks associated with being an early adopter while providing a valuable opportunity to establish metrics for success and learn from a smaller scale demonstrations. Identifying partners in academia, the private sector and across the region can provide LADOT with both the initial subject matter expertise, funding and capacity to support these explorations, as well as create a pipeline of resources for scaling a successful pilot into successful implementation across Los Angeles. These pilots should follow the same rigor of project evaluation and reporting, and they should be given the attention of a designated LADOT project manager as described in the strategy recommendations to ensure the organization can benefit from lessons learned for future applications. The strategy also defines a methodology for how to identify whether a pilot targets a specific geography (a corridor or district) or market (customer or mode).

Data as a Service

Data as a Service is the rapid exchange of real-time condition and service information between customers, service providers, government and the supporting infrastructure to optimize safety, efficiency and the transportation experience. These pilots are opportunities to move LADOT towards Data as a Service by giving the staff experience in managing and optimizing data-sharing partnerships, exploring the value of analytics, and testing new tools.

Analyze crowdsourced data for roadway design impacts on congestion.

Through existing data sharing agreements with Google Waze and Xerox's Go LA application, LADOT has access to crowdsourced information about congestion and trip planning preferences that could offer a valuable planning and project evaluation resource over time. This data should be included in the data inventory. The available Google Waze data could provide LADOT with insight into how road diets and protected bike lanes, for instance, impact traffic flow and even the perception of congestion. LADOT should partner to analyze this data and report on the potential opportunities (and potential limitations) that crowdsourced data offers to project evaluation.

Test customer feedback tools on public services.

In the digital age, there is a plethora of accessible feedback tools and platforms that would give LADOT better insight into how satisfied Angelenos are with their mobility experience - whether walking, biking or taking public transit. For example, private transportation services, such as ride-hailing services, provide the means for customers to rate service and access this information in advance of taking a trip. LADOT should test both direct and passive channels and establish a model to measure transportation effectiveness and happiness.

Develop an online project dashboard for this strategy.

There is a lot of innovative work underway, but timelines varies because of how a project is funded, who is executing the work, what is being analyzed, etc. One of the proposed actions recommends creating a project dashboard to make this work more transparent to stakeholders. In the meantime, LADOT should pilot an online project dashboard for this strategy to track status and metrics on these proposed projects. Outlining the work underway, funded or planned would simultaneously serve as a valuable internal exercise for LADOT while creating a new channel for the community and potential partners to engage with its government. One such means to measure success is by monitoring web traffic.

Deploy connected infrastructure technologies in Promise Zones.

Technology makes it possible to relay critical real-time information from our infrastructure to vehicles, smartphones and other receivers to make our public right-of-way safer, smarter and more efficient. Sensors at crosswalks can detect waiting pedestrians and automatically change signals; buses can sense bicyclists and pedestrians in blind spots and stop the vehicle to avoid a collision; streetlights and traffic signals can be programmed to detect when a vehicle is rapidly approaching an intersection and hold a change of lights to avoid a crash. LADOT should deploy a pilot of these sensors and other real-time communication technologies to better understand how this data can be integrated into its traffic management center operations. By focusing on the Promise Zones within Los Angeles, communities that are proportionally more dependent on public transit and active transportation, LADOT will be better positioned to leverage potential funding from the federal government and benefit from the deployment of multiple technologies in a limited geographic area.

Experiment with parking inventory technologies.

Trip planners typically account for the estimated time of travel from Point A to Point B, and often factor historical congestion data into their algorithms. However, the cruising time and distance traveled to find parking - estimated to cause 30% of congestion (Shoup) - is not factored into these tools. With existing smart parking capabilities and technology companies such as Sidewalk Labs investigating new ways to capture available parking, data on parking rules, and payment information can not only help make it easier to find available spots, but even pay for parking. LADOT start with an inventory pilot to understand what is available and eventually move to understanding parking in real-time to make it easier for drivers to find what they are looking for, help set a better pricing strategy, reduce congestion, and potentially encourage mode shift by more accurately reflecting total trip time.

Mobility as a Service centers on the customer; it provides a suite of transportation mode choices through a single platform and payment system to simplify access to mobility choices. While many elements to deploy a true Mobility as a Service model in the region are beyond LADOT's jurisdiction, these pilots can demonstrate how more shared mobility options, better connectivity, and improved interoperability between modes can shift travel behaviors for Angelenos.

Launch mobility hubs to integrate + connect modes.

LADOT, in partnership with the Los Angeles County Metropolitan Transportation Authority (Metro), is piloting a federally funded project to develop ten (10) mobility integrated hubs and dozens of satellite hubs. The vision is to create seamless connectivity between various modes of transportation through a single, integrated platform (LADOT Bike Blog). Mobility hubs, to be located at transit stations and new private developments, are a physical translation of the Mobility as a Service model. These hubs will provide first-last mile connectivity and on-demand services such as bikeshare, carshare, bike repair and storage, fare payment, etc. LADOT should establish an open toolkit for implementing scalable, context-sensitive mobility hubs and the City of Los Angeles should seek to implement this model at strategic public facilities - to serve both Angelenos and City staff. LADOT should identify non-mobility services that could be co-located within the mobility hub model. In Washington D.C., for example, a pilot with the online grocer Peapod is being tested at three stations. This allows transit riders to pick-up fresh groceries on their way home from an on-site attendant between the hours of 4PM to 7PM.

Pilot on-demand transit.

LADOT DASH is an affordable neighborhood circulator bus service. Resources are limited, however, to extend this fixed-route, fixed-schedule service to new neighborhoods and limited hours of operation may impede adoption by new riders. For lower density neighborhoods seeking new transportation choices, LADOT should explore a public-private partnership to deploy microtransit services, on-demand shared shuttles, and assess how this might improve connectivity to other transportation modes, shift travel behavior, reduce single occupancy vehicle trips, and ultimately improve customer satisfaction.

Expand shared services to low-income neighborhoods citywide.

The City of Los Angeles is working to deploy the City's first carsharing fleet of electric vehicles. This initial pilot is already funded by a $1.6 Million California Air Resources Board (CARB) grant. In addition to EV and hybrid fleet vehicles, the program will provide 100 Level 2 charging stations to support the pilot neighborhoods of Downtown Los Angeles, Westlake, Pico-Union, South Los Angeles and Koreatown. LADOT must evaluate regulatory constraints to expanding carsharing services citywide; potential access issues for communities that are "unbanked" or have limited access to technology; and, the challenges of behavior change when introducing a new transportation choice to a population. LADOT will benefit immensely from tracking the progress of this pilot initiative and evaluating how this could potentially be scaled across other disadvantaged neighborhoods.

Mobility as a Service

Test smart fares.

Today's payment system technology makes it possible to structure fare systems to different market segments, offering greater customization and flexibility in the fare structure. This would make buying transportation services more like a cellphone plan where services can be bundled and data can be purchased as appropriate to the needs of the customer. Smart fares empower the customer to choose from a menu such as off-peak usage, trip chain, frequency of use, and willingness to share their plan with a family member (Davidson), and affords LADOT and other agencies greater flexibility in pricing services.

Infrastructure as a Service is the idea that the use and access of public infrastructure should be subject to pay-as-you-go user fees that more closely aligns the costs associated with providing the infrastructure itself to how the infrastructure is being used. Since full-scale implementation of this model is contingent on state legislation and requires standardization, these pilots introduce interim ways to deploy technologies to respond more efficiently to changing infrastructure demand while testing public appetite for new approaches.

Deploy temporary car-free zones across the city.

Dense commercial centers could offer opportunities to introduce more car-free streets that limit access for single occupancy vehicles on either a partial (road diet), temporary or permanent basis. LADOT should leverage planned and new infrastructure services such as LED streetlights, protected bike lanes, sidewalks, and roadway resurfacing and painting to expedite road closures and visibly communicate these zones around Los Angeles. CicLAvia, for example, is the largest open streets event in North America (CicLAvia). The CicLAvia Heart of LA route connects six miles of roadway through the neighborhoods of Boyle Heights, the Arts District, Little Tokyo, Civic Center, Chinatown, the Historic Core and Macarthur Park, and could be a potential partner to test implementing infrastructure enhancements to support this regular road closure event making it less costly to host. LADOT should partner with the event organizers and other city departments to develop an implementation plan to quickly execute these changes.

Test assumptions around roadway capacity + utilization.

Standards define how the public right-of-way is designed and new state policies are requiring new measures that will shift away from level of service (LOS) to vehicle miles traveled (VMT). LADOT has access to data through ATSAC, its traffic management center, and other regional systems and partners that could validate our assumptions about how we use our roads during peak periods. Additional data may be required to fully understand the real-time environment but can potentially be captured through smart city

technologies available today. LADOT should capture and analyze this data around speed and traffic counts to develop an annual review of roadway capacity as a benchmark for future changes to land use, transportation modes, and roadway design.

Identify new infrastructure assessment tools.

What if the City's fleet of service vehicles and transit buses could collect real-time infrastructure condition information to update asset inventories regularly? This data would be valuable not only for the prioritization of public right-of-way improvements, but also for future automated vehicles, which will need clear roadway striping and signage to make it easier to navigate across Los Angeles. LADOT should issue a Request for Information (RFI) to assess potential solutions and consider a pilot deployment.

Launch an AV pilot.

Public transit is shared mobility that operates on a fixed schedule and route can provide considerable opportunity to introduce connected and automated vehicles to the public right-of-way in Los Angeles. Alternatively, the City has a large fleet of vehicles that support a variety of operations citywide. As a follow-up to the transportation technology strategy fellowship, LADOT will be hiring a FUSE Fellow in October 2016 to develop a business plan for the City of Los Angeles to deploy a municipal fleet of connected and automated vehicles, and will evaluate the trade-offs of either application. LADOT should plan to pilot a deployment as a test of the business plan and consider coupling the pilot with connected infrastructure.

Pilot an AV network on city streets + incentivize sharing.

Cities around the globe have implemented road pricing models to help discourage single occupancy vehicles, encourage more fuel-efficient vehicles, and promote a mode shift to more shared mobility. The peak travel periods in Los Angeles see considerable congestion, which could be mitigated by implementing a road pricing pilot on the most congested roads. As an interim solution, the City of Los Angeles should pilot a local street network, with priority lanes for AV shared vehicles, to understand how connected infrastructure and incentives can improve mobility. This pilot will require state support.

Infrastructure as a Service

LADOT / Jim Simmons

| 1 Build a solid data foundation. | 2 Leverage technology + design for a better transportation experience. | 3 Create partnerships for more shared services. | 4 Establish feedback loops for services + infrastructure. | 5 Prepare for an automated future. |

POLICY + IMPLEMENTATION + PILOTS

PLATFORM FOR MOBILITY INNOVATION

DATA AS A SERVICE + MOBILITY AS A SERVICE + INFRASTRUCTURE AS A SERVICE

Conclusion

LADOT proactively sought external resources to develop a transportation technology strategy with the understanding that technological innovation is reshaping transportation today. By looking forward and preparing now for future changes, the City can better leverage technology to make transportation more accessible, convenient, affordable, safer and better connected. LADOT must accelerate its role in planning for the impacts and benefits of shared mobility, automated vehicles and other transportation technologies by transforming into a platform for transportation innovation so to meet policy objectives and create truly great streets for all Angelenos.

Transportation Tech
STRATEGY

The Fellowship

This Transportation Technology Strategy was funded and developed through a one-year fellowship by the Goldhirsh Foundation in partnership with the Mayor's Fund of Los Angeles. The City of Los Angeles Department of Transportation (LADOT) sought additional capacity to examine the changing trends in transportation technology and its impact on the organization, the services it provides, and the overall mobility marketplace in Los Angeles. The citywide strategy outlines the future of mobility in Los Angeles through policy and pilot project recommendations to help ensure a safe, equitable and sustainable future for the city.

Working closely with former Chief Technology Officer Peter Marx and reporting to LADOT General Manager Seleta Reynolds, the transportation technology strategist was additionally supported by an advisory board representing national expertise on issues ranging from transportation planning, technology, shared mobility. The strategist relied on an extensive literature review, attending conferences and webinars, and hosted interviews of a broad range of national stakeholders and subject matter experts. In addition, an internal city team provided further support as a technical review committee that reviewed the strategy while it was under development.

The Goldhirsh Foundation, which has been making grants for almost a decade, seeks to connect the dots between the best emerging innovations and the financial, social, and human capital to make them thrive. More information, including the My LA2050 Grants Challenge, is available at **goldhirshfoundation.org**.

The Mayor's Fund of Los Angeles is a non-profit organization dedicated to improving life for all Angelenos. Uniquely position at the crossroads of local government, business, philanthropy, and the nonprofit sector, the Fund facilitates the communication and collaboration vital to solving Los Angeles' most complex challenges. More information on the Fund can be found online at **mayorsfundla.org**.

The Fellow

Ashley Z. Hand, AIA, LEED AP BD+C was appointed as the Transportation Technology Strategist for LADOT in August 2015. Previously, Ashley served Mayor Sylvester "Sly" James as the first Chief Innovation Officer of the City of Kansas City, Missouri and the first female municipal CIO in the country. Working collaboratively across departments, Ashley focused on process improvement and developing a digital roadmap through strategic planning, staff involvement and the use of lean methodology and design thinking. In addition, she championed an unprecedented public-private partnership to make Kansas City the most comprehensive smart city in North America by bringing digital infrastructure to a new downtown streetcar. Prior to joining the public sector, Ashley was an architectural designer and planner for the global firm AECOM where she worked with public and private sector clients across North America to adopt sustainable best practices and process improvement through community engagement, policy, and change management. Ashley holds a BA in political science from McGill University and a Masters of Architecture from the Pratt Institute and is a registered architect in the State of Missouri and certified green building professional.

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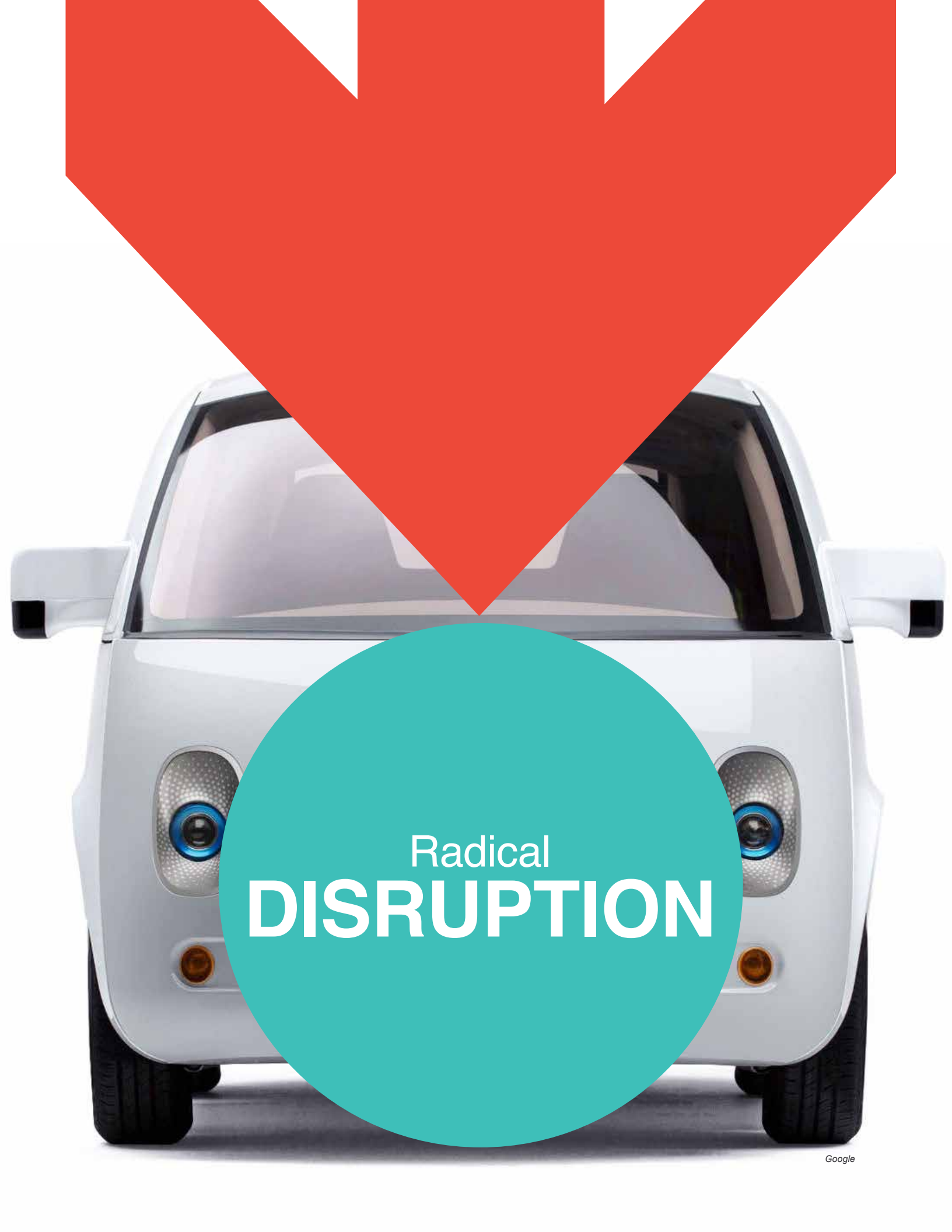**Marcel Porras**
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Radical
DISRUPTION

Radical disruption

Introduction

Why does Los Angeles need a strategy for technology and transportation?

Technological innovation is occurring at a mind boggling pace - introducing new services, transforming customer expectations, and disrupting everything from how we see the world around us to the way we move through it. With two thirds of Angelenos having smartphones (Pew Research, 2013) and a focus on closing the digital divide, it becomes essential to consider how transportation technologies will transform urban mobility options, impact land use and urban design, and introduce new disruption for local government as a regulator and service provider. While technology is not a panacea for the many challenges of urban and regional transportation, it offers LADOT and the City of Los Angeles a chance to rethink how we manage our public right-of-way, provide and partner to offer world-class services, and understand how to best meet the needs of our city.

The city and region are growing. Will traffic come to a standstill?

Over the next decade, Los Angeles County anticipates continued growth although at a lesser rate than previously predicted with recent declines in immigration and birth rates. Demographers continue to remind us of the growing number of senior citizens – to so-called silver tsunami – as the baby boomer generation will all hit 65 or older within the next 15 years. These changes have enormous policy and economic implications as the demand for elder services and care needs to be managed and funded (Gazzar) and transportation services must evolve to meet these needs so this population may maintain their independence. In the 2016 Southern California Association of Government (SCAG) Regional Transportation Plan, several key trends are highlighted:

- Southern California is projected to grow to 22 million by 2040 which is an increase of nearly four million people;
- Tax revenues may decline with as the aging population will be greater than the working population (15 to 64 years old);
- More people will desire more urban lifestyles which impacts demand for transportation and housing;
- Housing prices are increasing and people will still choose to drive alone;
- Moving goods around the region becomes a bigger challenge with growing consumer demand; and
- Impacts on our public health, environment and quality of life will be increase without a shift in transportation behavior (SCAG).

With this anticipated growth in the region, there are real concerns about the impact on traffic and congestion as our infrastructure strains to meet the needs of the growing population. However, it has been demonstrated time and again in cities across the globe that widening roads or building new infrastructure does not affect sustainable change to congestion. Los Angeles must evolve more creatively to address the pending challenges it will face as a result of its ongoing growth.

Transportation technology can offer the city, its residents and visitors, improved mobility options when congestion might otherwise get worse. Applications that help Angelenos share rides, maximizing the capacity of existing vehicles, for example, can greatly improve the efficiency of our existing public right-of-way while improving the overall mobility experience. Technology-enabled shared mobility services such as bikeshare can offer convenient alternatives to driving by providing a flexible resource for short trips. Technology-enabled services will provide seamless connectivity, better mode coordination and greater flexibility for Angelenos to choose how they want to get around and make it easy to pay for their transportation choices through a single platform. In the not so distant future, automated vehicles will provide safe, clean connections from public transit networks to final destinations across the region. In anticipation of these opportunities, LADOT and the City of Los Angeles must adopt a roadmap to prepare now for this growth to maximize community benefits with limited resources. Without action, the city and its communities are subject to the potentially catastrophic outcomes for the health and welfare of the city.

Los Angeles is a huge consumer of transportation but the status quo is unsustainable.

A bustling city and sprawling region of neighborhoods, commercial centers and corridors, Los Angeles has always been a major consumer of transportation. Despite its geographic scale, Los Angeles is the densest metropolitan area in the country - while our Downtown and other central business districts may not be as dense as Manhattan or downtown Chicago, the surrounding neighborhoods and suburbs are much denser than other urbanized areas (Sorensen, 21). The Los Angeles urbanized area has 5,551 persons per square mile, for example, compared to 4,313 persons per square mile in New York-Northeastern NJ (FHWA). However, our perception of sprawl is linked to the way people get around: since Angelenos take most of their trips by car, we perceive the region as low density. We generally think that places where people frequently walk, cycle or take transit tend to have higher population density. The region's combination of high, evenly distributed density means it jointly suffers from problems typical of density such as traffic congestion and poor air quality but lacks the benefits such as fast and effective public transportation and vibrant street life (Eidlin).

Typically density drives down the need to drive since trip destinations and origins are closer. Los Angeles is an anomaly. Los Angeles has a surprisingly high level of per-capita vehicle miles traveled (VMT) relative to its density due in part to policies supporting too much parking (and therefore making more people drive) and land use (people have to travel farther to live their lives) (Sorensen, 22-23). The Los Angeles urbanized area has an annual average daily traffic (AADT) on its freeways of 193,875 (compared to the second highest AADT of San Francisco-Oakland at 145, 461) (FHWA). This is a polycentric region with many edge cities – a term used to describe a concentration of business, shopping and entertainment outside a traditional downtown or central business district. High-density areas such as Santa Monica, Culver City, Century City, Long Beach, Pasadena and Glendale contribute to long distances between where Angelenos work, live and play, making it harder to get around without a personal vehicle. In addition, the availability of free and abundant parking makes it easier to choose to drive because it appears to be more convenient and while cities like San Francisco and New York restrict off-street parking, the City of Los Angeles requires it (Manville and Shoup, 5). Yet, it is estimated that roughly 30% of traffic congestion is caused by people cruising for parking spots – which adds up to a lot of wasted time, wasted fuel, and a negative impact on our air quality (Shoup). How, then, can we shift towards incorporating more sustainable, efficient transportation options to accommodate more people, more effectively while providing a higher quality of service through improved connectivity?LA is a huge investor in infrastructure with extensive built and technological assets.

Angelenos drive a lot and often alone. Unfortunately, Angelenos are all too familiar with the woes of traffic and waste more than 60 hours a year commuting, stuck and frustrated as they try to get around the city (Werbach). This is not unique to Los Angeles; the average private car in the United States only carries 1.6 people (Schmitt) although most are built to carry many more. We underutilize much of our existing roadway capacity because vehicles are not being used at their maximum capacity. Changing this is as simple (and complex) as changing our travel behavior. It is possible to improve the overall network capacity through incentives (workplace benefits, e.g.) or disincentives (expensive parking, e.g.) and this transportation technology strategy will outline opportunities to improve our transportation investments - whether it is a personal vehicle or access to public transport.
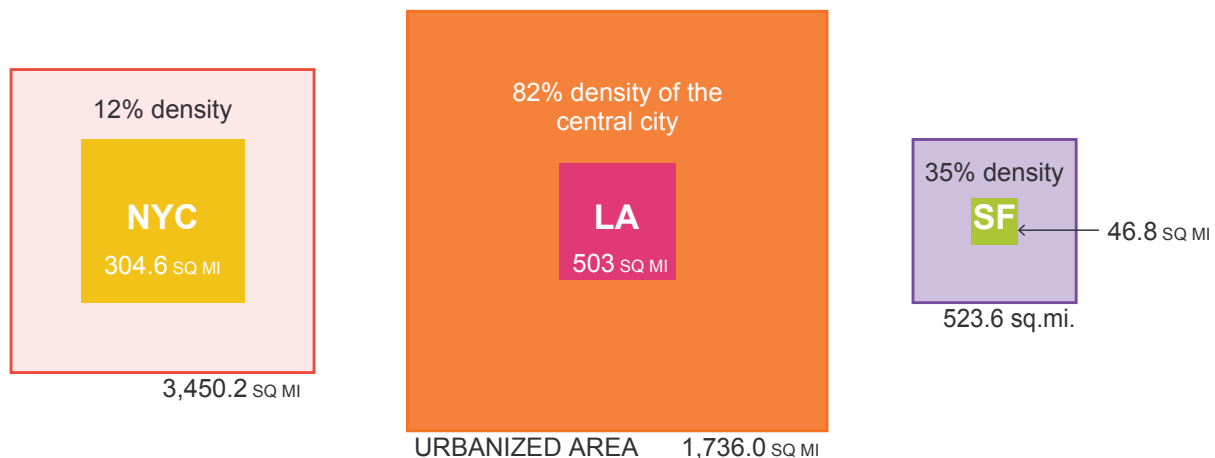
When comparing the density of the urbanized areas of Los Angeles, New York and San Francisco - which includes the suburbs as well - Los Angeles prevails as densest even though the City of Los Angeles is not as dense as compared to these other cities (adapted from Manville and Shoup).

Metro

The Los Angeles region made a significant commitment to improve transportation when it approved a half-cent sales tax to expand public transit across the region. Measure R, which took effect in July 2009, has been used to finance new transportation projects and accelerate those in the pipeline with the hopes of alleviating the pressure on our roadways to move people around the region. Years later, with the extension of light rail nearing completion and new subway extensions hitting major milestones in construction, there has been no noticeable improvement in congestion and ridership has not grown with the availability of new services as anticipated. Since much of the public transit system (our buses) does not have access to dedicated right-of-way, it is often stuck in the same traffic as everyone else which impacts the user experience and makes it less appealing. The network of subway and light rail does not yet provide complete coverage geographically nor does it offer around the clock service; people must rely on buses or other modes to connect to their final destination. The Measure R investment is improving the transportation network, however, and the impacts will accumulate in the years to come.

A second ballot initiative, scheduled for November 2016, could generate additional revenue over the next few decades to further connect the system and support infrastructure improvements. The final list of projects are still being determined but the proposed investments should make public transit easier and more convenient to use. As the population grows, the demands on our infrastructure will also expand as transportation consumption increases. If there are no changes to policies around parking, land use, or transportation technology, there will be limited ability to grow beyond the existing network capacity. Maximizing the utility of the public right-of-way while expanding access to shared mobility options will maximize capacity on our roads and improve the use of resources.

LADOT provides direct transit services to Angelenos such as DASH, Commuter Express and Access rides which help people move around neighborhoods, travel longer distances into central business districts, and provide an essential service to people might not be able to ride traditional transit or drive themselves. In early July 2016, the Los Angeles County Metropolitan Transportation Authority (Metro) and the City of Los Angeles introduced bikeshare as an extension of the public transit network which will provide another option for local connections in a city that has beautiful weather most of the year. LADOT is also developing a mobility hub pilot to better connect multiple modes of transportation by co-locating transport, supportive services such as bike repair, and information at centralized locations.

Technology has enabled the introduction of new transportation choices in Los Angeles. Smartphones and other technologies have led to the emergence of a sharing economy, making it possible to better connect Angelenos who need to move around with resources to help them get there. The private sector has introduced a variety of transportation options in recent years. Carsharing services, for instance, enable Angelenos to borrow a car on a short term basis or even loan their car to others when not in use. Shared mobility services offer additional choices to those who prefer not to drive themselves and have disrupted traditional transportation services such

as taxis with a great deal of media and fanfare. It is still not clear what impact these private services have had on public transportation and mobility as a whole since there is currently limited data for evaluation. There is a growing body of empirical research that demonstrates how shared mobility can change travel behaviors and even reduce vehicle ownership as is evident in the prolific work of the Transportation Sustainability Research Center, among other organizations. However, city regulators require more real-time data to fully understand the impacts on congestion, safety, or convenience in moving around as a whole. Furthermore, with all of these available services, both public and private, Angelenos are still paying a great deal to get around the city and region as transportation remains the second highest household cost behind housing. LADOT must take a comprehensive approach to mobility management; balance safety, equity and access; and track how new metrics to understand the changes these transportation technologies will have on the transportation ecosystem in Los Angeles.

Los Angeles is a huge investor in infrastructure with extensive built and technological assets.

The physical evidence of our current transportation choices is everywhere: freeways packed with vehicles; expansive and often underutilized parking lots; High Injury Network where the highest concentration of collisions occur; broken sidewalks; empty buses; lack of bicycle infrastructure, etc. Los Angeles has the densest road network among the nation's 14 largest metropolitan areas, providing over 50 percent more than the next city, Detroit (Sorensen, 21) and much of this infrastructure is dedicated to the tradition of driving alone. The City of Los Angeles has approximately 28,000 lane miles of streets making it the largest municipal street system in the nation (Bureau of Street Services). Maintaining this road and sidewalk network in a state of good repair requires a significant annual investment. The City of Los Angeles Bureau of Street Services is charged with repaving 2,200 lane miles of roadway per year which presents a considerable opportunity to rethink how this infrastructure will serve the needs of future generations by potentially embedding new technologies or adapting striping and signage to support a future with automated vehicles.

For generations, roads in the United States were designed with wider lane widths (11-13 feet) to create

a more forgiving buffer to drivers, especially in high-speed environments and lane widths less than 12 feet were assumed to decrease traffic flow and capacity. This misconception was refuted in a 2013 study by The Pedestrian and Bicycle Information Center and this research has informed the NACTO Urban Street Design Guidelines, which LADOT has adopted. This new approach to road design creates opportunity to rethink how to use this "extra" space in the public right-of-way and affords opportunities to better accommodate multiple modes while improving the overall experience of travel.

LADOT has also led significant efforts to build supportive infrastructure such as its traffic management center to help move vehicles more efficiently across the city through coordinated signalized intersections. This expansive network gives LADOT the opportunity to understand in real-time how the public right-of-way is being used but needs further investment to expand its capabilities to evaluate the speed on the roads, utilization and efficiency of the public right-of-way and better accommodate active transportation (walking and biking). Leveraging the data from this network could provide considerable insight to transportation planners and engineers within LADOT as well as the private sector. Developers, for instance, are often required to provide traffic studies to the Department of City Planning but this information could be available automatically from the city's traffic management center.

The City's expansive physical and technology infrastructure are considerable assets; the quantifiable and qualitative impacts of transportation technologies must be considered as LADOT and other city departments plan for capital improvements and strategize for ongoing maintenance of these assets. Both shared mobility and automated vehicles, the two technology trends that are the focus of this strategy, offer the potential to transform how Angelenos access and use the public right-of-way with substantial benefits to the city's goals for equity, economy and environment. Simply understanding the conditions of these assets and how they are used will significantly improve future planning and project evaluation as changes and improvements are made. However, a failure to proactively address the impacts these technologies will have on our city and region can reap potential disastrous outcomes – leading to greater sprawl, congestion and pollution. The intent of this strategy is to provide a policy framework and series of actionable next steps to make sure these benefits are realized and negative impacts are mitigated as best as possible.

Shared Mobility: Alternatives to the Status Quo

Global trends indicate that more than 6.2 billion private motorized trips happen every day in cities around the world so Los Angeles is not alone in the prevalence of the single occupancy vehicle (i.e. driving alone). With cities and metropolitan regions growing, it is anticipated that traffic congestion will bring cities worldwide to a standstill - with staggering economic and environmental ramifications - and a half a million people will be killed in traffic incidents each year (Future Lab, 4). Congestion is becoming so bad, in fact, that it will inevitably force alternatives upon us as drivers will be compelled to leave their cars at home and find more efficient ways to travel (Bouton, et. al.).

While these numbers are staggering, technology can enable greater efficiency on our roadways by filling existing vehicles, freeing the limited public right-of-way to better serve our communities. Technology, supported by wholesale and structural public policy changes, are needed to better coordinate the availability of transportation choices that provide Angelenos and its visitors with flexible options that are proportional and flexible in response to demand.

Consider how much time a personal automobile sits idle. We park our cars while we are at home, shopping, or at work, actually driving our vehicle for about five percent of the time. We purchase vehicles that meet our greatest needs (for instance, carpooling to soccer practice) even

if unnecessary for most of the time spent traveling (for instance, commuting alone to work), just like we set parking standards for Christmas Eve peak demands while letting land sit empty throughout the remainder of the year. These are inefficient uses of costly assets.

Shared mobility offers a scalable alternative to traditional car ownership, maximizing efficiency of the automobile or eliminating the need for ownership entirely.

Shared mobility - the shared use of a vehicle, bicycle, or other mode - is an innovative transportation strategy that enables users to gain short-term access to transportation modes as-needed. This includes both publicly and privately operated networks for public transit, on-demand ride services, carsharing, bikesharing, and the like. Depending on the jurisdiction or area, shared mobility can serve as the primary mode of transit or as a complement to fixed-route bus and rail services (Shaheen, 6). Definitions of all the known and current shared mobility modes are available through the Transportation Sustainability Research Center and Shared Use Mobility Center.

Shared mobility services have proliferated in recent years with the broad availability of smartphones and expanded internet and cellular connectivity. Smartphone applications, typically limited to a single mode such as a specific provider of bikeshare or carshare, can accurately track, in real-time, the availability of resources (e.g. availability of seats in a vehicle) and match them

ATSAC: The Central Nervous System for LA's Roads

ATSAC (Automated Traffic Surveillance and Control) is the centralized traffic control center for the City of Los Angeles, designed and built by the engineers of LADOT. The system provides real-time monitoring and adjustment of signal timing for nearly 4,400 signalized intersections citywide with over 20,000 loop detectors. These detectors collect anonymous information on vehicles as they pass over them which is sent to the centralized traffic control center. From this information, LADOT can estimate travel speeds on city streets and provides a system-wide view of traffic information. The system has been shown to reduce travel time by 12% and increase speeds by 16%.

Built to support the 1984 Olympics, ATSAC only manages traffic signals within the City of Los Angeles. Freeways are managed by Caltrans and adjacent cities have their own traffic control systems. While significant improvements have been made to this system over time, including better integration and coordination with adjacent networks, there is great need for further investment in basic facilities and supporting information technology infrastructure. However, ATSAC provides a wealth of potential data for planning and project evaluation purposes which can be accessed through the central data warehouse, RIITS.

Pixabay/ Efraimstochter

Shared mobility can complement traditional public transit such as bus + rail, but it needs to be integrated into a complete ecosystem of services.

There are barriers to these services that typically require access to technology, a credit card (or bank), and digital literacy, and more research is needed to understand the diversity of populations served by these services. In Boston, MA, for example, microtransit has been the most successful in higher socioeconomic neighborhoods that are already transit rich, but there is not enough market penetration to improve the overall mobility of the city at-large (Gurley). Furthermore, the public sector may consider shared mobility an efficient and economical way to quickly expand service, improve access, reduce environmental impact, lessen traffic congestion, and pressure on-street parking supply (SUMC, 18), but it will be essential to prioritize issues of equity and access to ensure it benefits more people more effectively.

With an aging population and the millennial generation putting off getting their driver's licenses until much later than previous generations, vehicle purchase behavior is also changing. Individual mobility behavior is changing as a result of shifting consumer preferences, tightening regulation, and technological breakthroughs (Gao). Car manufacturers and others have taken notice and have begun adapting their business models, even offering their own shared mobility services, in response to individuals increasingly using multiple modes of transportation to complete their journey and goods increasingly being delivered.

It is anticipated that there will be continued growth in these services, further disrupting urban mobility. Los Angeles is behind other U.S. cities in the wide adoption of a diverse range of shared services. While technology-enabled ride-hailing services are popular, the penetration of carsharing services and other shared modes that could help reduce vehicle miles traveled has lagged. With the introduction of electric vehicle carsharing services in low income communities and citywide bikeshare in 2016, there are several immediate opportunities to adapt best practices and lessons learned.

with consumer demand (e.g. I need a ride somewhere). Research has demonstrated the wide ranging benefits of a vibrant sharing economy as able to: provide more mobility choices; offer solutions to connect with transit; reduce traffic congestion, vehicle miles traveled, and greenhouse gas emissions; lessen parking demand and free up land for new uses; create independence for those who cannot afford to buy and maintain a vehicle; reduce transportation costs for households; provide new opportunities to earn extra income by renting out excess vehicle capacity; and, increase efficiency and convenience, especially when modes are linked together (SUMC, 1).

Shared mobility challenges the perception that owning a vehicle is the most convenient mode of travel. User surveys indicate that access to these shared services make it possible to either avoid purchasing or allow a family to get rid of an existing vehicle. Analysis by MIT and Stanford estimates that shared rides could reduce the number of vehicles needed to carry out the same number of trips by 70 to 90 percent (Gattis). As the second highest household expense, this opens up economic opportunity when the fixed costs of vehicle ownership are traded in for access to mobility services where households only pay for what they need.

There is substantial evidence in U.S. cities and in markets worldwide that shared mobility can thrive and meet the needs of communities when supported by the right public policy and regulatory framework. These services are successful when they are convenient, affordable, and accessible choices, but must also be factored into land use decisions and other regulatory considerations in order to make a significant impact. New policies should offer both incentives such as designated on-street parking spots to enhance the visibility and ease of access to shared services and disincentives that ultimately drive up the cost of vehicle parking. The City of Los Angeles must use both approaches to succeed in shifting behavior

SINCE 2004, BIKESHARE PROGRAMS HAVE GROWN FROM 13 SYSTEMS WORLDWIDE TO

855 SYSTEMS[1]

LADOT + METRO LAUNCH BIKESHARE WITH 1000 BIKES IN DOWNTOWN LA IN 2016.

Ridesourcing company Lyft is operating in **195** cities with **315,000** drivers

Uber works in **360+** cities **68** countries with hundreds of thousands of drivers signing up globally per month.[2]

IN 2014, MEMBERSHIPS FOR CARSHARING REACHED

1.33M PEOPLE ACROSS THE UNITED STATES

Each shared car takes about **9 to 13** cars off the road. Carshare has taken roughly **90,000 to 130,000** vehicles off the road.[3]

Shared mobility is the shared use of a vehicle, bicycle, or other mode of transportation that enables users to gain short-term access to transportation modes as-needed.[4]

Shared mobility is DISRUPTING transportation.

Shared mobility is a more efficient way to use resources and offers convenient, affordable and scalable solutions that complement public transit.

While all the impacts of shared mobility are not fully understood, traditional models such as taxis have suffered. The taxi industry has fought the introduction of rideshare which seeks a different regulatory standard, particularly on issues such as fingerprinting and background checks.

PRE-ARRANGED TAXI TRIPS (LA)
↓ **42%**

TOTAL NUMBER TAXI TRIPS (LA)
↓ **30%** [5]

1. Shared-Use Mobility Center. (2015). *Shared-Use Mobility Reference Guide*. Retrieved from SUMC. 2. Shaheen, S. (2016, January 11). *Shared Mobility Trends 2015-2016*. Retrieved from InnovativeMobility.org. 3. Martin, E., Shaheen, S., Lidicker, J. (2010). *Impact of Carsharing on Household Vehicle Holdings: Results from North American Shared-Use Vehicle Survey*. Retrieved from Transportation Sustainability Research Center. 4. Shaheen, S., Chan, N. (2015, Spring). *Mobility and the Sharing Economy: Impacts Synopsis*. Retrieved from Transportation Sustainability Research Center. 5. Nelson, L. (2016, April 14). *Uber and Lyft have devastated L.A.'s taxi industry, city records show*. Retrieved from The Los Angeles Times.

Connected + Automated: A Safer + More Efficient Vehicle Network

Angelenos may love their cars, but we really hate traffic. Our region is expected to continue to grow in the next decade, and if we maintain the status quo, congestion will only become worse. As a result of a phenomenon called illusory superiority, most American drivers consider themselves above average (Roy). Yet, in the United States, more than 30,000 people are killed each year in crashes and approximately 2.5 million are injured; the vast majority of these crashes are the result of human error (Anderson et. al., 4).

In 2013, 978 people suffered severe injuries in collisions and 201 people were killed while trying to move around Los Angeles. Nearly half of the people who die from traffic violence on our streets are walking and bicycling. Children and older adults are represented in alarming numbers, accounting for 30 percent of all bicycle- and pedestrian-related traffic deaths. While Vision Zero peer cities have been making progress in eliminating traffic-related fatalities, Los Angeles' record has not been improving (Vision Zero Los Angeles).

Without a significant shift in travel behavior combined with new technologies to make roads safer for all Angelenos, any relief will only be temporary. The existing model is unsustainable.

Traditional auto manufacturers and new entries into the transportation field by technology companies such as Google, Bosch, and Apple are in the midst of an "arms race" to develop automated vehicle technology that will completely transform our roadways in more ways than we can imagine. There are several different approaches being taken in developing the "self-driving car," and for the sake of simplification, this strategy defers to automated vehicle technology as the primary pathway but acknowledges the various iterations this technology might come to market first. As defined by the United States Department of Transportation, automated vehicles are those in which at least some aspect of safety-critical control function (e.g. steering, throttle, or braking) occurs without direct driver input. Automated vehicles may be autonomous (i.e. use only vehicle sensors) or may be connected (i.e. use communications systems in which cars and roadside infrastructure communicate wirelessly) (USDOT).

Arguably, automated vehicles are potentially the greatest transportation technology innovation since the invention of the internal combustion engine with significant implications for safety, accessibility, convenience, and our physical environment. However, most of this innovation is being driven by the private sector and the technology is evolving without including local government. With automated capabilities being introduced to vehicles in the market already and Google having completed millions of simulated hours and thousands of driving hours on the roadways of California, this revolution seems right around the corner. By working together now, the City can set priorities and identify opportunities to maximize the benefits of this innovation for the entire city.

Without a proactive role by local government, connected and automated vehicles may not fulfill the promise of making our roadways safer, more efficient, and more accessible.

Through a combination of automated vehicles, car sharing and right-sizing car ownership, it is estimated that up to 85 percent of automobiles in cities can be eliminated with a significant impact on congestion and creating a

V2V: Vehicle to Vehicle
Each vehicle is a node with the ability to send and receive critical safety + mobility information to other vehicles.
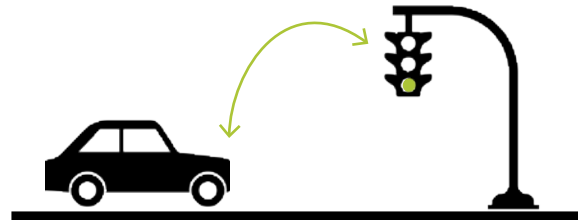
V2I: Vehicle to Infrastructure
Vehicles are able to send and receive information to surrounding infrastructure such as traffic signals and road sensors.

V2X: Vehicle to Everything
Vehicles can communicate with other vehicles, infrastructure and other users of the public right-of-way for a safer, more efficient transportation network.

There are a variety of terms used to describe the types of communications for automated vehicle technologies. Connectivity is an important input to realizing the full potential benefits and broad-scale implementation of automated vehicles (USDOT).

sea change for the auto industry (Weikel). By creating a culture of shared mobility today and working efficiently to adapt our digital and physical infrastructure to supported connected and automated vehicles in the future, Los Angeles can redefine the use of our public right-of-way and alleviate pressures on the built environment that currently support single occupancy vehicles (and their substantial parking requirements).

Waiting until the technology has reached the market could have devastating and unintended consequences of increased vehicle miles traveled (i.e. empty cars driving around the city), increased emissions (longer travel distances because drivers do not need to be at the wheel), and a fragmented city ringed by satellite parking structures. Without planning and preparation, Los Angeles may miss out on the advantages of this technology for generations. Additionally, there will be a considerable transition period if market forces alone drive the conversion from human drivers to automated vehicles since the average vehicle owner holds on to their car for about a decade. To ease transition and promote adoption, local governments can

define a policy framework to shape the desired outcomes in transportation and land use.

The approach being taken by the United States (both auto manufacturers and technology companies) assumes that these vehicles can navigate and operate safely within our cities without any intervention or new digital or physical infrastructure. The federal government up until recently had deferred any decision making and standards to the state governments, and the State of California is in the early stages of drafting regulations for automated vehicles. There has been limited consideration for what role local government should have in supporting this technology, and the innovation is rapidly evolving without local stakeholders at the table. Meanwhile in Europe and Asia, smart infrastructure is being tested in conjunction with connected and automated vehicle pilots to better understand how these vehicles might interact with their environment and provide valuable data. This provides a more holistic view of the challenges and opportunities of having vehicle-to-infrastructure communications, as well as testing the various technologies for V2V sensing.

Level 0	NO AUTOMATION	The driver is in complete and sole control of the primary vehicle controls - brake, steering, throttle, and motive power - at all times.
Level 1	FUNCTION-SPECIFIC AUTOMATION	Automation at this level involves one or more specific control functions. Examples include electronic stability control or pre-charged brakes, where the vehicle automatically assists with braking to enable the driver to regain control of the vehicle or stop faster than possible by acting alone.
Level 2	COMBINED FUNCTION AUTOMATION	This level involves automation of at least two primary control functions designed to work in unison to relieve the driver of control of those functions. An example of combined functions enabling a Level 2 system is adaptive cruise control in combination with lane centering.
Level 3	LIMITED SELF-DRIVING AUTOMATION	Vehicles at this level of automation enable the driver to cede full control of all safety-critical functions under certain traffic or environmental conditions and in those conditions to rely heavily on the vehicle to monitor for changes in those conditions requiring transition back to driver control. The driver is expected to be available for occasional control, but with sufficiently comfortable transition time.
Level 4	FULL SELF-DRIVING AUTOMATION	The vehicle is designed to perform all safety-critical driving functions and monitor roadway conditions for an entire trip. Such a design anticipates that the driver will provide destination or navigation input, but is not expected to be available for control at any time during the trip. This includes both occupied and unoccupied vehicles.

Five Levels of Automation per the U.S. Department of Transportation National Highway Traffic Safety Administration

Ford Motor Company estimates that there will be automated vehicles on the roads within four years (Ungureanu). It will take time for the entire fleet of vehicles on the road to convert to automated, as people replace their cars, but rapid adoption is anticipated among taxi services and ride-hailing services since almost 80 percent of the cost of a ride is the driver (Gattis). While the timeline of this technology hitting the market ranges from the aggressive predictions of five to ten years to a more realistic estimate of 25 to 30 years, LADOT should begin addressing some of the core outcomes today. Regardless of whether we ever attain a completely connected and automated vehicle future (i.e. no more human drivers), the introduction of this technology to our public right-of-way must be managed effectively as the stakes are so high. Developing real-time data on the state of infrastructure repair, markings and signage, traffic signal timing, and other map-related data to be shared with connected and automated vehicles will help improve navigation and focus future investment in infrastructure improvements along urban networks for these vehicles.

This transportation technology strategy will outline steps LADOT should consider in preparation for the arrival of connected and automated vehicles and a call to action to begin testing this technology in public transit applications immediately since there is considerable opportunity to capture federal funding, help shape state regulations, and provide an opportunity to test this technology in one of the most car-centric cities in the nation.

Challenges of a Changing Tech Environment

Cities design and build infrastructure to last for decades while technology changes at a much faster rate. Smartphones have revolutionized mobility with new services and applications changing how people move. New private sector services launch regularly and more choices have introduced competition into the mobility marketplace. LADOT is among many transportation providers redefining its role in this new, evolving environment. There has been a notable lag, however, among public sector transportation and infrastructure providers in integrating big data - which refers to the velocity and variety by which data is collected (Sattell) - into planning, design and operations to address issues of congestion and mobility. While the cost of acquiring data might be perceived as a barrier for cities to adopt new technologies, in fact there are several, interdependent barriers to change:

- A lack of transparency among complex networks with multiple participants - e.g. consider the multiple public and private providers within the Los Angeles region.

- Unclear methods to determine how to divvy the costs and benefits of sharing information. With more private companies in the mobility marketplace, different players have different goals and it can be difficult for local government to establish a level playing field.

- The monopoly of infrastructure management acts as

Mobility Transformation Center

M City is a full-scale simulated city designed and built to create an off-road testing environment for autonomous vehicles. It includes approximately five lane-miles of roads with intersections, traffic signs and signals, sidewalks, benches, simulated buildings, street lights, and obstacles such as construction barriers for closed testing by auto manufacturers. The facility opened in July 2015.

a barrier for new models and innovation in this space (Neumann).

Government action can ensure that these technologies help move the city forward in meeting its environment, economic development and equity goals in ways that can yield beneficial results. Keeping up with technological innovation is nearly impossible for government but by establishing a data-focused platform, it can better adapt and address these changes.

Additionally, simply because someone has designed an application or vehicle and offers an on-demand service does not result in market transformation. In fact, there are very realistic consequences to the introduction of technology that left unchecked could have negative impacts on Angelenos and the region as a whole. Automated vehicles, for instance, may not improve congestion but worsen it as vehicles can now drive around without passengers. In addition to higher vehicle miles traveled, automated vehicles could encourage greater sprawl as now passengers are no longer distracted by driving but can spend their "free time" sleeping, enjoying entertainment, or even working while traveling greater distances to get where they need to go. The most important potential consequence of new technologies is the impact on social equity. Since not everyone has the same access to technology or means to engage with these new tools (e.g. the unbanked population that does not have a credit card), transportation technology on its own does not promise a better city of the future and requires active participation from agencies such as LADOT to ensure the public good.

Transportation Happiness: A New Measure of Success

New technologies change behavior (Bouton, et. al). Consumers expect user-friendly, well-designed technology to help them access and connect with services and information. In response, public transit systems across the country have evolved and introduced new tools: trip planning applications to provide better information in advance of starting a trip; real-time information websites to help Angelenos navigate traffic and anticipate travel times; real-time arrival signage at transit stops for better on-the-go information; mobile ticketing for better access to transit payment systems; and other services. Public transit agencies are evolving, but not fast enough to keep up with the ongoing improvements and competition from private service offerings. Angelenos want services that are useful, usable, desirable, findable, accessible, and credible (Usability.gov). Government, in turn, must acknowledge that the traditional ways of delivering public transit services should be flexible as the mobility marketplace continues to evolve.

Los Angeles is one city within a greater metropolitan region that includes a multitude of overlapping public and private services, introducing complexity that makes it

LA Great Streets

challenging to access and understand how these systems work together (if at all). For new transit riders, for instance, it can be daunting to figure out what payment methods are required and available across services which is a potential barrier to adopting public transit as a preferred mode.

Services in Los Angeles are fragmented and difficult to navigate with different rules, access points and fare systems making public transit confusing and a barrier to adoption.

Customer experience focuses on having a "deep understanding of users, what they need, what they value, their ability, and also their limitations" (Usability. gov) while also accounting for the goals and priorities of the managing organization. A positive user experience will shape the quality of a customer's interaction and perception of a service. With so many competitive private mobility services in the sharing economy and considerable investment in public transit modes, local governments must think about the user experience across all modes – treating customers with hospitality and generosity at a high level will be key to the long-term viability of public transit investments. Understanding what issues influence satisfaction while traveling (Duarte, 30) and where these issues occur are essential to helping LADOT identify and prioritize opportunities for improvement. This ultimately should impact how we measure services in the future.

Studies show that even longer commute times do not impact "transportation happiness" as much as the mode choice itself. Research by McGill University on commuter satisfaction across modes – a survey of over 3,300 commuters who use walking, bicycle, automobile, bus, metro and commuter train in Montreal - found that pedestrians, train commuters and cyclists are significantly more satisfied than drivers, subway and bus users. Travel time matters less to walkers, bikers and bus riders than it did for commuters by other modes (St. Louis, et. al.). With new technology-enabled service models and increased strain on our infrastructure, it is becoming increasingly more important to evaluate transportation project and service impacts for more than just cost-benefit. Identifying metrics for measuring the quality of travel experience, the well-being of travelers and their travel behavior will help measure the competitiveness of modes.

To improve customer experience and choice, LADOT must define how it will measure transportation happiness to target improvements and investments in services and supporting infrastructure.

Technology evolves rapidly while investments in infrastructure may endure for fifty- to one-hundred years, defining urban form and development for generations.

These cycles are unbalanced and present a challenge for transportation planners and engineers who are charged with designing and maintaining the public realm. It is essential to consider how this infrastructure might more readily and efficiently adapt over time to incorporate new modes (and transportation technologies). Our approach to design and infrastructure must be grounded in the perspective of the users. This approach requires new data-driven approaches to the planning and design process, as well as ongoing project and service evaluation to ensure there is a feedback loop to guide improvement.

LADOT should set the goal of creating a mobility experience that is world-class. This transportation technology strategy will identify multiple opportunities to improve the customer travel experience through better planning, data sharing, process improvement, and partnerships.

Time Horizon

The timeline for recommended next steps ranges from starting immediately (TODAY) to complement everything that is happening today in Los Angeles, to actions that should be taken within the next three to five years as more foundational strategies take shape (TOMORROW), to looking down the road to opportunities in the next decade (FUTURE). Essential to all of these recommendations, it should be noted, is the importance of ongoing feedback and measurement of progress to ensure the intended outcomes of policy recommendations are being met and to allow LADOT to refine pilot projects and other initiatives as we learn more about their impact and even as new technologies emerge. While these recommendations are presented in a sequence, it is also important to acknowledge that most of these actions could (and should) occur concurrently as many of these actions are complementary. LADOT should approach this strategy as a living document that can be amended and added to as priorities continue to evolve, new technologies come online, and the department's capacity to handle data and new disruptors improves.

Wikimedia Commons/Pysäkinmerkki

Mobility as a Service: Incremental but Fundamental Change

Helsinki Finland has called for a complete transportation of its mobility networks by setting a bold goal of creating a comprehensive mobility on demand system by 2025. This vision is to transform existing public transportation into a comprehensive point-to-point system, enabling riders to purchase mobility across multiple modes in real-time via smartphones and create better access to cheap, flexible and more coordinated services. Helsinki is committed to this approach because it contends that the cost, convenience and ease of use will be competitive with car ownership (Greenfield).

2025 Mobility on demand: Helsinki sets a bold plan (and proves it won't be easy): Kutsuplus (Finnish for "call plus") started as an idea in a local university and grew to a pilot of fifteen microtransit vehicles that were owned and operated by the local government. A local tech startup, Ajelo, developed the dispatch system and application to allow riders to arrange and pay via smartphone for an on-demand van service that cost more than local public transit but was cheaper as a shared ride than a taxi (Kelly). The hope was to expand this service to SMS to enable those without a smartphone to access the service and even pay for the rides through a charge on the phone bill. Launched in 2012, the service offered amenities such as WiFi onboard and the flexibility of on-demand transit. The service, however, was closed at the end of 2015 because of the lack of ridership and the inability to scale (Brustein).

There were several challenges with this pilot because of how it was structured and funded. The Helsinki Regional Transport Authority provide 80% of funding through subsidies and there was no money for outreach to raise public awareness about the service or to scale up to offer better service with a larger fleet. The Transit Authority was also required to hire drivers on a three-year contract which created additional upfront costs and little flexibility to adapt (Kelly). The cost to run this program was simply too expensive even though there was 60% year over year growth in ridership.

In late 2015, the government suspended service while it searches for a private sector partner to take over (UUTISET). While this model was unsuccessful as it was initially configured, it does not mean that other cities cannot benefit from learning its failure to thrive: the city was never able to scale its service to increase market share and was somewhat held captive by the decision about what size vehicle would work for this program and how to execute. Adopting a more flexible approach could lead to future success in implementation.

Private sector attempting to keep moving mobility as a service forward: A startup called MaaS Finland has recently raised 2.2M Euros in its first round (Suson). MaaS Finland is developing a mobility packages service that will enable riders to bundle everything from public transport to taxis to rental cars in a simple monthly fee - and could even extend the service to include the delivery of groceries. The company targets a launch of its services in 2016 or early 2017. This model is not unlike what has been developed and proposed by Xerox in the development of the GoLA application. Starting with trip planning capabilities designed around individual preferences, Xerox plans to extend functionality to include payments and reservations.

Establishing broad partnerships for success: 20 European organizations, including universities, government agencies, and other industry groups, have joined forces to launch the Mobility-as-a-Service Alliance. The goal will be to create a scalable model that can be replicated in multiple markets while maintaining a focus on designing mobility services around individual needs (MaaS Alliance). There is no evidence that this alliance will be successful but it is an opportunity to advocate for standardization across markets where possible.

Role of
LOCAL GOVT

Role of Local Government

Goals

Smartphones and other technologies are enabling new transportation services to evolve very quickly and new players are entering this space. Some shared services have seen incredible success and have rapidly scaled across multiple cities while others fade as quickly as they were introduced, struggling to create a viable business model and customer base. This presents a considerable challenge for LADOT which must reassess its role as a regulator and service provider in the evolving transportation technology landscape. As a 21st century department of transportation, LADOT must:

Promote affordable, walkable, high-quality development around transportation hubs for the efficient use + access to services.

Affordable transit-oriented development can improve communities by making it easier for people to access transportation options near where they live and work. First and foremost, development should strive to reduce the burden of transportation on household budgets - the second highest monthly expense. Better connecting goods, services, and people can help economic expansion and growth. Development should be scaled to and centered on accommodating multiple modes, including automobile and transit networks as well as pedestrian, cycling and, eventually, automated vehicle networks.

Transportation and land use are inseparable and current methods for evaluating transportation services do not account for the productivity of land use or overall market productivity – rather they rely on delay-based metric. Integrating these considerations can help LADOT deliver better planning and services to Angelenos. Furthermore, today's technologies help meet people's demand in real-time, reducing the impact of mobility on our environment and society through greater efficiency. Urban design can amplify benefits and increase options for people. Density and diversity of such development should strive to connect with mobility options.

Maintain the public right-of-way and keep digital + physical infrastructure in a state of good repair.

The advent of new technologies has expanded the requirements of the built environment and infrastructure. The limited public right-of-way, from sidewalk to street to sidewalk, remains essential to supporting multiple modes of travel while also serving ecological functions and creating a sense of place. The design and management of these physical elements should be responsive and scaled to the modal mix as prescribed by transportation and urban planning best practices.

Digital infrastructure such as communications technology and smart city sensors provide an additional opportunity for better management and service response and therefore should be prioritized for installation, funding, maintenance, and management as a mechanism to generate and monitor new data. They provide a critical input to data-driven decision making in real-time. Local government needs the resources and capacity to maintain this infrastructure in a state of good repair to ensure the safety of all mobility modes.

Ensure safety, equity, and access of mobility systems through regulation and enforcement.

The role of local government as regulator and enforcer is a historical and essential responsibility of the public sector. It assumes shared principles advance the public good while firmly holding publicly-elected decision makers accountable to their constituents. The regulatory and enforcement function of local government balances individual self-interest with public policy in order to benefit cities.

Information and communications technology are already shifting the need for regulations focused on service quality. Since these applications provide information for

riders through "reputation" services, including data on the driver and vehicle in advance, the role of government is evolving. Local government must instead focus on public safety, through tools such as increased training, permit standards and data sharing requirements, as a central regulatory concern for local government in this evolving marketplace (Transportation Research Board, 100).

There must a critical evaluation of technologies that may leave communities behind as they are increasingly incorporated into access to services and transportation choices. Public agencies such as LADOT need to be considerate of the digital divide as new mobility services often require a credit card and/or bank account, access to the Internet, and a smartphone to arrange for services. Approximately eight percent of predominately low-income U.S. households lack bank accounts and 36% of Americans currently do not own smartphones. This percentage increases among those earning less than $30,000 (50 percent) and adults over 65 years old (73 percent) (Transportation Research Board, 98). This transportation technology strategy will outline policy recommendations and actionable next steps for LADOT to consider as it must reconcile critical mobility trends with its obligation to ensure equitable access.

Desired Outcome: Create a platform for innovation.

The headlines over the last few years have been clear: the launch of ride-hailing services such as Uber and Lyft in cities across the United States caught many local and state governments off-guard. Cities were and in most cases still are ill-equipped to manage these new service models. In a forward-looking city, though, such "disruptive" technologies and services must be sought out or even co-developed in order to both understand and address how they might impact cities and other transportation modes, and how to handle demand. Our question is this: how can local government be better prepared in the future to respond and anticipate changes to the mobility marketplace and remain effective as a regulator and service provider, if applicable?

As regulators and service providers, local government is not in the position to pick the transportation technology winners. Rather than supporting a single vision of the future dominated by a single technology, LADOT should enable a marketplace of choices through more effective, data-driven mobility management.

This strategy does not assume that local government will be the sole provider of public transit services. It may be impossible for public agencies such as LADOT to fully assess how a service it provides is competing or sustainable in the new mobility marketplace but there are new tools and methodologies to better understand this ecosystem. Considering the decades of investment in the traditional modes across the region (passenger rail, commuter rail, subway, light rail, streetcar, bus rapid transit, local bus, etc.), it is important to understand how our traditional assumptions may be changing with the emergence of new services and providers. Instead the emphasis of local government should be on the core measures for service: quality, safety, security, convenience, sustainability, affordability (Future Lab, 36) rather than the legacy of services with which LADOT is most familiar. This strategy outlines an approach for LADOT to evolve to provide and enable three key services in Los Angeles: Data as a Service, Mobility as a Service, and Infrastructure as a Service.

Go LA Application

Working in partnership with the City of Los Angeles, Xerox launched the Go LA application in January 2016 as one-stop mobile access to many public and private modes of transportation. The Go LA taps into the breadth of options available and computes the shortest, cheapest and most sustainable way to get to a final destination. The City of Los Angeles is piloting the app that aggregates and calculates the time, cost, carbon footprint, and health benefits from walking, biking, driving your own car, parking, taking public transit as well as private transportation options such as Lyft, Zipcar, and FlitWays. Within its first year, Xerox hopes to integrate reservation and payment capabilities into the app to enable travelers to seamlessly pay for their trip.

There are individual apps for various modes of transportation and some trip planning functions in other applications allow for planning multi-modal trips but few allow for a side-by-side comparison defined by user preferences. This tool will also learn about individual travel preferences to enable smarter recommendations for commute and travel options. Data from the application will also be shared with the City of Los Angeles and offer insights into how people travel around the region. This information is useful as cities look to redesign and update travel systems while optimizing capital spending on infrastructure and service improvements. In addition to the payment and reservation capabilities planned for future versions of the application, Go LA will also be expanded to include payment and reservations for the ride-hailing service Lyft in addition to including destination parking information.

Data as a Service

In the digital age, LADOT must be able to provide and receive real-time data from an increasingly complex marketplace of public and private transportation service providers, other jurisdictions, and connected and automated vehicles to maximize the efficiency and safety of the road and transportation networks. The San Pedro Bay Port Complex, the combined ports of Los Angeles and Long Beach, is the world's ninth largest container port (Port of LA). In 2015, more than 76 million passengers travel through LAX. As these gateways grow, so too does the demand for better logistics and more efficient infrastructure networks to keep people and goods moving.

Data as a Service is the rapid exchange of real-time conditions and service information between service providers, customers and the supporting infrastructure. This requires a seamless data exchange with a variety of partners and stakeholders, privacy and security protections, the capacity to analyze data from a variety of resources, and the ability to integrate this insight into a data-driven decision-making process (as opposed to an anecdotal one) for both system managers and elected officials. Data sharing is a relatively cost-effective way to enhance connectivity and system efficiency without constructing new physical infrastructure. With better data, LADOT will be in a position to become more responsive to the transportation needs of Angelenos as both a service provider and regulator of transportation in Los Angeles. *Urban Mobility in a Digital Age* proposes near-term investments in data infrastructure and the public sector workforce to support this service in the future.

Mobility as a Service

Mobility as a Service centers on the customer or mobility consumer, a person who purchases and uses transportation for personal use (Shaheen). It is a single platform and payment system that offers access to a suite of transportation mode choices, often bundled together in packages. It offers the ability to offer smart fares – priced and tailored to how the customer would access or use the system. Mobility as a Service requires collaboration and coordination across different transportation modes and providers while simultaneously creating a competitive marketplace of services to meet the real-time and changing needs of Angelenos throughout the day, week or month. While this places the burden of information exchange on public agencies and private transportation operators - both freight and passenger - Mobility as a Service can significantly improve access to jobs, education, healthcare, and other services by making it easier for Angelenos to find and utilize an increasingly complex suite of services through a single interface and effectively transforming the single-occupant automobile owner model.

LADOT has already partnered to make it easier for customers to evaluate transportation options through a trip planning application, Go LA, which compares mode options for the fastest, cheapest and/or greenest routes. Additionally, LADOT has piloted a mobile payment application for its transit services and there are plans to expand Go LA to include reservation and payment capabilities in Summer 2016. This experience with smartphone application-enabled services demonstrates the ability of LADOT in its role as a convener or advocate for regional Mobility as a Service. *Urban Mobility in a Digital Age* recommends LADOT establishes itself as a leading advocate for expanded access across the region through a series of actions to better connect the existing marketplace of public and private services.

Infrastructure as a Service

Our physical infrastructure requires ongoing maintenance and investment, but current funding mechanisms such as the gas tax are unable to keep up with the demand of our existing roadways. Infrastructure as a Service proposes that the use of public infrastructure should be subject to pay-as-you-go user fees that more closely align the costs associated with providing the infrastructure itself to how the infrastructure is being used. Infrastructure as a Service more transparently reflects the costs for the City of Los Angeles and other agencies to build, maintain and operate public infrastructure by charging fees for this service. With a solid data baseline, this approach can support tiered fees to ensure there is equity in access to the public right-of-way. Infrastructure as a Service can help shift behavior by incentivizing shared mobility, promoting staggered commute times and other active transportation alternatives.

As this is a fundamental rethinking of how we pay for and access our public right-of-way, Infrastructure as a Service requires a phased approach, which is already being introduced: the State of California has launched a nine-month pilot in Summer 2016 to test the concept of charging drivers for vehicle miles traveled as an alternative to the gas tax; and tolling high occupancy vehicle (HOV) lanes on the 110 and 10 Interstates is currently in place. Urban Mobility in a Digital Age includes recommendations to build and grow digital infrastructure in Los Angeles to enable this service and recommends best practice policies and regional coordination to support this goal.

Transportation technologies will continue to create new opportunities for Angelenos, local government and regional stakeholders to better access existing services while simultaneously creating a marketplace and demand for new transportation options. By becoming a universal platform for innovation and offering Data, Mobility and Infrastructure as a Service, LADOT can enhance connectivity and access across the city and greater metropolitan region.

Transportation Technology
STRATEGY

1. Build a solid data foundation.

2. Leverage technology + design for a better transportation experience.

3. Create partnerships for more shared services.

4. Establish feedback loops for services + infrastructure.

5. Prepare for an automated future.

1

Build a solid data foundation.

Transportation Technology STRATEGY

POLICY RECOMMENDATIONS

1. Define what can be shared.
2. Adopt privacy principles.
3. Develop a standard data sharing agreement.
4. **Create a regional blueprint for system integration.***
5. Establish design guidelines for digital infrastructure.

TODAY (0-2 years)

1. Inventory available data.°
2. Create a wishlist for other data sets + prioritize.°
3. Create a data analysis bench contract + grow internal capacity.°
4. Develop a roadmap for new data resources.

TOMORROW (3-5 years)

1. Make the data easier to use with data dictionaries and other tools.
2. Adopt APIs + other tools to streamline sharing.

FUTURE (6+ years)

- Leverage data to manage a more flexible transportation system with public + private service providers.

2

Leverage tech + design for a better transportation experience.

POLICY RECOMMENDATIONS

1. Create ATSAC 3.0.
2. Enforce congestion-busting rules for safety.
3. Adopt a customer bill of rights and metrics for transportation happiness.
4. Require corridor + building designs that serve multiple modes.
5. Eliminate parking minimums.
6. Rethink parking garages.
7. Stop widening roads.

TODAY (0-2 years)

1. **Code the curb to optimize access.***
2. Develop customer-centered requirements for public services.
3. Integrate real-time data + tech into urban design and planning processes.
4. Publish data on EV charging station locations.
5. **Advance fleet conversion to greener fuel.***

TOMORROW (3-5 years)

1. Create a unified wayfinding program.
2. Route transit by demand where suitable.
3. Expand ExpressPark citywide.
4. Introduce a portal for employers to manage transit benefits.

FUTURE (6+ years)

- Create a universal fare system for LA.

3

Create partnerships for more shared services.

POLICY RECOMMENDATIONS

1. Update regulations to include new transportation modes.
2. Make it easier to work with the City + provide a level playing field.
3. Adopt a new transportation demand management (TDM) ordinance for developments.

TODAY (0-2 years)

1. **Develop a shared mobility action plan.**
2. Form a multi-discipline mobility assessment team to understand changes + data needs.
3. **Designate an innovation pilot project manager.*°**

TOMORROW (3-5 years)

1. Bring sharing to City Hall through carsharing, bikesharing + carpooling platforms.
2. Launch a mobility lab.

FUTURE (6+ years)

- Implement Mobility as a Service.

4

Establish feedback loops for services + infrastructure.

POLICY RECOMMENDATIONS

1. Become a more responsive service provider by enabling feedback + measuring impact.
2. Establish a project evaluation standard.

TODAY (0-2 years)

1. Create a user experience working group.
2. Investigate new tools for the ongoing evaluation of infrastructure conditions.
3. Engage the entire community on infrastructure assessments.
4. Partner and support a marketing campaign on shared mobility.

TOMORROW (3-5 years)

1. Streamline LADOT online content + launch a project dashboard.
2. Prepare the workforce for changes driven by innovation in transportation tech.
3. Adopt multi-modal smart fare system.

FUTURE (6+ years)

- Develop a methodology to move towards Infrastructure as a Service.

5

Prepare for an automated future.

POLICY RECOMMENDATIONS

1. **Call for mobility innovation in California.**
2. Collaborate regionally to promote interoperability.
3. Launch a taskforce on data monetization strategies.
4. Advocate for new approaches to financing infrastructure projects.

TODAY (0-2 years)

1. **Develop a business plan for a city AV fleet.***
2. Create a dedicated staff position focused on connected and automated vehicle tech.
3. **Implement blind spot detection systems for public transit vehicles.***
4. Expand LADOT connected bus technologies fleet-wide.
5. Invest in lane markings that enhance effectiveness of lane departure warning and prevention systems.

TOMORROW (3-5 years)

1. Create better access to ATSAC data and enhance transparency of network prioritization for planning.
2. Develop an AV road network along transit and enhanced vehicle networks.
3. Launch a Data as a Service program to provide real-time infrastructure data to connected vehicles.

FUTURE (6+ years)

- Convert the public transit vehicle fleet to fully automated.

° *Action proposed for bench contracts.*   * *Action already planned or underway.*

Step One
DATA

1. Build a solid data foundation.

With limited resources, the City of Los Angeles must invest strategically in infrastructure and services that bring the greatest value to the city and meeting the greatest need. Data is at the core of driving effective decision making - whether in planning infrastructure or transit services; evaluating impact or assessing effectiveness of LADOT initiatives; or in relation to other priorities.

Smart city technology includes sensors and communications to relay real-time data to help managers understand how infrastructure is working, also known as "situational awareness." This technology is becoming more affordable and, with the availability of public WiFi networks and other communication technologies, easier to implement. Technology can help improve infrastructure, services and user experience by providing a real-time view of system demand, information for decision making, analysis for deploying better alternatives in the future and guiding more effective responses. Investing in technology that can improve the efficiency of infrastructure and provide a more global view for planning future improvements is significantly more cost effective than the traditional planning and maintenance approach for infrastructure.

The Downtown Center Business Improvement District, for example, uses sensors in public waste bins so staff can be notified when the bins are full. Instead of sending a waste collection truck around on a schedule, these bins are only emptied when necessary - saving time, energy and money. This feedback loop between infrastructure and manager can improve service efficiencies and free up

limited resources. With data, LADOT can more precisely evaluate the impacts of specific interventions such as road diets on safety, traffic patterns, mode shifts, etc. This will provide an essential starting point for rethinking the solution to congestion management and roadway safety.

In 2013, the McKinsey Global Institute concluded that, globally, $400 billion a year could be saved by "making more of existing infrastructure" through improved transportation demand management and infrastructure maintenance (Neumann). To attain this savings, however, LADOT and other city departments must access and understand underlying data to make strategic decisions about prioritization. While the City generates large volumes of data, it lacks comprehensive, quality data to plan for all modes, evaluate existing programs and understand how to adapt. Most shared mobility services are generating data which is not accessible to the City although it would provide considerable insight into how these modes impact public transit, environment, travel behavior and consumer preference. By sharing data and identifying external data sources, transportation planners will have a more complete picture of how people are moving. With policy emphasizing a more balanced approach to accommodate all modes (walking, biking, driving, shared rides, etc.), the City must identify new channels of quality data to inform decision making and future policies to optimize services and best protect public safety, accessibility, and equity.

How?

We need to unleash the wealth of data we have within LADOT, across other city departments and the region. The initial focus should be on making the data more accessible and usable which will lead to future understanding of how infrastructure and public and private service are meeting mobility needs of our community. We must leverage technology, partnerships and procurement to fill in the data gaps to ensure a well-rounded evaluation of all modes of transportation as well as equip our workforce with the skills and resources necessary to integrate data-driven decision making into their work. There are many staff who have a variety of data-related skills to contribute and building on their capabilities, LADOT can prepare for the ongoing influx of new data demands and opportunity.

The volume of data, the rate it is generated and the diversity of inputs will continue to grow as more sensors and services come online in the next few years. The introduction of automated vehicles (AV) will create introduce new sources of real-time data, for instance, through vehicle-to-vehicle, vehicle-to-infrastructure and other data exchanges. Vehicles will generate mapping data and need to communicate with other vehicles and infrastructure. In turn, vehicles might benefit from knowing traffic signal timing in real-time. LADOT will need to understand what data it has, its reliability and its value when shared. This understanding will contribute to better planning and evaluation of shared mobility services, improve the transportation experience and ultimately create an environment to maximize the benefits of automated vehicles.

LADOT

DATA FOR BETTER SERVICES

To better plan and assess the transportation system, LADOT needs to integrate a diverse dataset which describes:

Place + Space

Environment

People, Things + Movement

Disruptions + Events

Public Transport

Personal Automobility

Freight Connections

International Connections

Consumption + Transactions

A more detailed description of each data category is included in the Appendix.

MIND THE GAP: "Big data are assumed to accurately reflect the social world, but there are significant gaps, with little or no signal coming from particular communities." Geographic incompleteness of data due to different levels of wireless connectivity, unequal access to technology, and the collection of partial data samples from multiple sources all contribute to this issue. (Integrated Transport Planner, 26)

Define what can be shared.

The City regularly shares public data on its open data portal - information that would be available through a Freedom of Information Act request - making it easy for the community to access, visualize and share this information. Some data can be provided in its raw form but sometimes sensitive information needs to be aggregated to protect specific address or personal information. In other cases, the data is too sensitive to be shared without more constraints or is already regulated to protect privacy (e.g. the 1996 Health Insurance Portability and Accountability Act). Understanding the trade-off between public good, openness and access and privacy is important.

With growing interest in sharing data among partners, LADOT must uphold personal privacy wherever possible. Evaluating how the data may be used for analysis can help define the level of detail and anonymity necessary. For instance, personal information is not needed for planning analytics and should be anonymized or aggregated for protection. Staff and consultants without authorization should never have access to this information and protocol for how data can be exchanged and used should be clearly articulated as a citywide policy.

LADOT should define thresholds for what data can be completely open; what data can be shared with an agreement and therefore include more detail; and what data should not be shared without special consideration of the circumstances. It is also important to differentiate what type of data should be available in real-time (which will be particularly valuable for connected and automated vehicles and other services) versus being provided as a historic record. The traffic management center, for instance, does not currently archive any of the video data captured through its network of cameras out of concerns for risk and liability. Yet, this information could provide valuable insight into how our public right-of-way is meeting demand. Understanding what can be shared will also help shape the potential value of certain datasets if the City of Los Angeles opts to pursue a monetization strategy for some of its critical, real-time data.

An audit of data security will also help establish a critical baseline as big data becomes increasingly more available and critical to operations of public services, infrastructure management, and regulatory enforcement of the mobility marketplace. It is important to implement an audit process for the ongoing review and testing of security protocols.

NEXT STEPS:

1. Define thresholds for sharing of public data to protect individual privacy. Look to other practices such as the Police Data Initiative (body cameras) to develop a framework that is consistent across city departments.
2. Contract to audit data security and establish a baseline.

POLICE DATA INITIATIVE (PDI): BEST PRACTICES

Police and public safety data are a related and special aspect of open data – having information on all aspects of crime, safety, enforcement, and so forth are key elements of public policy and community relations. Yet, this data can be sensitive and the City of Los Angeles has committed to improving transparency by participating in the Police Data Initiative (PDI). This initiative, started in 2015, includes a comprehensive set of goals and guidelines to publish the information necessary for understanding some of the most challenging aspects of urban life while creating and maintaining trust. The goals are:

- *Use open data to build transparency and increase community trust.*
- *Internal accountability and effective data analysis (Smith).*

The Police Data Initiative touches transportation in many ways, not the least of which is around the use of video and telematics. LADOT should consider opportunities to adopt a citywide telematics standard and video sharing and retention standard.

Adopt privacy principles.

With the proliferation of big data, government must be good stewards of its data and be transparent in how it plans to use the data it collects, purchases or shares. Privacy principles will clearly articulate how the City will approach data in the best interest of the individual and community. LADOT should collaborate with public and private stakeholders to develop and recommend policies for consideration and adoption by City Council. LADOT should consider basing these draft principles on the White House consumer privacy guidelines as a starting point. Other cities have adopted privacy principles which can provide a reference point.

In addition, there are seven principles of "privacy by design" that should be factored into planning for future technologies. This is an approach to privacy that is embedded into the design specifications of technologies, business practices and physical infrastructures; privacy is built into the design specifications and architecture of new systems and processes (Cavoukian). LADOT should consider this framework as it implements new digital infrastructure for data collection and system management.

NEXT STEPS

1. Educate LADOT staff on the principles of privacy by design.
2. Propose privacy principles for adoption by policy makers.
3. Train staff on data privacy best practices.

Develop a standard data sharing agreement.

The City should develop a template for data-sharing agreements with academic institutions, nonprofit and public interest groups and the private sector that clearly outline the type(s) of data to be shared and how it will be transmitted; terms for how the data will be represented and used; guidelines for what will happen to the data at the termination of the agreement, etc. This will give LADOT and others a useful tool when leveraging the capacity of outside organizations to analyze and use City data while expediting these opportunities by providing a template from which to start. Furthermore, it will be essential in helping LADOT create a level playing field for reporting across future contracts, regardless if it is for data analytics or other services.

NEXT STEPS

1. Draft standard language as a starting point for all future data sharing opportunities.
2. Ensure that there is a data sharing agreement incorporated into all relevant contracts.

ADDITIONAL RESOURCES
RECOMMENDED READING

City of Seattle Privacy Principles.
Adopted February 23, 2015.
http://www.seattle.gov/tech/initiatives/privacy

City of Kansas City, MO Privacy Principles.
Adopted April 16, 2015.
http://cityclerk.kcmo.org/

Consumer Data Privacy in a Networked World: A Framework for Protecting Privacy and Promoting Innovation in the Global Digital Economy.
February 2012.
https://www.whitehouse.gov/sites/default/files/privacy-final.pdf

CASE STUDY

New York State Data Sharing Cooperative

A group of government and not-for-profit organization that have executed data sharing agreements to improve access to data among members. In addition to defining roles and responsibilities, there is a standard agreement that has been developed to streamline sharing.
https://gis.ny.gov/co-op/

The large technology players getting involved in the mobility space are creating new opportunities for crowdsourcing and aggregating very large sets of personal movement and location data essential for intelligent real-time transport system planning and operations (Integrated Transport Planning, 11).

Google

Create a regional blueprint for system integration.

LADOT, in collaboration with regional stakeholders and led by Metro, should actively participate in the upcoming process to update the regional intelligent transportation systems (ITS) architecture. This framework and standard, last updated in 2004, will help enhance regional interoperability for future technologies and will require a diverse team of stakeholders to represent various modes and considerations to be successful. LADOT should advocate to establish a regular update and review of this regional blueprint (previously proposed at three years) to keep up with changes in technologies as well as the addition of new stakeholders. This will enable the system to better reflect operational concepts and functional requirements while creating the opportunity to reevaluate project prioritization.

The Regional Integration of Intelligent Transportation System (RIITS) is sponsored by Metro and supports real-time information exchange between freeway, traffic, transit and emergency services as well as traveler information for an improved experience. Caltrans, LADOT, California Highway Patrol, Long Beach Transit, Foothill Transit and Metro all contribute information collected through their own Intelligent Transportation Systems to the network using this architecture and national ITS standards (RIITS). There have been some previous attempts to archive the data from RIITS through a program funded by Metro and developed by the University of Southern California, the Archived Data Management System (ADMS). However, access to this information and an understanding of what these resources have available that might inform better planning and project evaluation is still very limited. Furthermore, understanding how to better use the real-time information through RIITS will be very beneficial when investing in connected infrastructure and providing Data as a Service to connected vehicles operating within the region.

Revising the regional infrastructure to incorporate new modes and services will help prepare the region for future transportation technologies while enhancing interoperability and efficiency now. Additionally, LADOT and the Coalition for Transportation Technology should explore opportunities to use these existing data resources while potentially expanding the type of data captured that would benefit planning and project evaluation for both goods and people movement across the region.

NEXT STEPS

1. Work with the Coalition for Transportation Technology to advocate for updates to regional ITS architecture to align with policy priorities and this transportation technology strategy.
2. Define potential audiences and users of this data and create a more transparent pathway to accessing this data for planning, operations and project evaluation.
3. Advocate for the necessary resources to support a regional data exchange to support connected infrastructure and vehicles in the future.

PARTNERS

• Coalition for Transportation Technology
• County of Los Angeles Metropolitan Transportation Authority (Metro)

RESOURCES

• Metro has funding set aside for an update to the regional ITS architecture. RIITS and the ADMS system are additional resources.

TIMELINE

• Fall 2016

Adopt design guidelines for digital infrastructure.

With the potential proliferation of new digital infrastructure, the sensors and communications technology necessary to capture and relay real-time transportation data, the City of Los Angeles should lead by example and set high standards for well-designed equipment that integrates into existing infrastructure and/or is complementary. Much in the existing marketplace of sensors and communications infrastructure has been developed with little consideration for aesthetics. However, as a large market, the City and region of Los Angeles should push for well-designed equipment to be installed in the public right-of-way. If technology companies are not going to push functional equipment to higher design standards, LADOT should certPainly be an advocate for better aesthetics and establish a mechanism to ensure that the proliferation of pole attachments and other equipment does not contribute to urban visual blight.

The School of the Art Institute of Chicago, for instance, developed sensor designs that are produced by 3D printing technology and have partnered with the City of Chicago's Department of Transportation to test the sensors in real-world applications. It is an extension of the idea of building a relationship between the natural and man-made systems to create a more livable city (Sattell). With the wealth of design talent in Los Angeles, it would be an incredible opportunity to integrate public art into the Internet of Things and the sensors that help improve how the city moves.

NEXT STEPS

1. Convene a working group to define potential guidelines.

Urban Center for Computation and Data

The Array of Things (AoT) is an urban sensing project, a network of interactive, modular sensor boxes that will be installed around Chicago to collect real-time data on the city's environment, infrastructure, and activity for research and public use. AoT will essentially serve as a "fitness tracker" for the city, measuring factors that impact livability in Chicago such as climate, air quality and noise. A partnership to design sensors with local art students has advanced the physical qualities of these sensors in a more sensitive, thoughtful way.
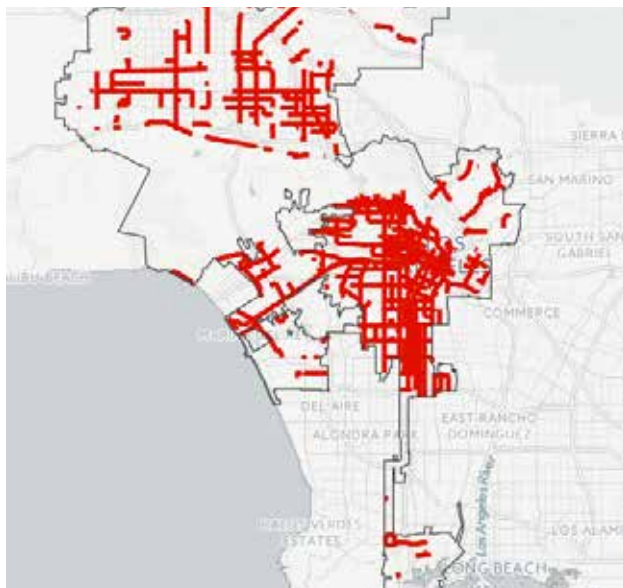
POLICY + DATA:
INSIGHT THROUGH ANALYSIS

Over 65% of all severe and fatal traffic collisions involving people walking occur on just 6% of our city streets. To achieve Vision Zero - eliminating all traffic-related fatalities in Los Angeles by 2025 - the City of Los Angeles is implementing a data-driven approach. The High Injury Network (HIN) spotlights streets with a high concentration of severe injuries and deaths, with an emphasis on those involving people walking and bicycling. The HIN analysis will help inform forthcoming policies, programs, and engineering design toolkit.

Understanding the data can help the City of Los Angeles prioritize limited resources to address areas of greatest need - in this case, focusing on making these corridors and intersections safer for all Angelenos.

The data needed to understand the transportation landscape is increasingly more complex. Special events, for example, impact traffic through street closures and greater demand as people travel to and away from an activity. Understanding the impact of these events can help LADOT provide better on-demand services as needed to support major cultural, sporting, political and recreational events across the city.

TODAY (0-2 years)

Inventory available data.

LADOT data resources have accumulated over time and a consolidated inventory would open the potential for collaboration among internal teams, across agencies and with external partners, contractors and the public. LADOT should identify valuable data by mapping what is available; whether the data is static or dynamic; who owns and manages it; how data is currently used and how conflicts are resolved; who determines access and permissions; etc. Involving partners throughout this process can help broaden understanding of the value of the data while also identifying challenges with sharing, and noting what data is outdated or is locked in systems that make it difficult to automate connectivity and exchange.

LADOT should develop an online catalog of the data inventory - including both open (and therefore available sharable through the standards terms and conditions) and available datasets (licensed/paid-for). This catalog should be coordinated with the City of Los Angeles' extensive open data catalog as part of its online repository of community data resources. While there may be limited applications today, making this information available could potentially spur further innovation in this space through organized hackathons or other entrepreneurial efforts. The development of this catalog should be widely publicized and shared across sectors to help raise awareness of its availability. It is important for LADOT to establish a regular schedule to review this inventory as well as assess the overall mobility marketplace to determine if there are any changes in what might be desirable.

NEXT STEPS

1. Catalog available data within LADOT, across city departments and other public agencies that have a direct impact on transportation in Los Angeles (modes, infrastructure, events, etc.) and map who owns the data, where it comes from and how it is used.

2. Identify any redundancies and gaps in the data.

3. Create a centralized location accessible to staff to see what data is available.

4. Develop roles and responsibilities around managing data and the overall inventory.

Live Maps/Google Play

The proliferation of smart phone applications makes it difficult for local government to compete by offering their own tools. Making it easier to share LADOT data with third party applications can help meet the needs of communicating to a large urban population.

Create a wishlist for other data sets desired + prioritize.

It is estimated that more than 50 billion devices will be connected worldwide by 2020, rapidly expanding the volume, velocity and variety of data related to transport and mobility (Integrated Transport Planning, 4). While it may be impossible to identify sources for all data useful in decision-making, maintaining a regularly updated wishlist would be useful when considering future public-private partnerships with data sharing agreements, creating opportunities to collaborate with academic institutions on research, and prioritizing enhancements to data collecting capabilities as a City. This wish list should be maintained in conjunction with the strategic and budget planning processes for LADOT with the additional input of other City departments.

Planning for modes such as walking and bicycling can be challenging when there are few public data resources that provide insight into how people move around the city and region. Volunteers convene at intersections a few times a year to count cyclists, for example, and this collection approach makes the data less reliable, far from comprehensive and not usable for effective planning. Having a more complete picture of the modes being used in the public right-of-way can inform service design and infrastructure priorities. In addition, more robust data can help with project evaluation. For instance, how do we measure the impact of roadway safety interventions? What data do we need to understand and measure security, quality, accessibility, affordability, sustainability, innovativeness and convenience?

It is important to assess the gaps impacting the ability to plan for future projects with a solid baseline; design and implement anticipated improvements; measure and communicate the impact through project evaluation. Transport Systems Catapult, one of seven technology and innovation centers supported by the United Kingdom's innovation agency, defined nine data typologies that provide a valuable starting point for consideration: place

and space; environment; people; things and movement; disruption and event-related data; public transport; personal automobility; freight; international connections; consumption and transaction data. See the next page for a more detailed breakdown in Intelligent Mobility Data of how this data may support better planning, design and operations.

In its 2015 report, Transport Systems Catapult further identifies 19 datasets that will likely drive the emergence of intelligent mobility: map data; weather; personal location data; network disruptions; planned events; real-time network capacity for people, vehicles and goods; public transport schedules; vehicle location data; fare and pricing data; sentiment data from service users and non-users; third party service usage data; and payment/ transaction data. Within these sets, there are three types: data that does not exist; data that exists in silos; data that is not open or available. Taking a comprehensive approach to understanding what data is needed to truly manage an effective mobility system will help LADOT in its planning, partnering and management of services and infrastructure (Integrated Transport Planning, 5).

LADOT should take a multidisciplinary approach to this data assessment, including other departments and organizations beyond the City of Los Angeles, and identify the core functions that create the need for having access to this data. There is likely to be overlap as multiple initiatives may require the same information. Data important to measuring pedestrian accessibility and the state of infrastructure would also be valuable to the City's sidewalk repair program, as an example, or to regional planning efforts by the Southern California Association of Governments (SCAG). Working corroboratively, LADOT may identify multiple benefits to capturing or even procuring new data sources, further justifying the potential costs associated with creating a comprehensive baseline and additional resources for funding.

Recently, the Kansas City Area Transportation Authority (KCATA) and the microtransit service Bridj announced a public-private collaboration to extend urban mobility through on-demand vans in a one-year pilot. Vans, manufactured locally by Ford Motor Company, will be provided as part of the manufacturer's Smart Mobility plan. The memorandum of understanding between the KCATA and Bridj defined the data to be shared: vehicle trips per hour; total trips; on-time performance; number of requests outside the service area; number of passengers per hour per vehicle; average price point; average walking distance; average number of stops per vehicle. The agreement also defines potential expansion to include data regarding net promoter score (to indicate growth); driver satisfaction scores; vehicle miles traveled reduction estimates; and general public perception monitoring. These metrics will be essential in helping both the public and private partners in this pilot to understand how the program is working, identify potential for expansion beyond the pilot area, and looks beyond some of the typical measures for success because of the availability of the technology to allow for capturing even more data. With a deeper understanding of what data is helpful in all aspects of mobility management, transportation agencies will be better prepared to ensure these requirements are included in future partnership arrangements as a tool for evaluation.

NEXT STEPS

1. Convene both internal and external stakeholders (e.g. other transportation agencies) who might find value in this data to identify potential resources to support this effort.

2. Identify what data is needed for planning, design and project evaluation that LADOT does not currently have access to at this time.

3. Prioritize these data sets based on the greatest impact each type of data might have on meeting overall policy goals.

Flickr/Jed Sullivan

LADOT has implemented several technologies to improve the experience of paying for parking through credit cards or mobile pay. Unlocking data around parking can help reduce emissions by decreasing the time spent looking for parking and make it easier to navigate around the city by factoring in the time spent to park and the availability of different options.

ADDITIONAL RESOURCES
RECOMMENDED READING

Interoperable Transit Data:
Enabling a shift to mobility as a service

This report by the Rocky Mountain Institute examines the evolution of and data behind mobility as a service and what will be required to shift to this new model. October 2015.

http://www.rmi.org/
RMIMobilityInteroperableTransitData

The Transport Data Revolution:
Investigation into the data required to support and drive intelligent mobility

This Integrated Transport Planning, Ltd. report breaks down various data typologies and offer a valuable framework for establishing a data inventory and wishlist as LADOT evolves into offering data as a service. March 2015.

https://ts.catapult.org.uk/wp-content/
uploads/2016/04/The-Transport-Data-Revolution.pdf

Denver Peak Academy

Implement a data analysis bench contract + grow internal capacity.

Local governments are increasingly feeling the pressure to tap and understand their data but often lack the internal skillsets to analyze this data efficiently. In 2015, Boston created the Citywide Analytics Team as a central point for the city to gather information and work across traditional departmental silos, drive new public-private partnerships around data projects, engage colleges and tech companies, and identify outside funding to help expand the impact throughout the city. This type of investment in data analytics capacity remains somewhat exceptional in local government but is an important response to the growing movement toward becoming more data-driven organizations.

As LADOT defines its needs for data analytics capacity, the City of Los Angeles should partner with other departments and establish criteria for on-call consultants capable of providing data analysis and visualization. These bench contracts should pre-define expectations for maintaining data security and privacy as a key function of the contract. Meanwhile, LADOT should create technology profiles for each of its positions to understand where there are needs to grow skills or hire new staff with these skills; develop a professional development plan for ongoing learning and training; and identify where there are existing talents and skills already within the department. LADOT as a data-driven, data-consuming agency must have skills in understanding and analyzing the data as well as visualizing complex data stories with easily accessible images and representations.

Finally, LADOT should establish an internal data committee to identify opportunities for analysis; regularly maintain the data inventory and standards; and evaluate potential partnerships to bring outside capacity to the organization.

NEXT STEPS

1. Identify internal resources and talent for data analysis at LADOT.

2. Identify potential contractors that can assist with data analysis.

3. Create an internal data committee for ongoing support.

Develop a roadmap for new data resources.

Transportation planners across the country are experimenting with new channels and tools to collect more rigorous and reliable data. Cities now have access to increasingly more accurate tools to generate the data for their own analysis. Smart city sensors, for instance, can passively and anonymously count pedestrians and cyclists when hung from streetlight poles or placed along walkways and bikeways. Creating a plan to integrate such sensors into existing sensor networks such as the loop detectors could help fill the gaps within the existing data. The advantage of this approach is that the City of Los Angeles can fully own the data it collects in the public right-of-way and maintain best practices of privacy by design with clearly defined uses for any data collected.

Alternatively, there are several companies working to convert data such as smartphone location data into valuable (and anonymous) information for transportation planners. While there has been some demonstrated success with these methods, there is considerable room for improvement. This practice of re-purposing data is creating a marketplace for governments needing to outsource data capture. LADOT should explore these resources as an interim solution to collecting the data itself since it could be more cost effective than building a comprehensive digital infrastructure to capture the raw data. Additionally, there are critical datasets, such as age and gender, which are missed by sensor data and would require alternative resources to help provide a more complete picture of transportation services in Los Angeles.

Transport Systems Catapult in the UK identifies five major mechanisms for data creation: manual collection; overt crowdsourcing; covert crowdsourcing; sensor-derived; and service provider generated. These mechanisms are imbalanced and constantly changing, making it essential to understand and continually evaluate what is available, how and where (Integrated Transport Planning, 5). The City of Los Angeles should work with regional stakeholders to identify resources to fill these gaps and collaborate wherever possible to create data feeds at this level to enhance the overall value and benefit of this data integration into planning, implementation, operations and management.

NEXT STEPS

1. Create a plan for securing new data resources, evaluating the trade-offs of purchasing data from third parties versus generating the data as an agency.
2. Identify potential funding resources to secure this data.
3. Prioritize what data is most important for effective planning and service evaluation.
4. Collaborate with other departments, including procurement services, to ensure these data priorities are integrated into activities citywide where appropriate.
5. Integrate digital infrastructure into future capital projects and investments in physical infrastructure.

San Francisco has joined Copenhagen, Portland, Seattle and Montreal by installing bicycle counters with digital displays on busy biking streets. These sensors are in addition to 24 invisible bike counters around the city to measure demand for bicycling and effectiveness of bike lane improvements (Bialick).

TOMORROW (3-5 years)

Make the data easier to use with data dictionaries and other tools.

The next step for the LADOT data inventory should be the development of documentation such as data dictionaries or descriptions of the data that make it easier for programmers to use. Wherever possible, the City should align its standards with those shared with other government and transportation agencies and consider coordination through the Coalition for Transportation Technology. LADOT should create an oversight role for all mobility and infrastructure data in collaboration with the Office of the Mayor and Chief Data Officer.

Mayor Garcetti recognized the importance of having the right data for decision-making and service-providing with his third Executive Directive creating Los Angeles' first open data initiative. Digital distribution and government transparency concepts have completely changed and this data is now available widely within Los Angeles through two online web portals:

- The City's Open Data Portal is available at and has roughly 500 datasets as of this writing on subjects ranging from budget to transportation, from sanitation to crime, and from culture to the Port. It is rated the #1 Open Data Portal in the US according to the Open Data Census (Sunlight Foundation).

- The City has also published a Geographic Information System (GIS) portal called the GeoHub at http://geohub.lacity.org. This portal contains more than 500 geographically-referenced datasets and is perhaps the densest public collection of urban data ever created.

These open data portals are widely used inside and outside of government for decision-making and end-user services. Wayfinding apps use open data to obtain street closure updates from the City. Educational institutions use these portals to analyze aspects of daily life. LADOT should further leverage these open data platforms to enhance internal and external collaboration.

While the process of making the data more usable is underway, it is strongly recommended that process improvements accompany this action. Lean process improvement is an approach to identifying and eliminating waste in processes without adding new resources or technology. This is an effective way to focus on what the intended outcomes of a process are (e.g. to ensure public safety or create a registry of services) without demanding more investment. LADOT should host lean workshops to streamline existing processes and identify opportunities to improve data quality. Raising awareness throughout the department about how data used throughout its lifecycle can help build a sensitivity to its integrity - from the initial stages of data collection, to ongoing maintenance and refreshes over time. Engaging staff and local academic institutions to outline strategies, best practices and planning for an inventory can bring together great resources for future data analysis initiatives. The City should develop and regularly host training to keep staff up-to-date on rules around privacy and data and a public dashboard should be added to the open data catalog with performance metrics.

NEXT STEPS

1. Create a position for a mobility data advocate and manager in LADOT.

2. Work with stakeholder partners to develop a standard for data documentation.

3. Adopt standards and formats that align with the Open Data Portal.

4. Implement lean process improvements wherever opportunities to improve data collection and/or management.

LADOT

Adopt APIs and other tools to streamline data sharing.

Whenever possible, LADOT and the City should seek to automate the process of providing city data to its partners through application program interfaces (APIs) and other tools to limit the burden on staff to share data both internally and externally. For instance, sharing data on road closures requires a manual process of communicating across multiple departments by emailing a static pdf document. Data-sharing partners such as Google Waze then enter the data into their own format to be shared by Angelenos navigating around the region. By automating data sharing wherever possible, staff can spend their time focusing on ensuring data quality, privacy, security and integration into city operations. Executing this recommendation will require technical expertise and systems with more open architecture.

It is important to engage the community in a broad conversation about how city government uses data to make decisions and manage services. Privacy principles (see previous recommendation) are a proactive way to demonstrate commitment to transparency and could include partnering with a local law school students for development. Additionally, events such as Transportation Camp and hackathons convene academics, practitioners, students, media and interested community members eager to discuss new ideas on mobility that can further inform how LADOT approaches data, shared mobility, user experience and the advent of connected and automated vehicles.

NEXT STEPS

1. Identify within the data inventory which datasets would be useful to automate.

2. Contract or bring in-house the ability to implement tools to streamline sharing.

3. Publish LADOT data regularly to both the Open Data Portal and Geohub.

FUTURE (6+ years)

Leverage data to manage a more flexible, integrated transportation system with public and private service providers.

LADOT must continue to leverage data to evolve its role in protecting public safety, access and equity in the transportation network across Los Angeles. The role of the 21st century department of transportation is evolving as new players enter the market; public agencies are shifting towards functioning more like a mobility manager than necessarily being solely responsible for providing infrastructure and services. With a solid data baseline, LADOT will be more effective in evaluating the impact of public transit services and aligning limited resources to meet shifts in demand. LADOT will have to evaluate how services it provides are meeting the needs of Angelenos and tapping into data can help provide a better understanding of how the entire ecosystem of services, both public and private, are working together. The short-term goals of equipping the LADOT workforce with the skills necessary to integrate data-driven decision making into their daily work will help LADOT position itself as a more responsive service provider and more effective regulator for the next generation of transportation technology-enabled services. Data will be essential for LADOT to support a platform of transportation services that are scalable, affordable, safe and convenient for Angelenos of all means to access.

Step Two
Experience

2. Leverage technology + design for a better transportation experience.

The personal vehicle remains the preferred mode for the majority of travelers in Los Angeles - creating congestion, impacting the environment and wasting hours of valuable time stuck in traffic. As the city and region grows, traffic will only get worse. The tools available to LADOT to manage this transportation system – traffic signals, paint and signage - are 19th century technologies that have not fundamentally changed in decades and have limited potential to transform the transportation experience in Los Angeles. LADOT needs to leverage new tools to encourage a shift towards more efficient shared modes to change the way Angelenos move around the city and change the traffic trajectory. LADOT must offer a convenient, affordable and quality experience for existing customers and to attract new users to use shared modes.

Mass public transit remains the best way to bypass congestion and move people in and out of densely populated urban centers but other options have emerged from the private sector. As part of a system of services, there needs to be consideration for the entire route - from start to finish. The City of Los Angeles has given considerable attention to the first-last-mile issues: how do people even access public transit services? Is it convenient? Is it safe? Is it affordable? When shared mobility services can connect to other modes, it eases the challenge of getting around the city.

Creating a positive transportation experience "focuses on having a deep understanding of users, what they need, what they value, their abilities, and also their limitations" (Usability.gov). This also takes into account the business goals and objectives of the managing organization - whether the public or private sector. Ultimately, how Angelenos interact and perceive a service will drive their decisions to use a mode as they decide how to move around the city and region. Research indicates that there is a direct correlation between the mode of travel and transportation happiness. Considering the hours spent moving around the region, understanding how the travel experience impacts the customer will be important in an increasingly competitive mobility marketplace.

If Angelenos and not the service provider designed a service, how would it be different? Peter Morville notes that information must be: useful; usable; desirable; findable; accessible; and credible. Prioritizing service changes, budgeting for improvements, introducing amenities and supporting technologies can also be a challenge with so many considerations and often conflicting interests. LADOT should establish sustainable mechanisms to ask for input from customers, incorporating passive feedback to understand demand, and integrate this information in the prioritization of services and improvements. A culture of continuous improvement will help support more competitive public services.

How?

By designing services centered on the needs of Angelenos, LADOT can make it easier to access the transportation network and explore new modes. LADOT must focus on providing useful information and amenities, refining processes for planning services and create experiences that will bring people back again. Travel requires multiple decisions: Where am I going? What route and mode(s) will I take to get there? How will I pay? When will I get there? What should I expect while in transit? What do I need to do when I arrive? Individual preferences and means will shape the answers but Angelenos need access to information regardless of whether the trip is starting from home, work or the airport. With the two most determinant factors of rider satisfaction with transit are service frequency and travel time (Transit Center), LADOT can learn a lot from understanding how customers perceive services and should be prepared to respond.

LADOT has leveraged more than 20,000 loop detectors at signalized intersections citywide to provide real-time traffic speed information on the website TrafficInfo. These detectors send data to a traffic control center, ATSAC (Automated Traffic Surveillance and Control), which can adapt signal timing to changes in demand and other conditions. The ability for the infrastructure to respond to the changes in conditions can provide critical tools to addressing congestion, creating a safer city, and ultimately improve the mobility experience. However, LADOT built

ATSAC in the 1980s and has grown it over time - rethinking how this infrastructure can be modernized to address the challenges of a more complex mobility marketplace is essential to keeping Los Angeles moving. Expanding the ability to passively collect data on how infrastructure is being used will help LADOT be more responsive to changing demands.

Through data sharing, LADOT has partnered with third party application developers such as Xerox (GO LA) and Google (Waze) to provide information that is relevant to their user base. User experience goes beyond just the provision of a smartphone application or website, however, and must start with the customer. Designing services, providing amenities, refining processes and creating experiences that will bring people back again must become integral to public services, our partnerships with private mobility providers, and infrastructure management.

Los Angeles County Metropolitan Transportation Authority rail stations received an overall grade of C in a statewide study of how transit rail stations encourage ridership and impact the quality of life in surrounding neighborhoods (Sklar). Public mobility services do not necessarily need to compete with the amenities or specific qualities of services that can be offered by the private sector.

However, to encourage ridership on existing modes and to create other successful public-private partnerships for publicly available services, it is important to create a quality user experience. Since rail lines are so expensive, it is essential that attention is paid to the surrounding areas, which will determine how effective the system will be. Access to these transit hubs and links to other modes will be critical to creating a healthy regional network. LADOT can work to enhance these station nodes by providing better connectivity with job centers, retail and service areas and residential neighborhoods through a network of services options for that last-mile of travel.

Ultimately, it is about putting the customer at the heart of all decision making. Some of the tools that have already been explored by LADOT and other transportation agencies in the region include: improving quality of static and real-time information (e.g. through the introduction of contextual journey planners); providing online booking and real-time travel information; facilitating seamless travel across the various public and private transport modes; improving punctuality and regularity of services; and improving security and perception of security; etc. By focusing on continuous improvement and investing in transportation happiness, public transit will evolve into an even more important mobility alternative.

LA Great Streets

An extensive British study found that the longer people spend commuting in cars, the worse their psychological well-being. And correspondingly, people feel better when they have a longer walk to work. People who switched from their car to active transportation: that is, walking, biking, or even taking public transit, got happier with their lives (Montgomery).

LADOT

POLICY

Support ATSAC 3.0.

ATSAC was designed and built to move vehicular traffic efficiently into and around the 1984 Olympics Games in Los Angeles. The network of loop detectors and video cameras has expanded over the decades to cover the city's signalized intersections and a dedicated team of traffic engineers have developed the algorithms and backend infrastructure to support this network of analog sensors. The system is somewhat adaptive to volumes of traffic and many of the signals are synchronized to improve flows and reduce traffic-related delay. ATSAC also provides support to transit systems with bus prioritization and light rail signalization.

As City policies have introduced priorities for modes other than vehicles, this system must adapt to the changing mobility marketplace and help improve the efficiency and safety of our public right-of-way. Considering the decades of investment in this system, it would not be practical to replace something of this scope and scale wholesale. New technology does not necessarily provide a better solution for some of these core functions (for instance, the analog nature of the system makes it secure from cyber-attacks). By layering new technologies over the ATSAC infrastructure and enhancing data retention and analytics capabilities, this traffic center can transform into a 21st century mobility management hub. Understanding the hierarchies within the signal network and making this information more transparent and available to LADOT planners can also help provide greater insight to the potential impact of new developments and changes in service demand on neighborhoods and across the transportation network.

Most critically, LADOT needs to evaluate in detail the data retention and analysis practices for ATSAC data with significant consideration for how this data will be used. Loop detectors already provided anonymized data which makes it easy to share with potential partners and across agencies as it does not contain any personal information. However, ATSAC also uses video cameras for incident management. This data is currently not captured and retained out of concern for privacy and the risk of potentially having to use this data in court. Video-as-a-sensor technology has evolved and only captures metadata (tagging information of interest such as the number of vehicles passing by a sensor or cars parked along the curb) while still providing the possibility of access in case of emergency. Policies should be considered that would enable LADOT to extend the capacity of ATSAC to capture and retain data that would be useful for the management of infrastructure, public safety and congestion on the public right-of-way. Rules around video data should be coordinated and standardized across other departments as well.

ATSAC should be upgraded to incorporate bicycle and sensors and signals along the defined cycling networks per the City's mobility plan. In Austin, a bicycle detection system is paired with an app so cyclists with a smartphone can "catch the lights" more often when biking (Atkinson). The Massachusetts DOT has launched signal phasing options for a more balanced integration of modes (Andersen). Combining strategies such as this will enable the department to have a more accurate understanding of how these networks are used while providing for safe passage through signalized intersections.

In addition, particularly as part of the project areas in the Mayor's Great Streets programs, throughout the Vision Zero High Injury Network and Promise Zones, pedestrian sensors should be tested. With this type of data, it could help the city prioritize reconstruction of sidewalks, planting of street trees, and other supporting infrastructure to make the city more walkable and pedestrian-friendly. Additionally, in neighborhoods that have a larger representation of an aging population, for instance, the ATSAC team should test more dynamic timing for pedestrians that might otherwise be at risk. LADOT should move towards making the ATSAC infrastructure a critical consideration in the planning and development of the city's street infrastructure and surrounding context.

NEXT STEPS
1. Fund the proposed ATSAC 3.0 roadmap to evolve the capabilities of this digital infrastructure to meet 21st century planning and project evaluation.
2. Include ATSAC engineers in the internal data working group.

Enforce congestion-busting rules for safety.

Los Angeles has transit priority corridors with responsive traffic signals, programmed and scheduled through ATSAC, to give buses green lights at the busiest times and in the most congested parts of the city. Dedicated travel lanes on busy streets are intended to help buses move efficiently during peak hours. Metro estimated that the Wilshire transit priority lanes would decrease passenger travel times by about 24%, around fifteen minutes. This requires enforcement of the rules around these lanes, however, to make a difference. After all, if buses are stuck in the same traffic as everyone else, it is difficult to justify the benefits of a shared ride without the time savings (among other conveniences described later). Many drivers abuse the restricted lanes to cut ahead of congestion which impedes public transit and creates additional safety concerns.

LADOT should examine opportunities to provide enforcement for the already prioritized transit corridors. For instance, video-as-a-sensor embedded in street lights could identify when and where transit lanes are compromised, notifying enforcement officers or automatically ticketing offenders. Alternatively, city fleet vehicles could be part of the solution. In New York City, for instance, buses along several busy streets will use cameras on the bus itself to document and ticket violators of bus-only lanes (City of New York). The City of Los Angeles and neighboring jurisdictions in the region need to create clear policies to enforce these rules to help keep the transportation network moving.

In the future, the successful enforcement of bus-only lanes will create opportunity to develop high-occupancy vehicle/ shared mobility lanes within the city as part of another pilot proposed later. This idea will also be expanded to include connected and automated vehicles in the future to provide a safe route for the transition period when both human and machine drivers occupy our public right-of-way.

The County of Los Angeles superior court is currently not enforcing red light camera ticket citations and fines which raises some concern as to why such rules would exist if not enforced. LADOT should evaluate whether this technology should be used to make intersections across the city safer by nudging drivers towards waiting for the next light rather than running a red light. If feasible, priority should be along the Vision Zero High Injury Network.

NEXT STEPS

1. Create enabling policies for enforcement of road rules and priorities that help keep shared modes moving across the city.

2. Collaborate regionally for consistency and system legibility.

Adopt a customer bill of rights and metrics for transportation happiness.

The TransitCenter defines three types of transit riders: occasional riders who take transit once in a while; commuters who take transit regularly but only for work; and all-purpose riders who take transit regularly for multiple purposes. The two most important factors driving satisfaction with transit are service frequency and travel time but other important considerations include transit station and stop conditions, real-time information, and reliability. (TransitCenter). Angelenos who ride their bike, walk or drive will have different requirements and the City of Los Angeles should consider how to improve the transportation experience across all modes through the services and amenities it offers – from pedestrian and bicycle infrastructure to smart parking solutions.

LADOT and policy makers should convene community stakeholders to draft and adopt a commitment to customer service and a good user experience for all modes of travel - whether pedestrians, cyclists, drivers, or transit riders. Everyone should work towards creating a safer, greener and more equitable urban transportation network. Since the majority of riders walk to transit, it is important to consider the conditions of sidewalks, the safety of pedestrian crossings, and other conditions as part of the experience. With new first-last mile modes, such as bikeshare, being introduced in Los Angeles, the supporting infrastructure and conditions for these modes will continue to grow in importance. The City's commitment to the public should be linked to both passive and overt customer feedback channels to encourage input from riders and system users for ongoing improvement. Recommendations regarding development a feedback loop to track progress in meeting these goals follow in the fourth section of this strategy.

NEXT STEPS

1. Work with community stakeholders to build upon existing customer service commitments to draft a customer bill of rights.

2. Develop metrics to track and measure transportation happiness in Los Angeles.

3. Share with other agencies in the region and identify opportunities to partner on improving results.

Flickr/MTA

Microtransit offers a more flexible model that is somewhere in between ridesharing and a fixed route, fixed schedule bus that has great potential to address the first-mile, last-mile connectivity problem. This model supports lower density neighborhoods which adds more value when considering a healthy mix of options in the mobility marketplace.

Require corridor + building designs that serve multiple modes.

Many buildings along some of LA's busiest corridors have their main entrances facing parking lots and garages with secondary, limited access to the street. This immediately highlights the priority for automobility and parking, making the building less approachable for pedestrians, transit riders, and those being dropped off. Salt Lake City, Utah has found that adding bike lanes, removing on-street parking and investing in streetscapes (street planters, better crosswalks, public art, colored pavement, etc.) can help calm traffic and create a better pedestrian landscape. This has contributed to increased retail sales in districts that have had this comprehensive approach to roadway design (Andersen).

ReCode LA, an effort to revise and update zoning code across the city, has already begun looking at standardizing requirements for street frontage by street classification and includes design elements from storefronts to the edge of the curb. By approaching site access as multi-modal, instead of only accommodating a car being driven and parked at a building, Los Angeles can greatly enhance the experience of getting to and from buildings by all modes.

Furthermore, LADOT should work with the City Planning Department to develop a data standard for building level information to be provided to help connect travelers via trip planning apps and other tools with the details of how they will actually enter and access their final destination, regardless of their physical ability or travel mode. This information could be integrated into trip planning tools, for instance, to help someone with a stroller or wheelchair find the most convenient access points to a building based on their mode of travel.

Gunnar H. Hand

Los Angeles has 110 pedestrian tunnels that were mostly built in the 1920s and 1930s with a $1M bond measure to "save the children" by making it easier to cross a busy street by passing under the intersection. In the 1980s, the City began closing these tunnels as they had become hotspots for crime and gang activity (Hamilton). This is an artifact of an era when roadway design was truly dominated by the vehicle - in lieu of making the streets safer for pedestrians, they were pushed underground.

NEXT STEPS

1. Work with City Planning Department and the ReCode Los Angeles effort to define best practice standards to enable better access.

2. Create a data standard for providing building access data to the City to help with point-to-point navigation.

3. Provide ongoing support to other departments responsible for implementing these standards.

NACTO

The National Association of City Transportation Officials (NACTO) has released design guidelines for the public right of way to better accommodate all modes of travel. These streetscapes should be extended to building facades and storefronts.

Eliminate parking minimums.

Policies and regulations are based on the technologies of the past, defined by the information that decision-makers had at the time. Rules for parking are generally based on building use and square footage with little consideration for location or proximity to public transit. This approach is outdated and fails to address additional variables that impact personal choices and behavior. The "Right Size Parking" project in King County (Seattle, WA) found that block size, population and job density, and walk and transit access to trip destinations influence parking utilization, in some cases by as much as 50 percent (Rowe, et. al., 26). Since developers cannot factor these considerations into their project plans, costly and often underused parking spots are added to the inventory in Los Angeles. Adopting a parking calculator tool similar to the King County Right Size Parking Calculator and offering incentives for developers who accommodate more shared modes onsite such as bikesharing and carpooling would not only help the bottom line of projects (making the cost per square foot of leasable space more competitive) but help reduce congestion.

A phased approach to implementing these changes could start with commercial developers who voluntarily accommodate multiple modes in exchange for reduced parking requirements or identifying overlays in transit-rich parts of the city. If located near existing transportation hubs, developers should be encouraged to create a travel demand management program, with the help of city data on mobility, to understand impacts and define a comprehensive approach to balancing all of the different ways people may access their building - whether on foot, bicycle, bus or shared vehicle. Travel demand management measures could include carpooling, vanpooling, subsidized or bulk-rate transit passes, on-site carshare service and parking, guaranteed ride home, telecommuting, unbundled parking, parking cash-out, education and program support, emergency transportation, transit shuttles and bicycle commuter facilities (Shared Use Mobility Center, 27) (see recommendation for a revised transportation demand management ordinance in the next section). LADOT work with developers early to assess whether adopting a mobility hub, a model currently under development, to provide access to shared services is ideal for their site and local context.

Reforming parking policies to enable more shared use of parking is another interim consideration. Decoupling parking from the sale or lease of housing units would give property owners more flexibility to sublease or share parking with other uses during nonpeak periods. In Santa Monica, California, a tech incubator created its own app to help tenants find available parking spots that were not directly associated with its building since the property was already in a transit rich area and did not need to provide the number of parking spots that would have been typically required by code (from presentation at Verde eXchange, January 2016). In San Francisco, California, a building developer offered potential tenants $100 in
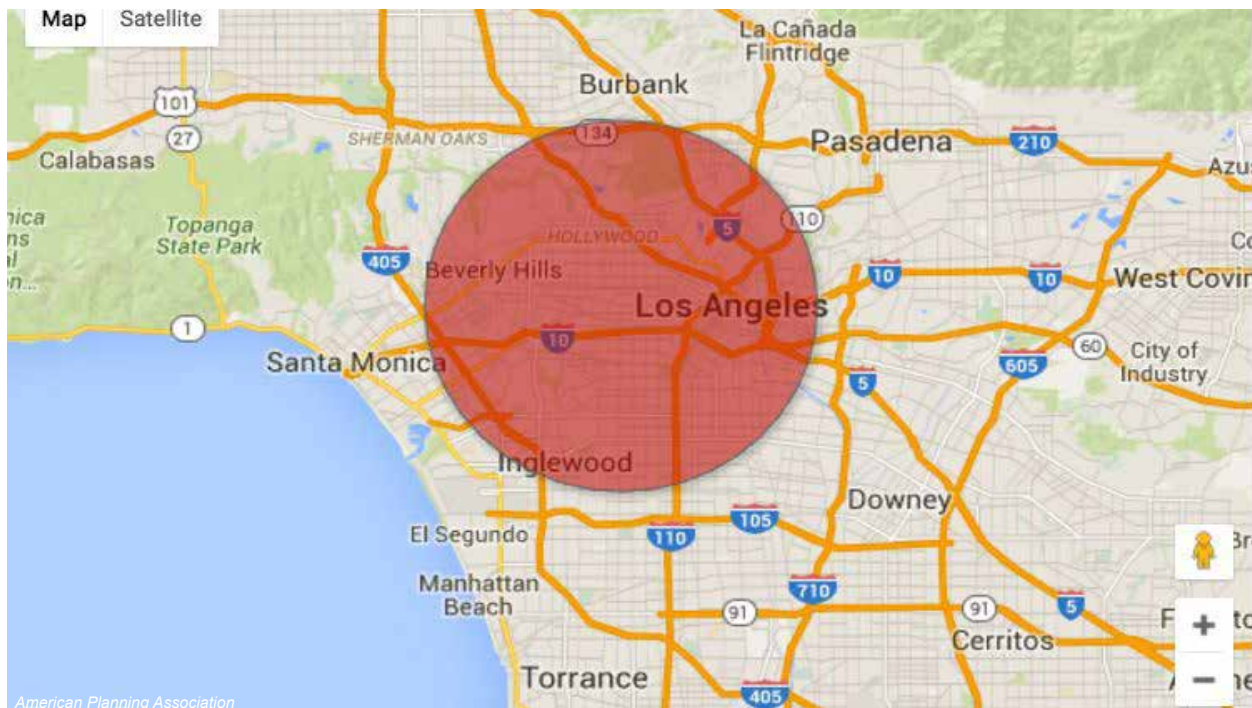
In 2014, 14 percent of Los Angeles County land was being used for parking, with an estimated 200 square miles of Los Angeles consumed by some 18.6 million parking space - 1.4 times the land dedicated to streets and freeways (Wattenhofer).

ride-hailing service credits to incentivize going car-free, thus eliminating the parking demand on the property. Creating more flexibility in the market can help incentivize alternative methodologies to supporting transportation to and from a building without being limited to just supporting the single occupancy vehicle. As new technologies emerge and transportation behaviors change, the City of Los Angeles needs increased flexibility to support new modes and access options.

These initial recommendations should be evolve into new requirements for all development, particularly those in transit-rich neighborhoods and regional centers such as Downtown Los Angeles. Projects should be required to provide feedback to LADOT to understand their effectiveness. In Cambridge, MA, building owners who develop travel demand management programs, for instance, report annually on their use to help the city understand their impact and the most effective strategies to promote shared rides and fewer vehicle miles traveled (City of Cambridge). LADOT would benefit from understanding the impact of new development and subsequent mitigation strategies on our roads and neighborhoods.

The financing of development projects is still a long way off from supporting projects that do not provide abundant (and even excessive) parking based on old formulas. The City of Los Angeles must consider its role in influencing this industry by eliminating requirements that making parking a standard for all new projects and supporting feasible alternatives.

NEXT STEPS

1. Adopt a parking calculator tool that allows for greater flexibility in parking requirements in the near-term.

2. Expand on the Modified Parking Requirement District ordinance to allow for greater flexibility in determining parking needs for new developments.

3. Consider unbundling requirements to include parking in the sale or lease of housing units.

4. Eliminate parking requirements for new developments.

Pixabay

ADDITIONAL RESOURCES
RIGHT-SIZE PARKING CALCULATOR

The King County Right Size Parking Calculator allows you to view estimated parking/unit ratios for multi-family developments throughout urban areas of King County, WA (Seattle area). The calculator is based on a powerful model developed from current local data of actual parking use. While it is intended to help support and guide parking supply and management decisions, it should not be viewed as a definitive answer. Rather, it should be seen as a resource to inform discussions, weigh the factors impacting parking demand, and help consider the proper provision of parking.

For any location selected, users are encouraged to develop scenarios and view the influence on parking/unit ratios by adjusting the model inputs. To help demonstrate the influence of priced parking, bundled and unbundled parking preset options are automatically generated for the parcel(s) that are selected in order to guide the user's decisions. Bundled assumes parking costs are "free" to the tenant, but are recovered through higher rental rates. Unbundled assumes parking cost is separated from rent, granting tenants a choice in parking use and resulting in lower total tenant costs.

http://www.rightsizeparking.org

Built in 1926, the May Company Parking Structure is among many historic parking structures peppering the landscape and breaking up streetfronts. If the need for parking changes with the introduction of autonomous vehicles, how might we reimagine these spaces for better uses than vehicle storage?

Rethink parking garages.

With the possibility that more households will seek alternatives to the traditional car ownership model, the demand for parking garage spaces at both residential and commercial properties will change over time. Providing incentives and a policy framework to rethink these spaces now could provide the "nudge" necessary to drive behavior change among commuters. For commercial garages, it may be impractical to design floor-to-floor heights that could be repurposed for other uses but the Department of Planning could provide some guidance for the best designs to be adapted in the future.

In addition, Los Angeles has the biggest disparity between income and rent in the nation. To keep housing prices in check, reports the Legislative Analyst's Office, California would have to build somewhere between 70,000 to 110,000 additional units each year; build denser with a particular focus on building more in coastal cities like Los Angeles and other central cities. Unfortunately, we are well behind where we would need to be to help provide any relief in the near future. While housing units in typical U.S. cities grew by 54 percent, the housing stock in Los Angeles only grew by about 20 percent between 1980 and 2010

(Barragan). The cause(s) behind this housing shortage are complex and beyond the scope of this strategy but it should be acknowledged that the availability of affordable housing in the region is an issue.

With this housing shortage in mind, it is also recommended that the City of Los Angeles review its rules around accessory dwelling units (ADUs) or "granny units" as well as attached garages and how they might be maximized through the conversion of residential garages into livable spaces. By facilitating ADUs, Los Angeles could potentially introduce new opportunities to provide multi-generational housing on-site, increasing density with limited new construction. An evaluation of these rules in their entirety could further enhance walkability by bringing more people closer to transit across the city. With the region's significant housing shortage, the change of use from vehicle storage to housing may provide some much-needed temporary relief for many communities across the city and should be considered as a potential strategy while other plans for improving the number of available housing units in transit-rich areas are in the works.

Weekday Peaks	Evening Peaks	Weekend Peaks
Banks	Auditoriums	Religious Institutions
Schools	Bars and Dance Halls	Parks
Distribution Facilities	Residences	Shops
Factories	Meeting Halls	
Medical Clinics	Restaurants	
Offices	Cinemas	

PEAK DEMAND PARKING

Different uses have different peak demand periods which suggests there are opportunities to share parking when multiple uses are closeby or even co-located. [Modified from the Victoria Transport Policy Institute + Green Parking Council]

In 2012, the City of Los Angeles passed a Modified Parking Requirement District ordinance to allow neighborhoods to get more creative in addressing parking demand at the local level. This approach acknowledges that the "one size fits all" approach is not appropriate to a city such as Los Angeles and offers several tools and alternatives to the traditional parking requirements. Understanding that parking has peak demand periods, like other transport demand patterns, the City of Los Angeles should consider enhancing strategies for shared parking to optimize the utilization of available parking by allowing different uses to share parking rather than requiring separate parking for separate uses (Green Parking Council).

NEXT STEPS

1. Partner with professional organizations such as the American Institute of Architects and the American Planning Association to explore policy impacts including cost of construction, cost of leasing/ownership, transportation demand, etc.

2. Eliminate barriers to innovation in existing policies by creating more flexibility for local solutions such as shared parking.

3. Understand actual parking demand in each context.

4. Educate the community, including building owners and tenants, about the benefits of these approaches.

LADOT

A bicycle corral on Abbot Kinney creates up to 18 new parking spaces for people on bikes in one car space in Venice.

With the construction of a new housing development on Normandie Avenue in Koreatown, the roadway was widened to meet the requirements of the current street designation. This is the only parcel on the block where the road conforms to these requirements. How could we have used this space better?

Stop widening roads.

Our streets are the backbone of our neighborhoods – connecting the places where we live, work and learn – and making up about 15% of all of the land in the City of Los Angeles (Great Streets). The highway dedication specification requires developers to dedicate land for the future widening of streets to accommodate "anticipated demand." This response has been automatic with limited analysis to better manage access and congestion around a new or repurposed building. In addition, roadway classification is based on a legacy system which means that developers are often asked to make public infrastructure improvements such as road widening when choosing to develop alongside a right of way that requires an update to meet the prescribed classification. The City of Los Angeles should update its policies around highway dedication to reflect goals articulated in its Vision Zero policies and Mobility Plan 2035 that require a better balanced public right-of-way that goes beyond just supporting vehicular traffic. LADOT needs greater flexibility to assess the impact of individual projects on traffic delays as it relates to public safety and pedestrian comfort.

In the future, connected and automated vehicles may not require the same lane widths as human drivers to operate safely in the urban environment. Road widening today is not only in conflict with goals for better balancing modes in the public right-of-way but should be considered only in extraordinary circumstances as so much land is already dedicated to moving vehicular traffic. In lieu of contributing towards physical infrastructure improvements, developers could pay fees towards a digital infrastructure improvement fund which can help build-out the necessary smart city sensors and communications technology necessary to support mobility in the future. Recently, there has been a shift in responsibilities from the Bureau of Engineering to the City Planning Department to manage the approval of exceptions to these requirements by creating a mechanism for developers to apply for a waiver.

NEXT STEPS

1. Stop requiring roadways to meet a standard width if it functions adequately to support demand.

2. Establish metrics and a toolkit to enable city staff to monitor the impact of new developments.

TODAY (0-2 years)

Code the curb to optimize access.

The rules around how our curbs are defined by the City of Los Angeles and follow standard specifications to ensure consistency across the region. Paint and signage provide information, visual cues and rules for access and availability of curbspace. LADOT should consider curbspace as a limited resource that needs to be flexible to changes in demand. Consider a neighborhood with high demand during daytime business hours: this place may require curb assignments for visitor parking and deliveries. These curb definitions could be very different from an entertainment district where peak demand may occur in the evening on specific days of the week.

Angelenos may choose different modes of transportation for different parts of their daily lives – opting for a private shared mobility service to go out at night, for instance, but taking public transit during business hours. LADOT needs a comprehensive understanding of how all of the city's curbspace is defined in an asset inventory; this data baseline will enable LADOT to measure the impacts of a more flexible curbspace as recommended in this strategy and the complete street design guide created by the City Planning Department. Additionally, LADOT should review the rules around curb definitions to identify opportunities to simplify and streamline regulations to make it easier to understand.

The complete street guide recommends that street lane widths be reduced to promote a safer, more accommodating right of way for all modes. How might LADOT leverage technology to make this flex space functional in real-time? What if curbs were an adaptable space that could directly communicate the status of the rules? What if the use of curbs could adapt to demand? The Express Park program allows drivers to identify and pay for available parking while demand-based pricing helps increase parking availability. LADOT should partner with car manufacturers to test the ability to communicate the availability of parking or drop-off space in real-time with the vehicles themselves.

Alternatively, with the right data, LADOT could pilot an adaptive model that allows for curb space to be reassigned (and priced) based on demand. For instance, in entertainment districts on a Saturday night, there may be a need to reduce the number of street parking spaces to allow for more curbside drop-offs by shared mobility services. In turn, parking fees on those streets could go up to reflect demand and incentivize a safer, shared ride home. LADOT could create shared ride hot spots, similar to what Lyft Line has done in San Francisco, to encourage passengers to get together at specific intersections to share a ride (Shaheen, 12). With the rise of new technology-enabled transportation services and automated vehicles, LADOT should evaluate how to distribute curb space to serves all modes.

NEXT STEPS

1. Launch a process of inventorying curbspace and identify opportunities to better reapportion use in the local context and real-time demand.

2. Simplify rules around curb access whenever possible.

3. Streamline signage and other information displays to make it easier to understand how and when curbs can be used.

Develop customer-centered requirements for public services.

Los Angeles bus stops are not regarded well for their contributions to a positive transportation experience and public transit advocates regularly bemoan the afterthought nature of transit stops across the region. LADOT should identify cost-effective and scalable solutions to improve the transportation experience for those who choose and rely on public transit and create public-private partnerships to fund these improvements. What if, for example, you could adopt a bus stop in your neighborhood and help crowdfund the improvements in exchange for naming rights? Non-digital improvements such as shade, a place to sit and schedule information can be helpful and, as riders rely more on technology to get around, providing access to the Internet and charging stations for smartphones can further improve the experience. Building on the success of crowdsourced programs such as People Streets, LADOT should partner with community stakeholders to establish a new and higher minimum design standard for public transit services to ensure riders are treated with decency and provided a convenient and comfortable experience.

This is consistent with the policy framework established in the Mobility Plan 2035 which recognizes that all modes are equally important to a vital transportation system in Los Angeles (Mobility Plan, 102). This recommendation is not intended to replace LADOT prioritization for route and

schedule optimization, service reliability, and convenience for public services but to complement these efficiencies and improvements.

NEXT STEPS

1. Adopt minimum design standards for public transit access points.

2. Host a forum of potential community partners to identify strategies to fund improvements.

3. Implement new baseline standards for an improved public transit experience.

Streetsblog USA/Memphis Team

In Memphis, volunteers are raising money to install bike racks and repair kiosks at three key bus stops to make it easier for people to ride their bike and catch the bus. In addition, these bus stops will provide schedule information to make it easier to plan your trip - without a smartphone or access to the Internet.

APUR

Paris is redesigning public plazas by counting the volume of vehicles, people and cyclists with automatic sensors and providing opportunities for direct community input on the desired outcomes of the redesign.

Integrate real-time data + technology into urban design and planning processes.

A 2006 study by the Brookings Institution found that, even among wealthy households, neighborhood characteristics influence how much is spent on transportation and how many vehicles are owned:

> "Neighborhood characteristics such as density; walkability; the availability and quality of transit service; convenient access to amenities such as grocery stores, dry cleaners, and movie theaters; and the number of accessible jobs shape how residents get around, where they go, and how much they ultimately spend on transportation (Marshall)."

In a recent study by researchers from the University of Texas, Arlington and University of Utah, 48 percent of persons living in HUD properties studied spent more than 15 percent of their income on transportation and are particularly affected in urban areas defined by sprawl and inaccessibility by transit. Creating more compact, walkable neighborhoods will help create more affordable housing by reducing the costs of transportation.

With the wealth of new, dynamic data, policymakers are challenged to rethink how it addresses some of our city's greatest issues and opportunities; how to become more responsive as a regulator and service provider; how to integrate the new data and insight instantaneously into planning and infrastructure projects. With aging infrastructure, considerable reinvestment in our built environment is critical and integrating data extensively into setting goals, measuring success and managing infrastructure on an ongoing basis will help maximize the limited resources we have to the advantage of our city and region. This also creates opportunity to leverage infrastructure to serve more than one purpose - rather than just designing something to address a single need, a more dynamic approach to the design process could

result in better solutions for multiple problems. LADOT must therefore adapt its decision-making and planning processes and fully leverage data insights into solutions through the use of analytics and learning tools early in the design process. Leveraging data to understand how development-driven public improvements driven can help LADOT and the city have a more comprehensive understanding of the complex solutions being implemented to meet the goals of Vision Zero and other policy priorities.

In recent years, there have been several dynamic urban planning and infrastructure design tools that have emerged, enabling both the public and private sectors to explore various assumptions and scenarios in the built environment by factoring in policy constraints, real-time environmental sensors, open data and even consumer preferences as a means to understand potential market forces that could drive the success of policy decisions. A smart city project designed for the outskirts of Tokyo, the Fujisawa Sustainable Smart Town, considered three layers of design: the base layer is infrastructure - the community's energy and information systems; the middle layer is the smart living spaces; the "lifestyle layer" sits on top and focuses on things such as recreation, health and transportation (Watson). Factoring these layers into the planning construction and management of the built environment will not only help in realizing cost savings and operational efficiencies but improve the overall citizen or customer experience by being more responsive to needs.

NEXT STEPS

1. Explore different design methodologies to better integrate data into project evaluation and decision making for new projects.
2. Consider adopting supporting software to make it easier to apply data to decision-making.
3. Leverage reporting from an updated transportation demand management ordinance to capture data on the impact on transportation behaviors.
4. Train staff on how to integrate data into work.

Publish data on EV charging station locations.

According to McKinsey & Company, "stricter emission regulations, lower battery costs, more widely available charging infrastructure, and increasing consumer acceptance will create new and strong momentum for penetration of electrified vehicles in the coming years (Gao, et. al.)." Expanding upon the efforts of the Department of Water and Power and other stakeholders to introduce more electric vehicle charging station infrastructure, LADOT should adopt or develop a data standard and provide the means to report the availability of both public and, as appropriate, privately owned charging stations in a consumable format.

Currently, there is considerable range anxiety in the Los Angeles region which impacts electric vehicle purchasing behavior - without the charging infrastructure, consumers are hesitant to buy pure electric and are more likely to buy hybrid vehicles. It would help drivers know the location of available of power; charger specifications; any associated costs or rules of access; and real-time status of the availability of chargers. LADOT should encourage the adoption of this standard regionally and advocate for this information to be included in tools such as GoLA and Google Waze.

NEXT STEPS

1. Adopt a standard format for supplying charging infrastructure location data.

2. Collect and consolidate all public infrastructure on open data catalog.

3. Create a tool for private EV charging infrastructure data to be included with protocols for maintaining quality of data.

4. Consider requiring all charging infrastructure that is available for public use (even for a fee) is reported to the City of Los Angeles to be included in the open data catalog.

5. Expand location data to include real-time availability data so vehicle owners will know more about how and when they can access this charging infrastructure.

Office of the Mayor

Pictured here is Mayor Eric Garcetti with the first public electric vehicle charger installed curbside in Downtown. Expanding this network of supportive infrastructure can help encourage market growth for cleaner vehicles.

ADDITIONAL RESOURCES
DATA EXAMPLES

Alternative Fuels Data Center

Alternative Fuels Data Center (Data.gov) could serve as a starting point. This data set makes it possible to search for alternative fueling stations near an address or ZIP code or along a route in the United States.

https://catalog.data.gov/dataset/alternative-fuels-data-center

PlugShare.com

PlugShare.com is an example of a website that aggregates residential chargers, public stations, high power station and in-use station data. This site does not differentiate between charging stations that are available in the public right-of-way, like those being piloted in Downtown Los Angeles, versus those that are in a public garage or on private property which could limit access.

http://www.plugshare.com/

- 3 LADOT Stations are currently fueling with Redeem
- In 2015, the stations received a total of 1.36 MM GGEs of Redeem

13,339
Metric Tons

Total greenhouse gas emissions reduced in 2015 by fueling with **Redeem**

That's Like:

Planting
341,486
Trees

Removing
2,815
Cars off the Road

4,781
Tons of Waste Recycled Instead Landfilled

*Emissions reductions estimates are annual figures based on data provided by the Environmental Protection Agency and the Low Carbon Fuel Standard (CA).

Advance fleet conversion to greener fuel.

This recommendation includes both advancing the transformation of the LADOT fleet to better alternative energy sources as well as supporting market transformation in the region by providing supportive infrastructure for the private fleet. As part of the department's efforts to meet goals established in the sustainability plan, LADOT is greening its fleet with four all-electric transit vehicles to be added over the next couple of years. Rather than waiting twelve years for full fleet replacement, the typical lifecycle for a public transit vehicle, LADOT is piloting the use of renewable natural gas from landfills amongst its CNG fleet. This gas is mixed into the fuel and LADOT will be increasing the percentage of this renewable gas as the preliminary results have been promising (see graphic above). The emissions improvement has been a significant contributor to reducing the environmental impact of transit operations. LADOT should continue its progress towards converting its own fleet to electric and cleaner fuel options.

The City of Los Angeles piloted the installation of curbside electric vehicle charging stations in Downtown Los Angeles. In addition to the first three, the City is in the process of installing an additional 15 stations which will make it easier for drivers to access charging infrastructure at curbside parking spots. The goal is to expand this network to up to 80 stations by the end of 2016 with funding being sought for an even larger network over time. This infrastructure will be essential to supporting a growing electric vehicle (EV) market in Los Angeles by easing range anxiety and making it easier for vehicle owners to access the charge they need to keep moving.

New technologies to support electric vehicles are rapidly evolving and should be considered as a complement to fleet electrification. Roadway electrification, for example, is being tested in Utah and offers a new way to provide charging for electric vehicles. Static charging enables vehicles parked over pads embedded in the roadway to recharge and could be located at bus layover stops. Alternatively, charging technologies can be spaced over a roadway for dynamic charging while the vehicle is moving. For new technologies such as this to be implemented at scale, the City of Los Angeles will need to consider how existing policies may impeded their application and remove potential regulatory obstacles for testing. LADOT should identify opportunities to collaborate with Metro to test and explore creative partnerships, funding approaches and alternative delivery methods to advance transportation technologies more expeditiously in the region.

NEXT STEPS

1. Accelerate the conversion of public transit and city fleet vehicles to greener fuels.

2. Continue to grow fleet electrification infrastructure such as curbside charging stations.

3. Adopt enabling policies to create more opportunities for new technologies, such as roadway electrification, to be demonstrated in Los Angeles.

TOMORROW (3-5 years)

Create a unified wayfinding program.

Tools for navigating Los Angeles must currently support multiple modes and users: pedestrians; cyclists; passengers; and drivers. Existing signage for traditional public transit is complicated and cluttered because it has to accommodate multiple systems that cross into and serve the city. It can be difficult to understand and navigate these systems, making it difficult to access services such as parking and bus transit.

LADOT has tested alternatives to complex parking signs readable, simple, and understandable with a six-month sign pilot program with newly designed, easy-to-decipher parking signs. The grid-style signs are clear and innovative, laying out a 24-hour cycle where parking restrictions are clearly represented in green and red. Los Angeles is the first metropolitan city in the country to test out these signs with the goal of decreasing parking citations due to misunderstandings created by confusing signs. The new parking signs are installed on Spring and Main Streets between 2nd and 9th Streets in Downtown Los Angeles. With today's technology, information can be communicated in real time, simplifying the challenges of navigating where and when you can use a curb. Beacon technology on parking signs can communicate to smartphone users whether you are permitted to park at that time of day. This is also being piloted in Downtown Los Angeles. LADOT should continue to explore NFC, Bluetooth and other technologies and create push notifications with partner applications to help Angelenos navigate and access transportation services across the city.

With the forthcoming LADOT program to launch mobility hubs, centers where multiple modes are co-located together to provide for better connectivity and access, new signage and wayfinding standards should be established for potential expansion beyond these hubs to the entire mobility network. Transport for London, for instance, has piloted and adopted an easy-to-use signage system that presents information in a range of ways, including maps and information, to help people find their way. They have expanded to working with various neighborhoods, business improvement districts and other community organizations to expand the scheme throughout the city. Metro has developed network identification guidelines as part of its first last mile strategic plan which would provide LADOT with a great starting point for collaboration. If Los Angeles is going to effectively support multiple transportation modes, including shared mobility, cyclists and pedestrians, it must be easier to navigate around the city and connect between modes. Technology such as real-time arrival displays and WiFi can further enhance connectivity and make these various systems easier to use.

NEXT STEPS

1. Convene a coalition of other agencies and transportation stakeholders to set standards and combine resources to move towards a more seamless wayfinding program. Leverage the existing standards defined in Metro's first-last mile strategy.

2. Release a request for proposals to develop standards for a legible wayfinding system that connects to mobility hubs and multiple modes.

ADDITIONAL RESOURCES
METRO GUIDELINES

Los Angeles County Metropolitan Transportation Authority First Last Mile Strategic Plan & Planning Guidelines

This document provides some guidance around establishing a regional standard for signage and wayfinding that should be considered as a foundation for any program developed.

http://media.metro.net/docs/First_Last_Mile_ Strategic_Plan.pdf

Flickr/NYCDOT

New York City developed its wayfinding program Walk NYC in 2013 to unify pedestrian maps, transit information and other important information in a simple, legible design that would make it easier to get around. By providing nondigital information on the streets, it helps make it easier for people without smart phones to connect and use public transit and walk.

The City is currently expanding its street presence to include public WiFi kiosks through the Link NYC program.

Route transit by demand where suitable.

LADOT has been focused on addressing first-last mile connectivity, finding better ways to make it easier for Angelenos to choose transit by making the first or last bit of their trip easier. The LADOT DASH is a neighborhood circulator bus with fixed routes and schedules across Los Angeles and neighborhood advocates often request these services be brought to their community. It can be difficult to assess actual demand, optimal routes and service schedules without better information; it is simply too cost-prohibitive this one model citywide. LADOT should identify new platforms for service delivery that provide greater flexibility to riders while optimizing the efficiencies of technology platforms.

In the Orlando suburb of Altamonte Springs, Florida, the local government has announced plans to subsidize Uber trips as an extension of its transit service to help solve first-last mile connectivity during off-peak hours. These rides will help keep the workforce connected to jobs when traditional transit is not efficient enough to warrant full service. By offering a call-in dispatch service, Altamonte Springs will bridge the digital divide by ensuring access to these services are not limited to people with a smartphone and data plan (Hertz). LADOT should explore leveraging existing technology platforms, such as the ones developed by ride-hailing services, to optimize connectivity in Los Angeles and provide alternatives to neighborhoods and communities that might support full-scale, traditional public transit service levels.

Microtransit provides on-demand shuttle services through smartphone applications and could provide an alternative, more cost-effective service delivery model for some neighborhoods with the benefit of moving more people at a time than a ride-hailing service. LADOT could partner with microtransit providers and precursor or in lieu of launching a new DASH route. This would help LADOT ascertain in a more agile way what the right size vehicle is required to support these services in the long run and whether there is enough demand to warrant a traditional DASH service or if a more on-demand model is adequate.

LADOT should seek an active role in identifying these partnerships as a means to extend access to service, improve available schedules, and provide dependable service models. If left to only private services, there is a risk in further stratification across LA – offering access to those who can afford microtransit while leaving everyone else behind. Research indicates that some of these microtransit services tend to operate most successfully in neighborhoods that are already rich with transit options so working more closely with local government can help strike a better balance. It is also recommended that these services conform to the transit pass standard, making it possible for passengers to claim these rides as part of their pre-tax commuter benefits. In a 2011 survey, the San Francisco County Transportation Authority found that providing shuttle services helped 63 percent of drivers move away from driving alone (Shaheen, 14).

LADOT also offers accessible rides to targeted special populations such as the disabled, older adults, and low-income groups. These services can be expensive to manage with limited convenience for the passenger (advanced scheduling, tools to access the service, etc.). LADOT should pilot outsourcing these services to private sector ride-hailing or microtransit providers and evaluate the impact on services (access, cost reductions, improved customer experience). Ultimately, LADOT will need to establish metrics to measure the impact of any on-demand services and will need partners to provide the necessary data to understand how they are operating.

NEXT STEPS

1. Evaluate the program in Altamonte Springs, Florida and consider piloting a similar program.

2. Explore feasibility of testing a microtransit model for a DASH route.

3. Partner with community stakeholders to build support and create a pilot user base.

4. Identify potential funding opportunities and launch request for proposals to support limited pilot.

5. Measure and develop strategy for expansion (if successful).

Expand Express Park citywide.

Express Park is a mobile technology that allows users to easily identify available parking in Westwood and Downtown Los Angeles, make reservations for the space and pay for the spot. In addition to a favorable community response - with less time being spent circling the block looking for available parking - this app will be integrated into the Go LA pilot. This data should be available via API to be shared and integrated into other trip planning applications such as Google Waze and should be expanded to include other payment mechanisms such as the Transit Access Pass or TAP card.

This service, along with the ability to assess availability and cost of parking as part of the trip planning experience, considerably improves the user experience. This program should be rapidly expanded across the city's busiest commercial districts and expand to integrate privately-owned parking spots and facilities.

NEXT STEPS

1. Continue with proposed expansion of smart parking citywide.

2. Identify new ways to leverage data available from this system for future planning and transportation demand management strategies.

LA Express Park is a program that fuses technology and demand-based pricing into an innovative parking management strategy. Created as part of the Los Angeles Congestion Reduction Demonstration with $15 million in grants from the U.S. Department of Transportation and $3.5 million in city funds, the program uses technology to help the city increase the availability of limited parking spaces, reducing traffic congestion and air pollution, and encouraging use of alternative modes of transportation. LA Express Park launched in Downtown Los Angeles on May 21, 2012 and has been expanded to include areas of Westwood.

LA Express Park was created to make traveling and parking downtown easier by making more parking available in the area and by giving drivers several ways to find where parking is available. The LA Express Park program incorporates several elements as key components: new parking meter technology; parking space vehicle sensors; a real-time parking guidance system; an integrated parking management system; and the LADOT Parking Management Center.

Demand-based pricing is a concept used to better match the availability of parking spaces to the demand for those spaces. When demand for parking is low, rates are low. When demand is high, rates increase. The concept helps motorists decide when to make trips and whether to use alternative modes of transportation based on where there is available parking and how much it will cost.The ultimate goal of this innovative project is to make driving and parking in downtown Los Angeles easier.

Introduce a portal for employers to manage transit benefits.

Some employers provide commuter benefits that reimburse employees with a pre-tax value for transit passes or parking. When Panasonic North America moved its headquarters to a downtown in New Jersey, it began charging market rate for parking and only offering parking reimbursement for park-and-ride. The percentage of employees commuting in their own cars dropped from 88% to 36%, cutting the average daily vehicle miles traveled in half. Because of the proximity to transit, ridership grew from 4% to 57% and Panasonic gave staff a 50% discount on transit passes. With effective outreach, Panasonic was able to transform commuting patterns of its workforce in a very short period (Jaffe).

A Transit Center study indicates that these benefits do not often reach enough people since they are not required. A 2013 survey found that only about 12% of employers offer commuter benefits and only 2% of American workers take advantage of them. Meanwhile, a staggering 87% of employers in the U.S. provide free, on-site parking (Transit Center). The commuter benefits model only supports two mode options: driving alone or taking public transit. These programs fall short of addressing the total options available and do not allow for much flexibility when employees might need more than one option in their commute. After all, your transportation needs may be different on Monday than they are on a Thursday. What if these programs created a greater incentive to share rides while creating the flexibility that most of us might need? Coupled with onsite services such as access to carsharing and bikesharing will make it easier for employees to exercise more choice. Cities such as New York City and Washington have passed legislation requiring employers

to offer a transit benefit and Los Angeles should consider something similar.

California state law also provides a parking cash-out program where employers of 50 or more employees who provide subsidized parking for employees must also offer a cash allowance in lieu of a parking space. Increasing awareness about the availability of this benefit will help encourage shared rides, reduce overall vehicle miles travel and lower emissions. From the perspective of the employer, the cost and hassle of administering these programs can create barriers to adoption and broad utilization which can impact their effectiveness in shifting commuter behavior. LADOT should work with Metro to streamline the management of commuter programs to make it easier for employers to adopt, ease the process of uploading new balances to employee transit cards, and promote these programs for increased adoption.

In the interim, LADOT and the Office of the Mayor could create a commuter benefit challenge and invite large employers across the city and region to promote and incentivize their employees to change their commuting behaviors. This could generate some interest and publicity while leading to potential long-term changes in behavior as was demonstrated in the changes around the Panasonic headquarters move.

NEXT STEPS

1. Partner with large employers in the city and region and create a commuter benefit challenge to shift commute behaviors.

2. Identify potential incentives to support the challenge.

3. Develop a one-stop portal to make it easier for employers throughout the region to provide monthly commuter benefits.

FUTURE (6+ years)

Create a universal fare system for Los Angeles.

A recent Metro board action proposed by Mayor Eric Garcetti called for the study and development of a universal fare system for all transit in the region. LADOT should collaborate with the Coalition for Transportation Technology and other regional stakeholders to develop a system that serves all modes with a single, universal fare card.

With the launch of bikeshare and the electric vehicle carsharing pilot in Los Angeles this year, LADOT should push for the adoption of a fare card system that would enable public transit users to access these services through the same payment system, simplifying the experience for users but also making it more accessible to unbanked populations who may not have access to credit cards and other payment tools or may rely on electronic currencies such as Bitcoin. A unified fare system can also make it easier for agencies to subsidize less affluent riders through a more standard regional approach while creating an efficient, integrated network (Brower). The upcoming launch of bikeshare services in Downtown Los Angeles this summer highlighted the importance of streamlining the fare system. While bikeshare is intended to function as an extension of the Metro transit network, it was challenging to get the fare card system to be seamless for the customer. Initially, it looked like it was going to create a dual system. Metro has worked to eliminate some of the barriers by making it possible for existing Transit Access Pass (TAP) users to register their card in the system and add bikeshare access while a new customer can purchase a monthly or annual flex pass online and receive the card in the mail (Sotero). This simplification will help adoption of the new mode choice and will give Los Angeles the unique distinction as the first US market to offer a single transit card for both bikeshare and public transit services.

LADOT has led the way as the first California transit organization to pilot mobile payments and should continue to serve as a catalyst for payment innovation in the region. Mobile payments offer flexibility to some extent but require access to (charged) smartphones and a dedicated application that enables payment at access points. LADOT was able to test what would be required on-board transit vehicles to verify payments, train staff to accept these payments through visual verification, and run a pilot of the LA Mobile app on both the DASH and Commuter Express services. This tool has also been expanded to enable Angelenos to pay for parking and parking citations. Adoption of the payment tool presents an additional barrier even to those who have access to a smartphone since the public sector must then encourage potential riders to download and activate the payment application. To ensure a positive experience, moving towards a comprehensive mobile payment system may also require supportive amenities such as WiFi access and phone charging capabilities at transit hubs so riders do not get stranded when they need to load more money to their account or if their smartphone battery is dying. Additionally, LADOT

LADOT

Wikimedia Commons/SPSMILER

GOVERNMENT INNOVATION
TfL + CUBIC LICENSE CONTACTLESS CARD TECH

Transport for London (TfL) has been working with Cubic since 2003 to develop the Oyster card fare program. The transit payment system has since been upgraded to support contactless payment systems such as debit cards, Apple Pay, and Android Pay. This technology will now be available for licensing to other transit systems through a £15 Million agreement with Cubic that will help London freeze transit fare prices for the next four years (Temperton).

This introduces two important opportunities for Los Angeles to consider. First, this is a tested success story that could help make it easier for Angelenos to pay for transit services through a common payment method that works across multiple modes. Second, the investment by TfL to develop this technology is paying off. Thought leaders and early adopters are often challenged by risk concerns when making early investments in research and development. As demonstrated in this project, there has been a significant return on investment for Londoners as this early deployment will now subsidize transit fares.

will need to consider pathways to enable fare payment for those customers who do not have access to a credit card or bank account. A final consideration is the fact that the current LA Mobile application does not have GPS or other location-aware capabilities (so LADOT does not benefit from this essential data) nor can it provide eligible riders with reduced fares (LADOT).

There are a variety of approaches to fare systems that can be leveraged to support mobility in the Los Angeles region. Smart cards are plastic credit-card size piece of plastic with an embedded microchip and this technology has been tested in markets around the world. These cards can either solely store data locally or provide a small processor with the ability to process small functions. These cards, which provide a better understanding of transportation behaviors and choices, can lead to a future of loyalty programs and more customized solutions for Angelenos. This technology, as applied in the regional TAP program, currently enables LADOT and Metro to use income-based fare discounts to ensure access for low income communities to bus and rail transit. Taking this technology a step further would allow for further testing of how much more affluent riders might be willing to pay to make up the difference in paying for the true costs of transportation (Chieppo). TAP is not currently an account-based system which means there is no individual

identifier that would make it capable of supporting a loyalty program, for instance, or a smart fare program. Smart fares, aided by technology, are more sophisticated fare structures, providing the right service to the right customer at the right price. Some potential strategies that should be tested include time of day pricing, particularly peak pricing; distance-based pricing; level-of-service pricing; usage-based pricing and even loyalty schemes for the most frequent travelers.

Some payment technologies offers essential insight into travel behavior by requiring a swipe in and out of the system – giving a more detailed view on the paths of travel across the city. The current TAP model would require significant investment in hardware at transit stations and within public transit vehicles since the fare system is not designed to track exits from the transit vehicles and stations. The Finnish city of Turku is offering new bus riders free travel when they apply for a bus pass that requires a touch-in, touch-out bus pass. Applicants that also have a driver's license qualify for this program as an incentive to shift modes. Transportation officials benefit from having data on trip origin and destination for riders to help improve services (O'Sullivan). This information has been difficult for agencies such as LADOT to collect although it is essential to have this anonymized data for transportation planning.

Transport for London (TfL) began piloting contactless credit and debit card readers in lieu of a ticket on bus services in 2012 and expanded to rail and Tube service in 2014. At the end of the day, the system calculates the distance traveled and deducts the correct fare, applying a daily or weekly cap if the rider traveled enough. This system, which also supports mobile devices with contactless payments tools, is now available to other markets via a public-private partnership between TfL and the fare technology company Cubic Transportation Systems (CTS). By sharing the lessons learned from developing this smart fare program, TfL will be able to apply this new income towards freezing fares for the next four years and supporting further investment in new infrastructure (Thomas). With the United States moving toward an EMV payment infrastructure, using chip-based technology for payments, there will be additional considerations for updating transit fare and parking payment infrastructure in both attended and unattended environments. Visa reports that 7 in 10 Americans have at least one chip card in their wallet and the total transition for the majority of cards to transition to EMV will occur within the next two years (Smart Card Alliance). These cards offer a more secure payment model and can help expedite the market shift towards contactless payment systems.

Technology also enables multi-purpose for payment mechanisms which would be another opportunity to test various incentives that might promote shared mobility. The Presto Card in Ontario and the Octopus Card in Hong Kong, for example, can be used for both travel and shopping (AECOM). From the customer perspective, a smart card can simplify the need to pay for services ranging from parking to congestion charges to HOV lane access to transit fares and payment for other transportation services. It could also be extended to include payment of other obligations to local government such as permit or business license fees, etc. or be bundled with access to other regional attractions to appeal to tourists and visitors to the region.

With LADOT to launch mobility hubs to create better connectivity between services at centralized nodes across the city, a unified payment system is essential to making the experience of changing modes and getting around easier. For LADOT to position itself as an agency that supports a flexible mobility marketplace while exploring alternative delivery models such as microtransit and other public-private service partnerships, a single fare system can make it easier to integrate these alternatives. In addition, a more unified system could provide valuable new data resources to transportation planners across the region about customer preference, mode split, and changing demand that is currently not available in a balkanized fare system. Los Angeles should be a leader in creating broader accessibility to services by eliminating friction in the payment system.

NEXT STEPS

1. Document lessons from existing implementation of mobile pay to be shared with the Coalition for Transportation Technology.

2. Develop a roadmap for better payment integration with regional systems through collaborating with Metro and other key stakeholders.

3. Collaborate regionally to advance a single payment system that can expand across multiple modes.

Metro/The Source

Step Three
PARTNERS

3. Create partnerships for more shared services.

LADOT and the City of Los Angeles cannot address congestion by simply expanding travel lanes as that leads to induced demand and increased traffic. There are few areas around the city that have the space to accommodate such expansions and there is little public appetite for eminent domain. Nevertheless, it will require a collective shift in behavior by many Angelenos to achieve goals for reducing transportation demand and maximizing the resources we currently have available. This change will likely occur gradually although the city may reach a critical juncture when traffic finally gets so bad that people will seek alternatives. Shared mobility can improve the efficiency of our roadways by increasing the capacity of vehicles, reducing vehicle miles traveled, and providing more choices/options that are scalable to needs. For instance, Angelenos' needs for transportation change depending on the nature of travel (work commute versus pleasure), time of day; how many people are moving together from the same origin point; etc. Factors such as cost, schedule, reliability and ease of use shape each transportation option. With complementary land use, shared mobility could provide more Angelenos with better options and LADOT should consider ways to better deliver these services as a 21st century mobility manager.

The traditional model of delivering transit services must be considered within the context of changing customer preferences and the availability of new technologies. LADOT has demonstrated a willingness to explore new approaches to delivering services and has embraced innovation. Understanding that the services we have today may no longer be competitive offerings in the future is essential to establishing and supporting a true platform for transportation innovation.

How?

LADOT should continue its focus on making it easy to engage and work with the City of Los Angeles as it is important to establish an early dialogue with new transportation providers to ensure public safety and other policy requirements are being met. Starting the dialogue early will help tech startups and others in this space navigate the complexities of City Hall before too many decisions have been made. Likewise, LADOT should consider new public-private partnerships to extend transportation services beyond its available capacity.

McKinsey identifies four major technology trends that are changing mobility. In-vehicle connectivity is creating crowdsourced information and real-time data to relieve congestion and provide new route options to drivers. The sale of plug-in and hybrid vehicles is estimated to quintuple by 2022 to 11% of the global market, reducing pollution and creating new demand on the supporting charging infrastructure. Carsharing and true ridesharing will reduce the number of vehicles on the road but increase vehicle miles traveled by 75% (in other words, there will be fewer cars but they will be in more constant use). Automated vehicles will be able to reduce accidents by 90%, saving thousands of lives, improving roadway capacity due to smarter driving; and save the U.S. an estimated $190 billion per year (Schmitz).

Transportation is the second largest expense for most households after housing. Households living in auto-dependent locations spend 25 percent of its income on transportation costs. Housing located closer to employment, shopping, restaurants and other amenities can reduce household transportation costs to 9 percent of household income (FHWA).

There is a widely-held belief that car ownership equates to freedom and flexibility (D'Costa). However, this comes at a cost to both the individual and to society as a whole. Transportation is the second largest expense for U.S. households. AAA estimates the cost of owning an average sedan at $8,558 per year, down 1.6% from 2015 due to lower fuel costs. Owning an SUV will cost the average household more than $10,000 based on driving 15,000 miles per year (AAA). Many of these are fixed hard costs because they are associated with ownership, including maintenance, registration, insurance, etc. The availability of new private mobility services is changing the way Angelenos move. These innovations are being driven almost exclusively by the private sector and has

Kansas City Area Transportation Authority has partnered with microtransit provider Bridgj and local van manufacturer Ford Motor Company to test on-demand transportation for its suburban areas.

a considerable impact on our infrastructure, public transit services, and communities. How land is used and how cities are designed also shape transportation decisions. Higher density, walkable neighborhoods, with fewer parking options, tend to create the conditions for people to test alternatives to driving alone (Bouton, et. al.). LADOT needs to embrace the potential of this evolving marketplace while maintaining focus on providing equitable access to safe services.

28 percent of car trips are a mile or less according to the Governors Highway Safety Association (Schmitt). Shared mobility can encourage greater use of transit by providing much-need connections for the first-last mile of trips. It is important, however, to consider these services as part of a system or marketplace of solutions. Riders are going to choose the mode that best meets their needs and priorities whether it is schedule, proximity to service, cost of the trip, environmental impact or even health benefits. Providing flexibility to choose the right mode requires supportive public policy and collaboration.

Mass public transit remains the best way to bypass congestion and move large numbers of people in and out of densely populated urban centers. As part of a system

of services, however, there needs to be consideration for the entire route - from start to finish. How do people even access public transit services? Is it convenient? Is it safe? Is it affordable? When shared mobility services such as bikeshare can connect to other modes, it eases the challenge of getting around the city. LADOT can offer incentives (and partner with others who can also offer incentives) to help shift behaviors and encourage more shared services. Rather than protecting traditional public transit modes such as bus and rail at all costs, local government should leverage the potential of shared mobility to expand regional mobility and attract new users to these traditional modes. Local governments are increasingly considering the benefits of partnering with shared mobility providers such as transportation network companies (Uber, Lyft, etc.) to extend services to communities with more flexibility and lower costs than rail and bus. Solving the mobility challenge will require bold, coordinated actions from both the public and private sectors. Technology, commercialization, funding, new policies and business-model innovation will help maximize the productivity potential of these services while creating a more sustainable urban environment (Bouton, et. al.).

POLICY RECOMMENDATIONS

Update regulations to include new transportation modes.

LADOT will need to adopt new tools to regulate technology-enabled modes of transportation as they are introduced to the regional ecosystem help protect public safety, provide access and ensure equitable distribution of services. Carsharing, a relatively small service in Los Angeles, for example, requires easily accessible places to park vehicles. Service providers prefer permits for street parking because it raises the visibility and accessibility of the service. Cities across the United States have been testing various cost structures, data sharing requirements, and guarantees for equitable distribution of services as part of their permitting process. Washington, D.C., for example, has made parking available for one-way carsharing services as long as there is at least one car in each ward (ensuring better access for all neighborhoods) and the number of cars in the public right-of-way equals the number of cars in private parking spots (Shared Use Mobility Center, 26). LADOT must adopt a permit structured to enable carsharing services to park on the streets to help support program growth and adoption.

Emerging transportation technology companies may quickly fail but the rapid growth of innovation will have a sustained impact on mobility, the economy and environment (Transportation Research Board, 7). Learning from these failures will help strike the right balance of regulation. BMW, for instance, recently suspended its luxury carsharing service in San Francisco, citing challenges with finding available parking within the

current regulatory framework and the lack of clear direction from the City. Rules created for data sharing, for example, should be applied universally across shared modes to avoid creating a competitive disadvantage when working with the City of Los Angeles. With the recent launch of the electric vehicle carsharing service program in South Los Angeles, LADOT will be able to better understand what is necessary to foster an environment where these services might thrive. For a service such as this, it will be important to go beyond just the permits for the specific service and consider the entire ecosystem necessary for success - including charging infrastructure, preferential parking, or incentives to spur adoption.

Other modes such as microtransit will require regulatory guidelines to operate within Los Angeles. LADOT should consider new fee structures, for instance, for access to curb space in light of the temporary congestion caused by the pickup and drop-off of passengers. In addition to generating some revenue for the city, it could also serve as a market balance to price out excess traffic while keeping the total number of vehicles and operators at a sustainable level (Brower). LADOT will need to evaluate fee structures within the existing service context to ensure a level playing field but also incorporate opportunities to rethink how we pay for infrastructure. The existing gas tax model for funding infrastructure, for instance, is failing to meet needs and shared modes may provide an opportunity to address a pay-as-you-go model, charging for the use of infrastructure to pay for its maintenance. Recommendations on best practice policies will be forthcoming in the Share Mobility Action Plan.

NEXT STEPS
1. Adopt best practice supportive policies for shared modes.

Shared mobility can also be an effective tool in meeting the goals set by the State of California to reduce vehicle miles traveled and greenhouse gas emissions by 15 percent by 2020 and should be factored in as a sustainable transportation strategy.

Communities can transform underused areas of L.A.'s largest public asset—our 7,500 miles of city streets—into active, vibrant, and accessible public space with People St, an LADOT program.

Make it easier to work with the City of Los Angeles + provide a level playing field.

Navigating policies and procedures to establish a new transportation service in any city can be complicated; each rule set differs across each city which can be both time consuming and expensive for start-ups to launch and new businesses to enter into the marketplace. LADOT should begin by evaluating and streamlining permitting and other government processes to help improve the customer experience, make it easier to follow rules and regulations, and encourage compliance with regulations. In July 2011, the City and County of Denver launched the Peak Academy to teach lean and six sigma methodologies to its staff, empowering them to work with supervisors to identify ways to improve processes without adding any additional resources or new technologies. Over the first four years of this initiative, City and County staff have identified $24.9 million of potential savings, actualized $9.2 million of savings while giving staff the opportunity to improve their own work by streamlining outdated processes and serving their customers more effectively (O'Brien, 8). In addition to benefits to the taxpayer, city and county staff have higher satisfaction levels working in an environment where they are empowered to improve.

LADOT should identify and prioritize processes that should become "paperless" and eliminate any processes that are redundant or not necessary to meet the intent of the guiding policies. If a policy outcome or procedure is no longer appropriate, it should be eliminated to save time and money. LADOT should develop internal capacity for process improvement and applying these practices on a regular basis can help ensure continuous improvement,

making it easier on both the applicant and LADOT staff while providing policy makers with essential feedback.

With new shared services such as carsharing and ride-hailing applications disrupting the mobility marketplace, it is important to evaluate whether existing rules apply to these models, how the rules might need to be revised (or repealed entirely) and how this will impact existing franchises and services already being regulated. In particular, it is important to balance the requirements around existing mobility services with what will be required of new services. It is a challenge for policy makers to both encourage and facilitate innovation while achieving greater public policy consistency among new services and the more traditional modes (Transportation Research Board, 2). One aspect of the challenge is how to classify companies as a service to be regulated; establishing standards such as driver insurance and background checks to ensure safety of passengers and others on the road; and reconciling how this new service will operate within the existing mobility marketplace has really pushed local authorities to think differently. While cities such as Los Angeles have introduced legislation and regulations to manage some of these requirements, the taxi franchises - which have seen considerable disruption in all markets - remain frustrated by regulatory requirements that apply to their industry but do not apply to the ride-hailing services.

LADOT does not need to play the role of picking the winners and losers in this rapidly changing environment. Taxicab companies are concerned they are losing business due to new competition and are unable to compete due to inflexible regulations. NACTO has recently released policy guidelines to navigate the decisions whether to loosen regulations on the taxi industry, tighten regulations on ride-hailing services, or do a combination of both (NACTO). This self-assessment approach should also apply to LADOT's

ongoing evaluation of public transit services such DASH circulator buses, Commuter Express and access ride. These services should also be subject to change as the needs of its customer base evolve. For instance, if the existing mix of fixed route, fixed schedule bus services are no longer meeting the needs of Angelenos in parts of the city, then LADOT may consider alternative service delivery models such as micro transit or on-demand transit. LADOT should serve as a platform for shared mobility services and work to convene neighborhood stakeholders and service providers to identify the appropriate solution. The challenge will be to identify the rules and regulations that solely support the status quo and ensure they are not a barrier to progress. Ultimately, LADOT should provide a consistent platform across the entire mobility marketplace with level requirements, expectations for data sharing and reporting, and regular review of the impact of these regulations.

NEXT STEPS
1. Streamline information and processes for new businesses.
2. Eliminate paper processes wherever appropriate.
3. Follow best practices in data collection, fare setting and access policies around new shared services.
4. Work with partners through NACTO, the National Association of City Transportation Officials, for instance, to identify model policies for consistency to make it easier to provide transportation services in Los Angeles.

ADDITIONAL RESOURCES
BEST PRACTICES

NACTO Best Practice Policy Guide

The National Association of City Transportation Officials (NACTO) recently released a best practice policy guide for regulating ride-hailing services. The guide outlines opportunities and challenges when regulating for safety and mitigating the potential negative impacts of congestion, pollution, and loss of service for the disabled and disadvantaged. With an emphasis on collaboration, NACTO illustrates a spectrum of policy approaches and defines the potential consequences. This overview is applicable to recommendations to update regulations to be inclusive of new transportation modes; to provide a level playing field; to leverage data to manage a more flexible transportation system with public and private service providers.

http://nacto.org/wp-content/uploads/2016/06/Policy-Ride-Hailing-Services-2016.06.pdf

Shared Mobility Policy Database

A national clearinghouse of best practice policies for shared mobility.

http://policies.sharedusemobilitycenter.org/#/

LADOT

Exploring new approaches takes a community effort. Bike corrals are an on-street solution to bicycle parking and have been a key part of the LADOT People St. Program. Eligible Community Partners can apply for approval to create projects that enhance the quality of life in this city.

Skyscraper Page/Muji

Rethinking parking demand by creating a sustainable transportation demand management strategy and offering alternatives to accessing the site can create opportunities to rethink the costly construction of more parking structures. Eliminating platform parking structures can also improve the streetscape.

Adopt a revised transportation demand management ordinance for new developments.

The City of Los Angeles has an existing transportation demand management ordinance for new developments but it requires an update to meet the policy goals defined in the Mobility Plan 2035 and ensure compliance with Senate Bill 743 which provides guidelines for analyzing transportation impacts on the environment. An effective transportation demand management ordinance can help improve mobility and access, reduce congestion and air pollution, and increase safety by promoting walking, bicycling, public transit and other sustainable modes (Cambridge). The ordinance can provide developers with tools to help reduce vehicle trips and traffic congestion through vehicle trip reduction measures such as: subsidized public transit passes and other incentives; ride-sharing services; bicycle and pedestrian facilities; flexible working hours; preferential parking for low emission and zero emission vehicles; etc. (National League of Cities). An updated ordinance would enable the City of Los Angeles to be more proactive in the planning and development review process to work with developers in identifying and implementing opportunities to reduce the impact of new development on transportation systems and the public right-of-way. In addition, the City of Los Angeles should provide developers/owners with a simple tool to report back to the City and consider how to maintain flexibility if the desired outcomes are not being achieved. This ordinance should be updated regularly to reflect new

transportation technologies as they continue to facilitate improved efficiency and mitigate congestion through better communication and coordination.

NEXT STEPS

1. Convene stakeholders to understand opportunities to improve the existing ordinance and frame new tools to be incorporated into the process.

2. Revise the transportation demand management ordinance (and follow adoption process).

3. Establish metrics to measure the impact of the new policy for ongoing tracking and reporting.

TODAY (0-2 years)

Develop a shared mobility action plan.

Cities such as San Francisco and Seattle are working towards developing a comprehensive approach to the shared mobility marketplace by developing and adopting plans to guide government regulation, planning practices, and coordination with other services. The City of Los Angeles should develop a similar model plan that comprehensively assesses the current landscape of smart mobility tools and solutions and specifically defines new strategies and policies to help meet the transportation-related targets established in the City of Los Angeles Sustainable City pLAn. A shared mobility action plan would outline strategies necessary to meet the target of growing carsharing services by 2% in 2025 and 5% in 2035 while incorporating approaches to ensure accessibility of the underserved to costs barriers for use.

The shared mobility action plan will address modes such as carsharing and bikesharing as part of a comprehensive approach to understanding how these different options impact the overall mobility marketplace. This document will further guide the LADOT in developing policy recommendations and supporting programs, allocating resources and coordinating with other departments and agencies in the region around shared mobility. The Shared Use Mobility Center is already developing an inventory of recommendations for the region that could provide a valuable starting point for this shared mobility action plan. The National Resources Defense Council, an environmental action group, has partnered with LADOT to fund the development of such a plan to be released in Fall 2016.

NEXT STEPS

1. Work with the NRDC consultant to identify implementable next steps and policies.

2. Consider internal opportunities for education throughout this process.

3. Implement.

Scoot Networks

Understanding best practice policies and providing a clear public policy framework for shared mobility will support an ecosystem of mobility choices that are scalable to the needs of Angelenos. Pictured here is an electric scooter-sharing service in San Francisco operated by Scoot Networks.

One proposed approach to the Mobility Hub pilot features consistent branding and easily identifiable characteristics to make it a beacon for mobility services. The hubs will be scalable, offering a suite of services that are site-specific. [Image: Metro]

Form a multi-discipline mobility assessment team.

Technology evolves really quickly. In the time it has taken to develop this transportation technology strategy, new shared mobility services have emerged, the California Department of Motor Vehicles has released draft regulations for automated vehicles, new partnerships have launched between companies such as Lyft and Google and the status quo has been challenged yet again. It is virtually impossible to keep up.

The creation of a new division within LADOT to support mobility management which includes public transit, taxis, and shared mobility will make it easier for the department to address the introduction of new shared services. It is evident that we are still in the infant stage of new mobility offerings and consumers are learning to make trade-offs when it comes to evaluating costs, convenience, service and time (Bouton, et. al.). While it may be impossible for local government to be aware of all advances in shared mobility, including keeping track of the introduction, successes and failures of new business models in a market as large as Los Angeles, it is important for LADOT to incorporate these new modes into its planning, design and management strategies since resources to provide public transit options are limited. The department should continue to position itself as an agency receptive to mobility innovation and an effective partner that is capable of evaluating impact while balancing public priorities by creating a welcoming front door for new services to engage City Hall.

LADOT should convene a multidisciplinary mobility assessment team to catalogue and evaluate the impacts of new mobility options in the community. Creating an ongoing forum to discuss policy impacts, identify potential changes to operations and make recommendations for leadership to consider will be a positive step forward to helping ensure mobility planning, in this new ecosystem of services, is coordinated with other strategic policies and activities of the city. Not unlike the City of Boston's role for its Chief of Streets, this mobility assessment team should convene the various stakeholders involved in the planning, design and management of the public right of way as well as transportation service providers to provide a comprehensive and collaborative approach to evaluating and understanding the transformations underway (and coming) in the mobility marketplace.

There is additional value in having this team track the required data to plan for services and engineering while also assessing the impact of new transportation technologies in the mobility marketplace. This team should work in coordination with the Data Committee proposed in the previous recommendation.

NEXT STEPS

1. Convene a diverse but agile group of stakeholders to review new innovations in transportation technology and evaluate potential impacts on policy, operations, or mobility as a service.

2. Exchange best practices and new ideas for better collaboration and coordination.

Designate an innovation pilot project manager.

Local government is surprisingly complex but often has limited resources to help users by providing communication, digital content, and other support. This makes it difficult to develop sustainable partnerships without staff dedicated to implementation. Since effective partnerships start with shared goals and collaboration, LADOT should designate a project manager for each public-private partnership to advance mobility technology by helping assess the quality, safety, security, convenience, sustainability and affordability factors in evaluating new opportunities, technologies and services. LADOT can provide valuable insight to existing and potential partners by sharing the priorities and policies of the public sector and offering the experience of the agency in implementing successful experiments with new tools, services and operations. By designating an innovation pilot project manager, LADOT will also benefit from more rigorously capturing the outcomes of pilot projects, lessons learned from partnerships and share this information with the rest of the department.

NEXT STEPS

1. Ensure new pilots and partnerships are supported by an LADOT project manager.

Flickr/Sam

LADOT designated a project manager for the Google Waze partnership to facilitate an ongoing dialogue with the app service about city priorities, to provide a single point of contact and ensure the latest information is available on both sides of the partnership.

New LED Light
49% less Energy Consumption

USB Port Recharging Station

Real-Time Bus Arrival Information

Free Wi-Fi

Beacon

The result of a public-private partnership and pilot initiative, Los Angeles has installed bus shelters with free public WiFi, real-time arrival signage, LED lighting for energy savings and a USB charging station. These smart bus shelters provide a new standard for basic services for those waiting for buses. There are currently 19 smart bus shelters that have been installed across Los Angeles, focused around the Mayor's Great Streets corridors.

TOMORROW (3-5 years)

Bring sharing to City Hall through carsharing, bikesharing + carpooling platforms.

Technology developers have created tools that make it easier to connect demand to resources. Similar to the recommendation that proposes leveraging existing shared mobility platforms for public transit, the City should explore setting up a carsharing and bikesharing initiative across city departments to maximize its own fleet and promote shared resources while introducing the convenience of these services to city staff. These platforms already include customer service and in-vehicle technology that can be licensed and deployed by LADOT and the City of Los Angeles for its own programs without the burden of development.

Google Waze is also rolling out its carpooling app and large employers such as the City of Los Angeles provide a great target audience for a tool such as this. Other carpool apps have been specifically tailored to meet the demands of large employers and the City of Los Angeles should consider partnering with a platform provider and consider creating an incentive structure to help promote shared rides to and from work.

The City of Los Angeles currently offers a voluntary rideshare (home-to-work) program for employees in vans that carry between 8-12 people. The City estimates a monthly savings for an average daily commute of 100 miles per day is $996.10. This program is currently managed manually but the City of Los Angeles should examine if there are technology platforms that could improve the efficiency of the program and fill any empty seats; provide greater flexibility for employees who want to rideshare only a few days a week/month; and make the process for signing up more streamlined.

NEXT STEPS

1. Partner to launch a shared platform for city employees.

2. Create a staff challenge to shift modes with prizes and incentives for greatest shifts by department.

3. Track mode shift and impact on environment.

Chariot Facebook

Rather than reinvent the wheel, LADOT and the City of Los Angeles should look at existing platforms to promote shared mobility among its staff and consider creating an incentive for alternatives that avoid driving alone to work.

Launch a mobility lab.

Los Angeles is a center for technological innovation and experimentation across multiple sectors and transportation technology is one of many areas of strength. As a car-centric city, there is considerable interest in testing new ways to shift mobility behavior, provide new services, and test new innovations. For instance, there are companies in Los Angeles working to develop hyperloop technology that would disrupt long distance and even inter-city travel. Supporting entrepreneurial innovation in transportation technology not only has the potential to benefit the local mobility marketplace but economic development in the region.

Once LADOT has assessed and opened its data, the department should launch a living lab for mobility innovation, opening up its infrastructure and data to for testing the latest transportation technology innovations as they emerge. Designating zones around the city for infrastructure innovation, inviting staff to participate in pilots, and making it easier for technology entrepreneurs to test new ideas in mobility will continue to push Los Angeles ahead in making a safer, more livable city. LADOT should partner with outside organizations including private foundations, academic institutions, technology companies and others to develop a laboratory environment for testing, piloting and eventually implementing the latest ideas in transportation technology. Los Angeles should focus on becoming a leader in this sector and a place for experimentation.

In Virginia, there is a limited access road with two lanes and three bridges, embedded sensors, lighting and weather system controls, LED modules and a differential GPS station. This smart road has been designated for the testing of new pavement technologies and as a proving ground transportation technologies (Perch). In the Bay Area, El Camino Real in Palo Alto has been equipped with video cameras, GPS, and advanced ITS features to create a test bed for connected vehicles. These areas are important but Los Angeles should a real-world, urban "living lab" for the demonstration of these innovations. This could be a great catalyst for further innovation and economic development by attracting companies and entrepreneurs who are interested in bringing their ideas to market here.

In Finland, the Living Lab Bus joint project uses electric buses as a platform for testing new innovations, offering a place to validate solutions in a real-world environment. The buses will be used for testing user-oriented smart services and technologies, from user interfaces and passenger services to sensors and operator solutions (Science Daily). The emphasis of the Finnish experiment is to improve user experience and, for years, the LADOT DASH buses have been a place for similar testing and innovation. These experiences should be shared extensively within the department and across other transportation agencies in the region as it provides an opportunity to learn from best practices and failures. Additionally, an internal operations team has been established within LADOT that tests various technologies. By expanding and improving communications about the tests and pilots underway, LADOT can further leverage the outcomes across planning, design, construction and operations of services and infrastructure.

The traditional procurement process can be difficult to navigate for entrepreneurs and even more impossible as a channel for introducing new technologies. Pilots without clearly defined goals, internal champions, and metrics for success can limit the benefit of these experiments - even for the most exciting opportunities. To cultivate a culture of innovation at LADOT and provide a space for new technologies to be tested, LADOT should support an urban laboratory for transportation technology. It is recommended that LADOT partner with other organizations, including the Coalition for Transportation Technology, to establish a liability framework that would protect the city and public safety while simplifying the process for engaging with the City of Los Angeles to test new ideas. Furthermore, LADOT should explore a potential funding mechanism from the Mayor's Innovation Fund to support preliminary costs associated with creating a living lab, potentially offer incentives to neighborhoods that are willing to support this experimentation. The goal should be to establish a long-term sustainability strategy that provides resources, capital and people to maintain an ongoing program of mobility innovation.

NEXT STEPS

1. Convene a partnership meeting to discuss support and feasibility for a mobility lab.

2. Understand potential risks and liability associated with testing new technologies in the public right-of-way.

3. Establish a funding stream such as the Mayor's Innovation Fund to pursue potential opportunities.

4. Examine the procurement processes around public-private partnerships to ensure scalability of pilot projects.

BEST PRACTICES
FINNISH TRAFFIC LAB

The Traffic Lab's priorities include new service concepts for mobility, traffic automatisation, the Internet of Things, as well as pilots that are strategically significant to trade and industry, companies and regions. In addition, an EU dimension to the Traffic Lab comes from NordicWay that focusses on testing V2V and V2I communications. The Growth Corridor Finland network is also involved, and its goal is to be the enabler for Mobility as a Service type of experiments.

http://trafficlab.fi/

FUTURE (6+ years)

Implement Mobility as a Service.

What if you could purchase mobility like your cell phone plan? Over the course of a month, for instance, you might plan to bike to work a few times, would like to ride public transit at least once a week, and might need access to a car on occasion to attend a regular event. What if you could purchase these rides in a way that was similar to a cell phone plan (I need XX minutes for talk, XX GB of data, XX texts per month)? For instance, a commuter may need 5 rides a month on the Metro subway, 10 rides on a bikeshare, 5 carpool rides and 15 rides through a carsharing service and paying through a single fare system or smart card can provide the much-needed flexibility to design a personal transportation plan to meet your needs.

This approach, known as Mobility as a Service, can help reduce vehicle ownership and use of private vehicles within city centers. By bringing together multiple modes in a seamless way, it is more convenient, reliable and cost effective to create a mix of modes that suits the individual traveler. LADOT would have to partner with other service providers such as Metro to facilitate such a marketplace but this could also be tested in conjunction with a mobility service aggregator such as the Go LA application launched in January 2016. LADOT should pursue setting up pilots targeting core groups such as school-aged children, new residents, and non-transit users as well as large employers.

NEXT STEPS
1. Create a workplan to launch a Mobility as a Service program in conjunction with the mobility hubs.

Los Angeles Times/David Bohrer

Carpooling + Culture Change

The proportion of U.S. commuters who shared rides peaked at 20 percent in the 1970s with less than half of that number sharing rides today (Huet). There are several smartphone applications that are finding new ways to ease the friction of carpooling by helping connect drivers and riders, scheduling rides, and managing the transaction of money electronically. Employers and social networks provide obvious associations that might help tip drivers to share their ride with someone they know.

With whom would you ride?

San Francisco start-ups Scoop and Hovee have launched applications to test this potential carpool market but with different strategies around the audiences and networks that might be willing to ride together. Scoop has partnered with large employers Kaiser Permanente and Cisco Systems to provide 10,000 riders per month with the average user taking 4-5 one-way trips per week. By connecting employees, Scoop sees the additional benefits of pairing individuals who work together as it might create new workplace connections. Alternatively, Hovee pairs carpoolers who are already connected via other social media challenges, assuming that these connections indicate shared interests and personal networks and therefore perhaps increase willingness to ride together. No U.S. application, however, has taken the strategy of the highly successful European company BlaBlaCar which connects people on the basis of chattiness (Huet).

Easing the challenges of identifying others to carpool with as well as simplifying the transaction of money to cover the cost of the ride has its appeal. However, one challenge for these apps is while they can help with coordinating the details for a carpool, there is no way to guarantee the ride will arrive on time. Reliability is entirely subject to the network users (Huet).

Google Waze is currently testing its carpool application RideWith in Israel among Waze users. With extensive information about commute patterns, Waze is confident it will be able to match you with someone that shares a similar commute. Google estimates that one in four drivers in Los Angeles currently use Waze to navigate city streets - imagine the potential reduction to congestion if it were able to get at least two if not more people to share their ride to work?

The transportation network companies are offering services such as Lyft Line and Uber Pool that allow drivers to pick up multiple passengers headed in the same direction. This enables riders to split the costs of a ride for the duration of the ride that is shared while potentially earning the driver more money for longer rides. If a rider opts to share her ride but no one is matched, she still benefits from the lower fare. Lyft, which was founded on the idea of offering shared rides, says one third of its rides in San Francisco are in fact shared (Stone). Lyft Line is also operating in New York City and Los Angeles and Uber Pool offers services in San Francisco, New York, Paris and Los Angeles. The number of markets continue to grow which makes these services appealing to traveler who are now able to acces the same service through the same application in a number of cities.

Existing regulations: do they enhance or deter adoption?

Uber CEO Travis Kalanick claims that Uber Pool has saved 7.9 million miles of car trips and 1,400 metric tons of CO2 with 100,000 new people carpooling every week since its launch in Los Angeles in 2015. Uber will soon be launching a commute feature which will enable commuters to pick-up passengers on their way to work. The problem, Kalanick says, is that the regulatory framework makes it difficult to innovate in this space. Commuters cannot charge more per mile than what is allowed by the federal government's cost of vehicle ownership ($0.54 per mile). Kalanick is staunchly opposed to this restriction since carpoolers may be inclined to pay more (or share their cars) if reimbursed at a higher rate. This tipping point remains untested although more evidence is anticipated from efforts underway by Scoop, Hovee and others in this space.

MTC is partnering with carpooling apps

The San Francisco Bay Area Metropolitan Transportation Commission has partnered through its request for partnership process with three carpooling apps, including Carma, Scoop and Lyft to encourage shared rides and take advantage of existing capacity to reduce congestion (MTC).

Carpooling benefits from the support of a technology platform that eases the friction of coordination. LADOT should build on lessons learned in San Francisco and test different strategies for combining carpoolers on their ride to work. Laying a foundation today and promoting a culture of carpooling will help maximize the benefits of sharing in an future with autonomous vehicles.

TITAN 215-268-0073

HEY COMMUTERS:
Would you use a rapid transit line along the Boulevard to get to Center City?

215-987-5444
Yes

No to:
-987

Your **privacy is impo**
won't use your phon

PHILADELPHIA
2035

Textizen

Step Four
FEEDBACK

4. Establish feedback loops for services + infrastructure.

Cities are complex systems of systems that are designed to support the daily lives of people. People are dynamic and so too are their priorities and needs. Consequently, LADOT cannot operate without the understanding that there must be a continuous process of self-evaluation to ensure that the needs of stakeholders are being met effectively. With technology accelerating the pace of change, it will be essential for LADOT to identify new ways to ensure it understands demand and create mechanisms for integrating these shifts into its operations and management of transportation systems in Los Angeles.

With decades of investment in the public transportation services, it can be a challenge to introduce new technologies, new amenities and new partnerships that will disrupt the systems as we know them. Through effective performance management, organizations can take regular temperature checks to ensure they are on track to meet their goals but also identify early on if there are challenges. This approach should not be limited to just the public services operated by LADOT but should extend to any potential partnerships with shared mobility providers as a requirement of the partnership. Otherwise, there is a risk of further stratifying mobility services along socioeconomic lines. Public transit services could fail to meet the needs of the communities serve and lose out on potential new riders by not offering a positive experience. Customers should always be at the heart of decision making.

How?

Government is improving user experience by providing instant access to information, trip planning and mode options, service disruption notifications, fare payment, parking services and other amenities. Applications are relatively easy to access and offer personalized functionality. By opening new channels to access services, it is essential to consider the implications on the organization itself. For instance, if you create a tool that tracks potholes in the streets, you must evaluate the impact on city operations (the filling of potholes) and set expectations (if I report this pothole, how long before it

gets filled?). This new channel may create pressure to rethink customer service but it is not insurmountable.

Engagement with the business community (particularly large employers) and the community at large to encourage practical, well-informed, sustainable travel and location choices can help transform behavior (Future Lab, 40). Local government and private mobility providers can use marketing campaigns to help raise awareness about the available mobility options and let consumers better evaluate their contribution to pollution, congestion, health, safety and affordability. Technology can be disarming for communities that are unfamiliar or uncomfortable using it. As a result, transportation agencies need to partner with local organizations and other community stakeholders to help raise awareness and lower the barrier to access these services by helping users understand how they work. Effective education and outreach is essential to driving adoption and changing mobility behaviors.

LADOT can begin by directly soliciting feedback from its customers to understand how the mobility ecosystem is meeting its needs. Cities have also begun experimenting with analyzing unstructured data such as social media to understand trends and issues related to the quality of life, safety and effectiveness of services. Smart city sensors – both embedded on vehicles and within our physical infrastructure – can passively provide feedback on the way our public right-of-way is being used and if demand is being met. These tools should be adopted with a strategy for how the learnings will ultimately shape services and infrastructure or they are otherwise a wasted investment.

Become a more responsive service provider.

Access to smartphones, the marketplace for applications, and online reputation tools such as Yelp have contributed to a culture focused on reputation. If people do not think they will get a good experience, they will not try something. What happens when someone has a negative experience on public transit? This experience, no matter how atypical, is posted and broadcast far and wide across social networks. How often do people post positive experiences versus negative experiences and how does this skew the general public's perception of transit safety, convenience, cleanliness, etc.? Without understanding user perception, it is impossible to have a complete picture of the transportation experience. The City of Los Angeles must therefore require customer feedback as a key element of performance management and evaluation. LADOT should begin by evaluating public services for their existing feedback channels and standardize the practice of collecting feedback (tools for feedback, policy for how this data is used and procedure for integrating feedback into performance measurement/management).

There is often resistance by service providers to ask these questions but LADOT should be confident that it can provide an excellent customer service and create tools to manage and measure that input. Providing channels for Angelenos to give feedback also benefits the LADOT as it builds confidence that public services can be responsive to the needs of the community served. LADOT should test and explore new ways to provide more responsive transit and communications solutions that could be easily deployed when there are large events, service disruptions, and other anomalies to typical service levels and test the most effective tools for communicating changes to the system.

LADOT should streamline feedback channels for the public and test these tools at key access points to the system (e.g. mobility hubs, transit stops, public buildings, etc.). This feedback should be shared on a publicly facing dashboard and used as part of the performance evaluation for all services being offered.

NEXT STEPS

1. Establish feedback performance metrics for public transit and other transportation services.

2. Assess other department resources for collecting feedback and reaching out to users.

3. Prioritize opportunities, test new outreach and report on outcomes via the project dashboard (see recommendation).

Establish a project evaluation standard.

Setting the metrics for evaluating project or initiative success can be a very valuable exercise. It can help participants better understand what success might look like and what other precedents might exist while giving project managers a deeper understanding of what needs to be evaluated throughout implementation. With the changing mobility marketplace and the potential shift in roles for transportation agencies, it is important to create a project evaluation standard for measuring all initiatives to help in their review and comparison. This process needs to be built into all project schedules as it can tend to be an afterthought, making it difficult to reverse engineer the performance measurement after something has been started. By building up a high standard for project evaluation, LADOT will create another valuable feedback loop that will help the organization in identifying new data sources and requirements for future assessments, contributing to future planning, design and implementation.

NEXT STEPS

1. Adopt a best practice previously used or recommended by LADOT staff.

2. Test. Reevaluate. Repeat.

LADOT

Crowdsourced and city data can help LADOT assess new roadway designs, looking at how infrastructure impacts congestion and reduces greenhouse gas emissions, improves safety, and contributes to improving transportation happiness. Establishing an evaluation standard that is consistent across all projects can help the department compare various local conditions and engineering practices to create a better transportation experience.

ACCIDENT

type: ACCIDENT
subtype: ACCIDENT_MINOR
reliability: 7.0
pubMillis: 1.462917e+12

DataScience created a proof of concept for mapping streaming or historical Waze data based on the feed. As an example, here's a snapshot of the Waze data from the city's feed [Image: DataScience/Dave Goodsmith]. Leveraging Google Waze data and other resources in project evaluation can help with planning and project evaluation practices.

Providing service to a diverse region with stakeholders of all needs can be a challenge. However, customer services starts by providing opportunities to continually review and understand how LADOT can do a better job serving the needs of its customers.

TODAY (0-2 years)

Create a user experience working group.

LADOT should create a user experience working group representing both public and private sector stakeholders to evaluate the existing transportation experience on public transit and its supporting communications and services. This team will be primarily charged with investigating new channels for collecting feedback from customers – whether directly or indirectly – and making recommendations to LADOT communications and management as to how to deploy these channels. It is important to focus on how these channels are accessible to the general public and what biases they may unintentionally infer as a result of the sample population providing feedback. Helping LADOT to navigate these challenges will be essential to providing valuable performance management input. This working group can also help facilitate recommendations for improvement, prioritization strategies and future opportunities to further enhance user experience in support of the recommendations in the "Leverage technology and design for a better transportation experience" action.

NEXT STEPS

1. Convene diverse stakeholders to identify new channels for capturing customer feedback.

2. This team may also assist with developing a whitepaper with recommendations for a customer bill of rights (see previous recommendation).

3. Take on one project (i.e. LADOT website) and establish a way to reconvene this process regularly.

Investigate new tools for the ongoing evaluation of infrastructure conditions.

City fleet vehicles cover a lot of ground in Los Angeles. What if DASH buses that travel throughout neighborhoods in the city could provide sidewalk condition information for faster, more effective prioritization of capital improvements? What if parking enforcement vehicles, street sweepers and pool vehicles could also contribute to data collection, acting as mobile sensors across the of Los Angeles. LADOT should explore whether existing cameras or new sensors could be installed on fleet vehicles to track roadway conditions, curb conditions (particularly for buses), etc.

The City of Boston piloted an application called StreetBump which uses the gyroscope in a smartphone to determine how smooth a road surface is and to identify areas where there are poor street conditions. While some of this technology still requires substantial investigation and optimization for accuracy, it presents an alternative methodology than the more manual approach to collecting this data during a fixed period of time. Other sensors attached to vehicles could be used to evaluate in real-time conditions in the public right-of-way and this data could be factored in to planning for capital infrastructure improvements and also provide potentially valuable information to connected and automated vehicles to optimize route planning.

NEXT STEPS

1. Issue an RFI on possible solutions and information about the technology requirements.

2. Consider a pilot for DASH service.

LADOT

Engage the entire community on condition assessments.

If you have ever tried to submit a complaint or notify the city of something, you may have discovered that there is more than one channel. While 311 is intended to be the front door to city services, each department has a variety of reporting mechanisms on their website(s) for public complaints. Some of these feedback tools are very easy to use while others are cumbersome. Each division has different reporting requirements, for instance, with some fields being required by some but not by others. It should not be the responsibility of the customer to figure out where to navigate to get help and share information with the City.

LADOT and the city should streamline public reporting of public right-of-way conditions through 311 and eliminate department-specific processes to report issues. In addition, LADOT and the other departments managing the public right-of-way should work together to make reporting to 311 available through multiple channels, such as social media, online and through the application, encouraging the submission of geolocated photos wherever possible. Standardizing the type of data collected and simplifying these tools can help the city encourage crowdsourcing and more "eyes on the street" to cover the entire city.

Just as it is important to improve the experience of reporting infrastructure conditions to the city, clear policies need to be established on how to respond to these reports. Establishing clear lines of internal communications, including who has what authority to "close" a request or respond to a community member can help expedite the process. Setting clear rules around the response time and communicating this information to the customer will help manage expectations. After all, if I

report a pothole but it cannot be addressed immediately because of prioritization or budget constraints, the City should communicate to me how my complaint will be handled so I do not get unnecessarily frustrated with city hall. Proactive communication will lend itself well to higher citizen satisfaction.

Los Angeles has a variety of community organizations at the neighborhood level, including city-supported neighborhood councils that are actively involved in improving the livability of their community. LADOT and the city should actively engage and educate neighborhood leaders on how to access and use these streamlined reporting tools to provide additional capacity to understand infrastructure conditions across the city. Educating stakeholders (including city staff) on how to use tools such as my311 will help the city to better crowdsource condition assessments.

The Google Waze city partners have also been interested in creating a channel to 311 for crowdsourced reports of poor roadway conditions. This is an imperfect technological solution as the geolocation of incidents are not precise enough to provide the City of Los Angeles with enough detail to be valuable. However, LADOT should consider participating in this discussion as these stakeholders all have a shared interest in the same outcome: better information on roadway conditions.

NEXT STEPS

1. Audit existing public reporting tools for LADOT. Encourage other departments to do the same.

2. Adopt a roadmap to define steps to eliminate workaround reporting and streamline to 311

3. Grow awareness of these tools by training staff on how to use them.

KCRW/Saul Gonzalez

Tools such as the City of Los Angeles 311 application provide instant access for stakeholders to report and share essential information about services, infrastructure and other community priorities. Supporting increased functionality of this tool will help open up additional resources to support those who do not have access to a smartphone.

Partner and support a marketing campaign on shared mobility.

The most rapidly growing shared mobility modes involve the sequential sharing of vehicles, each user in turn having exclusive use of a motor vehicle or bicycle. The growth of concurrent sharing of vehicles by strangers, however, would have a more consequential impact on affordability, personal mobility, vehicle use, energy consumption, traffic congestion and environmental benefits as compared to the sequential modes (Transportation Research Board). For users to adopt, they must have enough information to make an assessment or even be aware it is available and local government does have substantial influence over communication tools such as signage and advertising along the public right-of-way. The tools can range from permitting street and curbside markings, signs, street fixtures, and wayfinding signs as well as regulating private sector signage and advertising (Shaheen, et. al.)

Access can be stymied by a lack of understanding of who is eligible to use these services, how they are paid for (and how expensive they might be) and how they might complement a daily commute or other travel needs. Raising awareness among populations such as families of school aged children, visitors to Los Angeles, large employers, and other target populations can help improve adoption. LADOT should partner and encourage stakeholders to develop and launch a public awareness campaign around shared mobility modes in partnership with Metro, service providers, advocacy groups and others active in this

BEST PRACTICES
NUDGING

Shifting Behavior to Achieve Change

Providing some great case studies, *A Practitioner's Guide to Nudging* defines several types of nudging and provides a framework for understanding potential impact (McGuffin). In Copenhagen, Denmark, for example, the city paints green footprints to garbage bins to reduce pedestrian littering on sidewalks by 46%. This case study is an example of discouraging behavior through nudges (Ly, et. al., 10) and could be incorporated into improving the transportation experience; creating a more legible Los Angeles; piloting mobility hubs; and launching an education campaign around shared mobility.

http://www-2.rotman.utoronto.ca/facbios/file/GuidetoNudging-Rotman-Mar2013.ashx.pdf

space and adopt tools to help raise the visibility of these services in our densest urban settings.

NEXT STEPS

1. Partner with other stakeholders to develop a network for user education on shared modes.

2. Develop and execute curriculum for first year. Refine with feedback and repeat.

The Los Angeles Vision Zero Initiative recently launched an awareness campaign at bus shelters to educate drivers of their responsibilities when involved in a crash.

TOMORROW (3-5 years)

Streamline LADOT online content and launch a project dashboard.

Online content can be a simple, cost-effective way to communicate a lot of information about available services, fares, changes to services, etc. LADOT has accumulated an impressive array of programs with great online resources but each has its own web address and standalone sites making it confusing to those outside the transportation agency. Access to information on services should be simple and online content should be organized in a way that is easily accessible to the general public in a useful way. Since programs typically work toward multiple policy goals and link to other services or policies, LADOT should be able to simplify online content in a way that makes it more accessible.

Engaging the community of users, other city department stakeholders, and even other transportation agencies in an exercise of focus groups and "card sort" exercises can help shed some light on the biases that we often carry when we are intimately familiar with a program. Card sort exercises are a tool often used by website developers to understand how potential users may search and organize content and it can be an effective tool to help refocus online content to the audiences (while busting the existing bias of government silos). Leveraging web analytics such as what visitors are searching for can help guide a streamlined user experience. Ultimately, it would be desirable to see a single online mobility information hub for all of the region's transportation systems that cross into the city so some consideration should be given as to how the organization of this information could be expanded to be more inclusive.

Public agencies such as LADOT have a lot of work underway and multiple initiatives running concurrently to meet city policy priorities such as Vision Zero, sustainability, etc. LADOT should create and launch a public-facing project dashboard for improved transparency on the status of these initiatives to make it easier for the public, prospective and existing partners, and even other transportation agencies to understand what work is happening within LADOT. If possible, an API should be developed to share this data with others, such as Metro, who maintain a similar database of regional activities. There may be additional opportunities to standardize this dashboard with the Coalition for Transportation Technology as a way to create an at-a-glance view of regional mobility-related activities.

NEXT STEPS

1. Host a card sort exercise to engage stakeholders and understand how information should be organized.

2. Consider consolidating to a single online "mobility hub" and the content could be repurposed through APIs and other data sharing agreements.

3. Collect project list, metrics and supporting data to create a project dashboard.

4. Release an RFP to collect proposals on how a pilot might be structured.

5. If necessary, identify funds and implement. Track traffic and feedback for continuous improvement.

6. Run a test and measure. Track best practices for future training materials. Evaluate and report.

PROJECT DASHBOARDS
REGIONAL EXAMPLES

Metro Project Tracker

This searchable listing of projects allows the public to access information about project schedules and budget by project name, type and location. Additional information is available by clicking through to a project description, construction notices, events and even project contact information.

https://www.metro.net/interactives/datatables/project/

Prepare the workforce for changes driven by innovation in transportation technology.

Investing in the existing workforce to grow internal capacity for data analytics, developing skills and understanding about the importance data can play in planning, design, and management of mobility services will be essential as the mobility marketplace continues to see technology-driven disruptions. A stronger understanding of data and the integration of best practices in the workplace will also help the transportation agency become more effective partners. Innovations in transportation technology are announced daily and urban mobility is transforming, making it difficult for transportation planners and engineers to stay on top of the changes and its impact to their practice. Job descriptions currently include work-related duties and technical requirements that are specific to a job function. LADOT should evaluate each job function and define the most desirable technology skills needed for each position - with consideration for new skills such as database management, programming, analytics and visualization. This assessment can also be helpful in identifying gaps in professional development and training opportunities for staff and inform the creation of an annual schedule to help public sector staff maintain their skills. This assessment should include all staff - not just office-related functions - since these functions will likely be impacted by new technologies as well.

LADOT sponsors participation at industry conferences and already supports a brown bag series to exchange ideas and share work across departmental divisions but more cross-training and technical skill sharing will significantly benefit the entire department. Training on new technologies and trends in shared mobility, for instance, can help prepare LADOT for changes to public transportation services and operations. During Mayor Mike Bloomberg's administration, for example, the City of New York created a leadership exchange program to break silos in city hall by having department leaders switch roles so they could gain a new perspective on work of related departments. Los Angeles has 14 different divisions of departments working in the public right-of-way and an exchange of this kind would enhance collaboration on shared goals across a large organization. Additionally, cross-training across different agencies such as Metro and Caltrans would further foster a culture of collaboration and innovation among transportation professionals in the Los Angeles region. The Coalition for Transportation Technology could serve as a launching point for this program.

With the arrival of connected and automated vehicles, there is a significant risk that many jobs will be displaced or reassigned to new functions. Los Angeles is a major origin point for freight entering through the Port of Los Angeles and the Port of Long Beach. In addition, many people are employed in roles that require driving or rely on the current conditions of vehicle ownership - long-haul driving, local delivery services, valet services, auto mechanics, etc. The extent and pace of workforce disruption is difficult to predict and it is not the role of the LADOT to offer workforce redistribution strategies for all potential job losses in the future. However, the City of Los Angeles should set an example as a municipality by creating a preliminary workforce training plan in anticipation of automation that will impact its existing workforce in the next five to ten years.

Local universities, tech companies, other city departments and other transportation agencies are also interested in growing the skills of their existing and future workforce. Collaborating with local university programs in transportation, planning, computer science, graphic design, etc. can introduce talent and new approaches. Meanwhile, the local technology sector may have events or training opportunities offered at a discount for public sector employees that are worth exploring. Recently, the Office of Sustainability for Mayor Eric Garcetti hosted an open house about electric vehicles (EV) at a local tech hub as a precursor to kicking off its EV carsharing pilot - bringing together public and private sector thought leaders to exchange ideas, learn about new technologies, and hear more about opportunities to advance this sector.

NEXT STEPS

1. Identify cross-training opportunities.

2. Develop technology profiles for each job description.

3. Identify staff resources and skill deficits. Partner, recruit, retain.

LADOT

LADOT employs a diverse workforce but all play a part in contributing to data-driven organization. It is important for the workforce to understand their role in collecting and maintaining good data and cross-training is an essential way to demonstrate how this data is important to other job functions in the agency.

Adopt a multi-modal smart fare system.

Technology makes it easier to implement more sophisticated fare structures, providing the right service to the right customer at the right price. Smart cards make it easier for transit agencies to introduce more nuances when setting fares and can create programs that are more tailored to the customer. These systems create an additional demand-based feedback loop that can enable LADOT and other transportation agencies to understand how pricing can impact behavior and mode choices. LADOT and its regional partners should consider how to extend fare systems beyond just traditional public transit modes to other first-last miles solutions as part of a suit of services to meet mobiles needs. Some potential strategies that are underway or could be tested include:

Income-based fares to alleviate the burden of the cost of transportation on those Angelenos who can afford it the least. Some have reported that higher income customers are willing to pay more if it will subsidize the cost of service for other riders. In a 2014, researchers demonstrated that user knowledge about public subsidies also influences their willingness to pay for public transportation services and encourage agencies to be more transparent about the existence of subsidies (Drevs).

Time of day pricing, particularly peak pricing. This approach better reflects the higher costs of providing

services at busy times of day; can help shift rider decisions to travel during the peak periods; and can grow ridership during off-peak periods (TRB). This approach can also be applied to other discounts such as senior fare rates to encourage ridership in off-peak periods. Alternatively, on days with poor air quality, fares can be lowered to encourage shared mobility.

Distance-based pricing which would require a shift to a tap-in, tap-out approach and the creation of zones across the region or a calculation of fare between the origin and destination. Smart fare cards make it easier to implement this approach and would more closely align fare costs to the customer's utilization of the system.

Usage-based pricing which can offer different rates based on who is using the system - a casual rider, full-time commuter, a visitor to the city, etc. When bundled with other modes, this can help customers develop a plan that works for how they plan to use different modes and allow for a mix of services to be incorporated into a transit fare plan.

Bundling with other offers. For example, Dallas Area Rapid Transit implemented a mobile ticketing platform integrating third party offers such as access to the State Fare to provide a convenient way for customers to bundle transit purchases with the purchase of State Fare tickets (Wilson). This approach can offer an incentive to take transit when attending a large event such as a sporting event, concert, festival, etc.

Loyalty schemes for the most frequent travelers. In Montreal, more than 340 merchants and 1,000 event partners are part of a customized loyalty program that works specifically with each transit customer. The agency was careful to manage privacy as that can be a concern by keep key information separate and only pulling the data together when assembling offers. The engagement rate was very high with nearly two-thirds of mobile ticketing customers clicking through to offers. The initial pilot with 20,000 OPUS card users was such a success that the transportation agency opened it to the full 2.5 million OPUS card users in 2014 (Schlosser).

NEXT STEPS

1. Collaborate with the Coalition for Transportation Technology and other regional stakeholders to establish some preliminary goals for adopting smart fare structures.

2. Identify a potential pilot and the resources required for demonstration.

3. Expand the smart fare card upon demonstrated success, if applicable.

FUTURE (6+ years)

Develop a methodology to move towards Infrastructure as a Service.

Californians pay some of the highest gas taxes in the nation (API) but drive on some of the worst infrastructure conditions (Hartgen, 3). The gas tax as we know it is failing to sustain our infrastructure demands - improved fuel efficiency of vehicles and low gas prices are not helping the state close funding gaps for infrastructure projects. In addition, with the growing popularity of shared mobility and the potential for automated vehicles to further change driving behavior, LADOT will likely see a significant and irrecoverable drop in parking revenues, another essential funding mechanism for a variety of projects citywide. Understanding that the status quo is unsustainable, the State of California launched a nine-month road charge pilot in Summer 2016 with 5,000 volunteer drivers who will share their driving behavior to see if there are alternative ways of structuring finances for infrastructure repair and maintenance (State of California).

Infrastructure as a Service is the idea that the use and access of public infrastructure should be subject to pay-as-you-go user fees that more closely aligns the costs associated with providing the infrastructure itself to how the infrastructure is being used. Since full-scale implementation of this model is contingent on state legislation and requires standardization, these pilots introduce interim ways to deploy technologies to respond more efficiently to changing infrastructure demand while testing public appetite for new approaches.

While the statewide pilot is underway, LADOT should collaborate regionally to develop a roadmap to identify potential funding mechanisms that are more sustainable than the current gas tax model. Congestion or value pricing is a system of surcharging users of public goods that are subject to congestion through excess demand. Structured to act more like a user fee, congestion pricing is more transparent than a hidden fee or tax because it more closely reflects how and when infrastructure is used. This can also be an effective tool in driving behavior change as has been demonstrated in cities such as Stockholm, London and Singapore (Newcombe).

Cities such as Atlanta and Seattle have begun testing this strategy through modeling, studies or similar pilots. In California, the pilot will test different ways to charge for miles driven rather than the gas consumed to fund infrastructure. Surveys indicate that some groups such as the Millennials (ages 18-24) generally support this approach (Jaffe). Once in place, even naysayers support the new model as it generates the necessary revenue for improved infrastructure and more clearly aligns usage to fees paid.

Infrastructure as a Service will require a fundamental rethinking of infrastructure in our city. Rather than attempting to implement broad-reaching policies all at once, LADOT should consider "nudging" to change behaviors to avoid heavy-handed and poorly supported solutions. LADOT could begin by identifying and focusing on priority geographic areas such as the Vision Zero High Injury Network or dense commercial districts with cordon charges. Alternatively, LADOT could focus on particular vehicle types such as heavy commercial (which can create more wear and tear on the infrastructure) or low occupancy vehicles at peak periods (which contribute to more congestion) with infrastructure usage fees can help generate funds necessary to build and support infrastructure as well as the management of these programs. Congestion pricing intends to shift behavior by encouraging drivers or shared mobility passengers to travel during off-peak times to avoid additional charges. Stockholm is looking at how these fees could then be used as an added incentive for cyclists by directing these revenues towards bike repairs, upgrades, tires, etc. (O'Sullivan). Since much of this regulation occurs at the state level, LADOT must advocate for change.

NEXT STEPS

1. Work with the Coalition for Transportation Technology to develop an infrastructure as a service roadmap.

2. Identify potential pilot opportunities to test cordon strategies and congestion pricing in Los Angeles.

3. Introduce a managed lane network in and around the city.

4. Consider regional fare strategies that reflect the true cost of transportation across all modes.

5. Leverage the efficiencies of technology to create subsidies and support of equity policies.

OTHER RESEARCH
KILOMETER-BASED TAX

Finnish Traffic Lab research compared the current practice (gas tax and vehicle tax) with a kilometer-based tax. There were 1,034 Finnish respondents to an online survey.

The results show that 41% of the respondents would choose the kilometre-based tax and 30% would stay in the current system. 28% of the respondents could not choose between the options. The respondents supporting kilometre-based taxation considered it to be especially positive that the new payment system would support the purchase of a new car with the abolition of the car tax.

http://trafficlab.fi/research-and-results/

Step Five
AUTOMATED

5. Prepare for an automated future.

McKinsey estimates that by reducing the human factor behind the wheel, automated vehicles (AV) could reduce accidents by as much as 90%, saving thousands of lives and up to $190 billion per year in the U.S. alone by 2050 (Boulton, et. al.). In addition to supporting goals for Vision Zero, AV could help meet goals for reduced emissions, improved mobility, and reduce congestion. However, left unchecked, automated vehicles may simply replace existing vehicles one-for-one over the next couple of decades. With a growing regional population, contribute to worsened traffic, increased sprawl, more vehicle miles traveled and emissions. With the recent U.S. Department of Transportation Smart Cities Challenge, it is clear that more and more cities are taking notice of the importance this technology will have to their communities but no single approach has emerged. LADOT must consider how it can support the introduction of this transportation technology by promoting shared mobility and offering connected infrastructure to support these services.

Connected and automated vehicles could benefit from information being relayed in real-time from the surrounding infrastructure such as roadway conditions, traffic signal timing, pedestrian volumes, or traffic along bicycle networks. There are several potential challenges to relaying data from the infrastructure to vehicles in motion such as connectivity, latency, and standardization. Likewise, infrastructure managers would benefit from anonymized information from vehicles in the public right-of-way such as the path of travel and roadway conditions.

LADOT should test the ability to create a data exchange from DASH and Commuter Express buses to ATSAC and city infrastructure. For instance, LADOT could install onboard monitors to empower drivers with more information about conditions along their path of travel. A study could help LADOT understand how this information is useful to drivers and how it might impact driving behavior while identifying any potential challenges with this real-time data exchange. Los Angeles should become a leader in establishing data standards for V2I or vehicle-to-infrastructure communications. A similar effort that was never completely executed to provide real-time signal information to Metro Orange Line buses could be used as a starting point to test and deploy onboard monitors that can receive this information.

How?

When automobiles were introduced, entirely new systems of regulation, infrastructure and supportive services and industries had to be created; these changes occurred very quickly. Transportation planners and engineers must be ready to anticipate how shared mobility and connected and automated vehicles will revolutionize mobility - creating incredible opportunity to impact our environment, economic development and equity in positive ways.

There are several terms used, often interchangeably, to define self-driving, autonomous or automated vehicles. For the purposes of simplicity, this strategy focuses on connected and automated vehicles and does not necessarily support one classification over another. However, it can be helpful to understand the differences. Connected vehicles use technology to communicate with nearby vehicles and infrastructure. These vehicles use this information to enable crash prevention by providing a 360-degree awareness to provide vehicle operators with information they might otherwise be unable to see. Mobility applications can help transportation managers monitor performance of systems while providing real-time information about traffic conditions that might reduce the environmental impact of their trip.

Automated vehicles operate in isolation from other vehicles using various internal sensors, LIDAR and radar to detect its environment and navigate safely. LIDAR is a sensing technology that calculates distance by measuring the time it takes for a light to hit an object and bounce back. This technology (which you might recognize as the knob on the top of the Google car) has been very expensive to develop and include on test vehicles. Rapid development and improvement, however, will significantly reduce the size, weight, cost and power requirements for

Angie Smith

Hopscotch was a mobile opera performed in 24 cars around Downtown Los Angeles in Fall 2015. The performance followed four different routes around the city and performances sold out (Gelt). What if we transform how we move and our daily commute became a platform for learning, the arts, and sharing local talent? Self-driving vehicles offer a new way to think about this time spent.

this technology as a result of research underway at the University of California, Berkeley.

It is estimated that the volume of all digital data is doubling almost every 1.2 years (Integrated Transport Planning, 7). With the growing role of technology in mobility, digital infrastructure in our public right-of-way becomes increasingly important. Technology changes quickly, however, and introduces new complexities to transportation agencies who have to reconcile this pace with the challenges of evaluating options, executing a slow-moving procurement process, starting up systems that lack standards, and planning for yet another asset that will have its own lifecycle. This infrastructure, however, can help measure and support the City's environmental, economic, and equity goals by introducing new levels of connectivity and access to information. For example, vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications can help prevent cars from running red lights, alerting them to when a car ahead is decelerating, and communicating a car making a left turn which are all strategies that will help avoid future accidents (Miller).

There are many anticipated benefits with automation including increased productivity, safety and efficiency on our roadways. There are also significant implications for the workforce that manages, operates and maintains vehicles and systems as they are today (Dopart, 7). While these changes will take time, it is essential to address opportunities now to help lessen the negative impacts since workforce development also takes time. A successful, incremental approach will require multiple priorities: the re-education and training for existing workers; preparation for people entering the workforce; and the development of safety net resources during the transition period. Labor organizations can be vital partners in helping navigate this transition.

Entire businesses around the "crash industry" will likely be impacted - from auto body shops to the insurance industry itself. Professional drivers will also be impacted. In public transit, even with complete automation of driving functions, there will still be an important public safety role for staff on buses and the additional vigilance of human eyes will further enhance the benefits of connected and automated vehicles. This section defines a few key strategies to help move towards a new transportation agency model of the future by developing the skillsets of the existing workforce and fostering an environment that will attract and retain the talent of the future.

POLICY

Call for more mobility innovation in California.

The State of California is among a cohort of a few states actively developing regulations for automated vehicles. In December 2015, the Department of Motor Vehicles issued preliminary draft rules as a precursor to the formal rulemaking process. LADOT and the Coalition for Transportation Technology should actively participate in the feedback on this rulemaking process to help Los Angeles become an early market to test and implement connected and automated vehicle technology.

Safety should remain the highest priority in formulating these rules but it is possible that the State of California could inadvertently curb the advancement of this technology with unintended impacts. The preliminary draft requires a licensed, human driver behind a steering wheel with a brake pedal. The Google cars, for example, have neither steering wheels nor pedals so this proposed rule would pose a setback after thousands of hours of on-street testing (Thomson). In addition, expecting a human driver to quickly take over driving functions at the request of the vehicle, particularly if the person has been distracted by other activities, could cause a delay which poses a potential safety issue (Anderson). While the intent may be to start incrementally, these rules can shape adoption of this technology and Los Angeles should be actively involved in influencing the process of development. In response to the initial draft, LADOT provided a letter for consideration (see Appendix), outlining some of the concerns about how the proposed rules may limitation the deployment of this technology to its greatest advantages as initially defined.

Some speculate that the biggest hurdle for AVs will be adoption at scale, particularly with the lack of clear definition and harmonization of regulations at the city, state, national and even international level (Bouton, et. al.). California has already been ahead of the curve by taking regulation of automated vehicles under consideration and as a major city Los Angeles should have a seat at the table.

The National Highway Traffic Safety Administration (NHTSA) has also been called upon to develop a model policy for state governments after a long period of leaving these developments exclusively to the states. In January 2016, U.S. Transportation Secretary Anthony Foxx announced that action will be taken within the next six months to develop this recommended policy that will make it possible for vehicles to operate without a human driver. While this guidance is still forthcoming at this time (August 2016), Los Angeles should track the outcomes of this process as well.

NEXT STEPS

1. Support legislation that will make Los Angeles a potential testbed for automated vehicle technology.

Collaborate regionally to promote interoperability.

With big data, it is important to adopt standards for collecting and formatting this information to make it accessible - not just to the organization but to external partners. The massive amounts of transportation data generated by shared mobility providers could help LADOT better understand urban mobility patterns. Los Angeles should be a leader in advocating for greater standardization regarding what data is required of these private providers but also how it is shared. The Coalition for Transportation Technology could be an opportunity to further enhance standardization across the region with the goal of improving interoperability of systems. Since a traveler is likely to pass in and out of the City of Los Angeles into the surrounding county or its other 87 cities as well as across the 191 in the greater six county region, it is increasingly more important for there to be a uniform experience across all jurisdictions.

With greater regional interoperability of systems, there are opportunities to develop purchasing mechanisms that would enable the City of Los Angeles to invest in new technologies by leveraging the scale of the entire region. If procurement was occurring on a regional level, there would be more opportunity to use limited funds for greater benefit to LADOT and mobility as a whole.

NEXT STEPS

1. Support the Coalition for Transportation Technology through active engagement and leadership.

Data as a Service: The following outlines a few ideas about how to use data to enhance or create new services to improve user experience; improve efficiency of operations; prioritize infrastructure maintenance and construction; and ultimately build stronger mobility networks for the City of Los Angeles and the surrounding region. These data sets could serve as a starting point of a larger process of identifying how different data types could be used to improve the mobility experience.

DATA	POTENTIAL SERVICE
Bicycle counts	Infrastructure usage; further investment business cases; maintenance prioritization
Local events information (including sporting events, concerts, etc.)	Transit capacity service planning; smarter traveler information services
Traffic speed and count data	Real-time journey planning and updates across all roads
Real-time parking space availability for both on and off-street parking	Enhanced trip planning and true price comparisons across modes
Real-time vehicle location and capacity information	Optimized fleet utilization for goods movement across logistics providers
Real-time air travel departure and arrival data feeds	Ground transportation and handling optimization; reduced passenger waiting
Region-wide local bus fare data	True trip planning price comparisons across modes
Bus and rail occupancy data from passenger ticket purchase, barriers and electronic ticket machines	Smarter traveler information services to reduce passenger waiting and avoid overcrowding
Real-time bus and rail vehicle locations in the region	Smarter traveler information services to reduce passenger waiting
Aggregated historic passenger ticketing data for bus, rail, air, sea modes of travel	Optimized service and capacity planning across networks; smarter trip planning for travelers

Adapted from *The Transport Data Revolution*, Pages 17-18.

Launch a taskforce on data monetization strategies.

In the age of information, data is a valuable currency and the City of Los Angeles, among other transportation agencies in the region, has significant financial value locked away in its enterprise systems. With the arrival of connected and automated vehicles, for instance, auto manufacturers may want access to real-time information about traffic signal timing for route optimization and LADOT should determine if there is any potential to capture value from sharing this data to support the necessary digital infrastructure and services. While some of the potential market for mobility-related data may be immature and still emerging, LADOT should identify potential data of value outside the agency and any integrity challenges; recommend policies around data monetization; and establish a plan for how this revenue might be used (to either offset costs or generate new revenue).

Smarter technologies and better user interfaces will start to impact the revenues generated from parking violations, for instance, as drivers will begin to rely on real-time notifications in advance of parking meter expiration, thereby avoiding tickets. LADOT should form a task force of public and private sector stakeholders to evaluate the opportunities and implications of seeking to recover costs and potentially generate revenue through data monetization. If a monetization strategy is adopted, LADOT should develop an online marketplace to make it easier to buy and access available data. A transparent approach to Data as a Service will help further accelerate the development and commercialization of user-focused intelligent mobility services (Integrated Transport Planning).

NEXT STEPS

1. Convene a taskforce to evaluate potential opportunities to generate revenue from data as a service.

2. Adopt recommendations and next steps.

Advocate for new approaches to financing infrastructure projects.

The population is growing and so too is congestion. Meanwhile, infrastructure strains to meet the needs of this rising demand. Ongoing financial constraints and the lack of consensus around the role of the federal government in funding infrastructure presents an "ongoing challenge" in planning for public investment. Local and state governments are therefore seeking alternative models and funding sources to keep up with infrastructure demand – and much of this is focused on maintenance and repair and not new projects. Infrastructure spending as a percentage of GDP has shrunk to about 2.4 percent from its peak of more than 3 percent during the 1960s (Miller). State and local governments account for about 75 of all infrastructure spending, including capital and operations and maintenance. There are several evolving strategies to finance future infrastructure projects. Here are a few:

Charging by Mileage: With the increasing efficiency of vehicles and fleet electrification, the California gas tax, a user fee system, is no longer a sustainable mechanism to fund the construction and maintenance of public infrastructure. This model was predicated on the idea that your gasoline consumption reflects your usage of the public right-of-way and would therefore proportionally provide the necessary funding to maintain the roads. However, the gas tax no longer amounts to a fair distribution of the cost burden and transportation officials are increasingly supporting charging for vehicle miles traveled or mileage fees as an alternative strategy (Ecola). This approach will require careful consideration of how implementation will be structured to avoid unintended consequences that might put certain Angelenos at a disadvantage that they cannot afford. Technology enables a mileage fee approach but there needs to be a broader conversation across the state as to the means of collecting this data, what type of information should be collected, and how it will be used. This strategy has already addressed issues of privacy and security for locally captured and stored data but this would have to be considered statewide for this type of an approach. As previously mentioned, there is a State of California road charge pilot underway to test several data collection methodologies and ascertain the potential impacts now. LADOT should monitor this progress and learn from the findings and recommendations.

Sales Tax: The Los Angeles region has gone to the general public with Measure R to raise essential funds to support public transit and roadway projects and the voters agreed. Across the country, governors and mayors are advocating for sales tax increases, new tolls or higher user fees to pay for vital initiatives like bridge replacements (Miller). With the upcoming second ballot measure, the region will once again be asked to consider how important these projects are to the economic vitality, equity and environment.

Public-Private Partnerships (PPPs): PPPs and performance contracting are mechanisms for delivering infrastructure projects but still require fine-tuning in local government procurement processes, improvement

LADOT Bike Blog

Reseda Boulevard, LA's first iteration of the Great Streets program shows how streets can facilitate low-stress travel with a parking protected bike lane and an attractive walking environment.

of the permitting processes and project timelines, and refinement of risk allocation. PPPs bundle construction with operations and maintenance and have been used to tap the efficiencies and resources of the private sector for public investment (Engel). In absence of a national infrastructure investment plan, local leaders are increasingly embracing PPPs (Miller). This methodology has several documented best practices including how to choose partnerships; how to include partnerships on government balance sheets; and good governance practices (Engel).

Infrastructure Banks: Cities like Chicago have developed infrastructure banks to allow for more creative financing tools for local projects. More recently, proposals for a national infrastructure bank have emerged. An infrastructure bank is a mechanism for attracting private investment for public purposes and are intended to eliminate some of the political challenges of public project financing (Galston). These ideas are still evolving as there are issues with governance and tax-exempt financing.

Different Ownership Models: Digital infrastructure is new and presents an opportunity to think creatively about ownership models. Nearly three-fourths of households in the United States are supplied with electricity by private, investor-owned utilities whose rates are regulated by public utility commissions. Communication networks, oil and natural gas pipelines, rail freight are among the many examples of private ownership of public utilities (U.S. Department of the Treasury). As smart city technologies become increasingly more integrated into the operations

and management of infrastructure and transportation services, it is essential to consider who the owner of this infrastructure should be. Public leasing models have not always been successful and they are seen as a short-term gain and long-term loss (Galston). If a model of private ownership is to be undertaken, with guaranteed access to the City of Los Angeles, there are several additional policy considerations regarding data privacy, security, and other protections of the public good.

Municipal Bonds: Municipal bonds are loans that finance public works like schools, roads, water treatment plants, parks, etc. and often pay tax-exempt interest. This marketplace is evolving and there are new ways for individuals and professional investors to invest in municipal bonds. While traditionally there has been a long list of intermediaries between the individual investor and a municipal bond, this gap is being narrowed by the creation of new ways to directly invest in these opportunities – lowering the price to buy and raising the potential returns. In August 2014, Denver crowdfunded $12 million worth of mini-bonds online which sold-out in 16 minutes (Cortese). Like some of these other models, there is room for further innovation but this too introduces an alternative approach to traditional mechanisms for funding municipal projects.

There is likely no single solution to funding infrastructure – both physical and digital – in the future. LADOT should work with other City departments to advocate for more innovative solutions at the state level to make it easier to provide the infrastructure necessary to support mobility in the future.

City of Los Angeles Bureau of Engineering

Sixth Street Viaduct Demolition as of March 16, 2016. The $449 million project to replace the beloved bridge, the Sixth Street Viaduct Replacement Project, is the largest bridge project in the history of Los Angeles. With funding from the Federal Highway Transportation Administration and CALTrans, the project is being led by the City's award-winning Bureau of Engineering.

TODAY (0-2 years)

Develop a business plan that considers opportunities for a city AV fleet.

The transportation landscape is quickly evolving towards self-driving vehicles. Most new vehicles sold today include some kind of automated capabilities for some of the most monotonous aspects of driving such as braking, lane keeping, or adaptive cruise control. With new self-driving vehicles entering the market, cities will see drastic improvements in safety because human error will be minimized for standard driving tasks. There is currently a race among cities to attract pilot projects and test track programs to further explore this technology and the federal government has announced plans to release $4 billion in funding research and pilots in the near future. LADOT is looking to begin and subsequently expand a fleet of automated vehicles as it will help meet Vision Zero and Sustainability Plan goals for transportation.

Alternatively, there are some cities exploring the development of public AV transit fleets both in the United States and across the globe. The City of Beverly Hills and the County of Contra Costa, California, for example, have announced ambitious plans to introduce automated vehicles to address first-last mile connectivity from major public transit networks to final destinations. There is a need to evaluate the trade-offs of the various implementation models and how it would be structured as either a city-owned fleet or public-private partnership.

To advance the transportation technology strategy recommendation to pursue a public automated vehicle pilot, it is recommended that LADOT partner and fund a one year fellowship to identify a business model and program recommendations for consideration. This Fellow will serve as an internal consultant to help department leaders and internal stakeholders fully explore the full range of implementation strategies for automated vehicles to better address the rapidly changing mobility needs of the second most populous city in the country. See the Appendix for a copy of the job description for this fellowship.

NEXT STEPS

1. Identify partner(s) to support a fellowship.

2. Hire fellow to develop AV business plan.

EasyMile

EasyMile and GoMentum Station announced today an exclusive collaborative agreement to launch the first fleet of EZ10 Shared Driverless Vehicles (SDV) in Northern California for prototype testing and future commercialization.

Create a dedicated staff position focused on connected + automated vehicle tech.

With the rapid pace and competition to bring AV to market so fierce, LADOT should create a dedicated role to track and implement new solutions for automated vehicles. For LADOT to become a true platform for transportation innovation, it will be essential for the organization to remain aware of new federal standards as they are introduced, identify opportunities to integrate connected infrastructure technologies into future capital and maintenance projects, support regional inter-operability, and prepare LADOT to pursue future grant and partnership opportunities to fund the deployment these technologies.

This role will require qualifications that enable LADOT to navigate the complexities of this technology while effectively communicating across department divisions how automated vehicles will transform business as usual at LADOT. This staff person could also fulfill the role of innovation pilot project manager in regards to the proposed to the connected vehicle, connected infrastructure and automated vehicle pilot recommendations and serve as the department liaison to the Coalition for Transportation Technology.

NEXT STEPS

1. Identify funding and resources to create a new staff role.

2. Hire a qualified candidate to support AV at LADOT.

ADDITIONAL RESOURCES
SIMILAR ROLES IN SAN FRANCISCO + VIRGINIA

San Francisco's Metropolitan Transportation Commission has a dedicated staff focused on connected vehicle deployment that could serve as a model. The work plan, which requires 55% of total staff time, for this position includes the following scope:
- Provide support to include information about the Catapult Bay Area Program in 2040 Plan Bay Area update and other agency documents as needed.
- Develop and maintain MTC's strategic plan for the Catapult Bay Area Program.
- Represent MTC in committees and working groups that support connected vehicle initiatives and deployments.
- Provide updates to the Arterial Operations Committee, as needed.
- Provide internal coordination through oral and written reports to update management and/or staff on the status of the Connected Vehicle Program.
- Facilitate outreach and external coordination to support the development of the Catapult Bay Area Program to external partners at the local, regional, state, and federal level.
- Manage consultant task orders, involves defining and ensuring compliance with scope, budget, & timeline
- Manage the consultant, involves giving direction to the consultant, overseeing work products, and ensuring high quality deliverables.
- Lead MTC's efforts to deploy Catapult Bay Area Program project(s).

The Virginia Department of Transportation is creating a Connected and Automated Vehicle Program Manager role which includes the following description:

The incumbent will serve as the program manager for VDOT's Connected and Automated Vehicle Program. Responsibilities include, but are not limited to: developing and overseeing the Agency's long term strategy for deploying and integrating advanced vehicle technologies; conducting technology assessments, risk assessments, observing industry best practices and developing technology strategic plans as necessary; serving as VDOT's subject matter expert on Connected and Automated Vehicle technologies, policies and standards; staying abreast of industry trends and maintaining a knowledge repository for the Agency; working with key stakeholders within VDOT, other Virginia agencies and local jurisdictions to develop, implement and maintain Virginia's Connected Vehicle Program Plan. The incumbent will also: serve as VDOT's Connected and Automated Vehicle Program Champion by promoting the program on a local level through outreach, education and support; represent VDOT in committees and work groups that support Connected and Automated Vehicle initiatives and deployments; lead, direct and manage the planning, design and implementation of Connected Vehicle systems; identify and advocate for resources, innovative processes and procurement methods to accelerate and sustain a statewide approach to VDOT's Connected and Automated Vehicle Program; develop and support procurement activities; work with other divisions and work units to identify processes to mainstream Connected and Automated Vehicles into the Agency's Plan, Deliver, Operate, Maintain and Support (PDOMS) Model (ITVA).

Implement blind spot detection systems for public transit vehicles.

Every year, more than 200 people are killed while trying to move throughout our city. Nearly half the people killed on our streets are those who were walking or bicycling, and an alarming number of them are children and older adults. In fact, traffic collisions are a leading cause of death for children in Los Angeles (Vision Zero). Bus drivers are busy with riders boarding and paying fares, watching their surroundings and driving a large vehicle. It can be difficult to keep track of all of the potential risks to a safe ride - including pedestrians and cyclists in blind spots. In support of the goals of Vision Zero to eliminate traffic fatalities by 2025, LADOT should implement blind spot detection technologies on its DASH buses. This technology is designed to warn drivers when there is something in a blind spot and if no action is taken can automatically brake to bring the bus to a stop.

Furthermore, LADOT should partner with a research organization or academic institution to evaluate how this technology impacts driver behavior. For instance, does this tool make it easier for drivers to become distracted or ease up on surveillance of surroundings because they come to depend on the notification by the technology? Understanding the consequences of integrating technology and humans can help LADOT address training needs and evaluate the tradeoffs of these tools.

NEXT STEPS

1. Implement smart sensor technology to address Vision Zero goals.

2. Identify partners to study the impact of this technology on the LADOT workforce.

Expand LADOT connected bus technologies fleet-wide.

LADOT has already begun introducing connected bus technologies to its Commuter Express and DASH buses. Services such as WiFi make it easier to support existing mobile e-ticketing services and will open up the potential to add additional amenities and technologies in the future. The integration of GPS, global positioning systems, provides real-time location data which helps fleet managers with the flow of buses along their routes and riders can know when to expect their next bus. You can text a number at your DASH stop, for instance, to find out when the next bus will arrive. LADOT should investigate how this data can be used to further optimize bus routes and avoid clumping and service gaps.

Other DASH services include next stop announcements, mobile data terminals, headsign and fare box animation and automated passenger counting. This data can be helpful for planning and evaluating the overall service levels of each route and can be used as a metric when launching on-demand public transit pilots for comparison. The convenience of having announcements automatically made can help passengers navigate the system more seamlessly and improve the customer experience.

By providing communications and information technology connectivity on buses, LADOT can apply tools to help track demand, monitor safety, and provide valuable information to operators and transportation planners. LADOT should ensure that all technologies implemented have an open architecture that is agile and adaptive, allowing the applications of the future to plug in without a considerable reinvestment in the basic connectivity required to support these tools.

It is important to include training on these technologies for operators and maintenance teams to ensure these services are applied universally and cost-effectively. In addition, it is important to train LADOT planners and engineers on how this data might be integrated into their planning, design and project evaluations. LADOT should share its work with the Coalition for Transportation Technology to help establish a regional standard to enhance interoperability and implementation across other transit fleets.

NEXT STEPS

1. Extend connected bus technology to the entire LADOT fleet.

2. Compile customer feedback on usefulness and value of WiFi and on-board charging.

3. Develop and share best practices with the Coalition for Transportation Technology.

Syncromatics has been working with the LADOT Transit team to test and deploy connected vehicle technologies and will be working to extend these capabilities across the entire fleet. As these technologies continue to evolve, it will be important for LADOT to support an open architecture that allows flexibility to adapt in the future as new technologies continue to emerge.

While adding protected bike lane infrastructure is underway in Los Angeles, many streets only offer cyclists sharrows or a painted bike lane near the road edge. Collaborating with auto manufacturers to determine whether drivers can be alerted when they cross into a bike lane can help prevent high injury crashes and fatalities.

Invest in lane markings that enhance the effectiveness of lane departure warning and prevention systems.

LADOT and the City of Los Angeles will be challenged to adopt best practices in preparing for an automated future in the absence of standards across the industry for signage, lane markings, and connected infrastructure. However, one thing that is well-documented is the need for clear and well-maintained street markings so that the automated vehicle sensors can detect and read the road more accurately.

Vehicles today are already equipped with sensors to help make the drive safer. Lane departure warning (LDW) systems rely on a camera positioned on vehicles to detect road striping (paint) and notify drivers when they are drifting too close to the edge of a lane. Different manufacturers use different warning types – some use an alarm sound while others cause the driver's steering wheel or seat to vibrate. These systems have been shown to improve lane-keeping by up to 34% (AAA). Active lane keeping or lane departure prevention systems will actually maneuver the car back into the lane to prevent departure or provide assistance to the driver to do so. Some of these systems, however, only operate at certain speeds: the Acura's system only works between 45 mph and 90 mph while Mercedes' works from 0 to 124 mph (Haj-Assaad). These

technologies have proven to be safer than infrastructure-based solutions such as rumble strips which can startle a driver and cause over-correction.

These systems are less effective on roads where lane markings are faded, in poor condition or missing entirely but are a precursor to more full-scale AV sensor technologies. With the City of Los Angeles planning to annually repave and restripe 2,200 lane miles of roadway, there is considerable opportunity to explore how lane striping can improve safety on our city streets by ensuring the infrastructure can communicate conditions to vehicles equipped with this technology. With the growing bicycle infrastructure – including bike lanes – across Los Angeles, LADOT should collaborate with car manufacturers to explore how this technology and updating paint specifications can help keep drivers and cyclists safer.

NEXT STEPS

1. Work with auto manufacturers to understand what technologies the City of Los Angeles should be embedding as they resurface roadways.

TOMORROW (3-5 years)

Create better access to ATSAC data and enhance transparency of network prioritization for planning.

The City of Los Angeles traffic management center, ATSAC, is unique in that it was completely designed, built and managed by city engineers since its inception in the 1980s. It provides a systemic view of our roadways and leverages signal synchronization to make the flow of traffic more efficient citywide. However, how this network is prioritized is not well-understood outside of the team of engineers that manage its complex algorithms and operations. It is recommended that LADOT work to open up the data in ATSAC and its network prioritization to make it easier for transportation planners and other engineers in the department to understand how it works. This information could be useful when large developments, for instance, are planned that may impact these flows. Incorporating this network into larger decision-making efforts could be essential to more sustainable practices in the long term. Opening the internal lines of communication across department functions through cross-training is also encouraged.

NEXT STEPS

1. Diagram and inventory the available ATSAC data and system architecture.

2. Test assumptions and streamline architecture wherever possible.

3. Establish a regular calendar of these checks to ensure the system is meeting the desired outcomes.

LADOT

LADOT
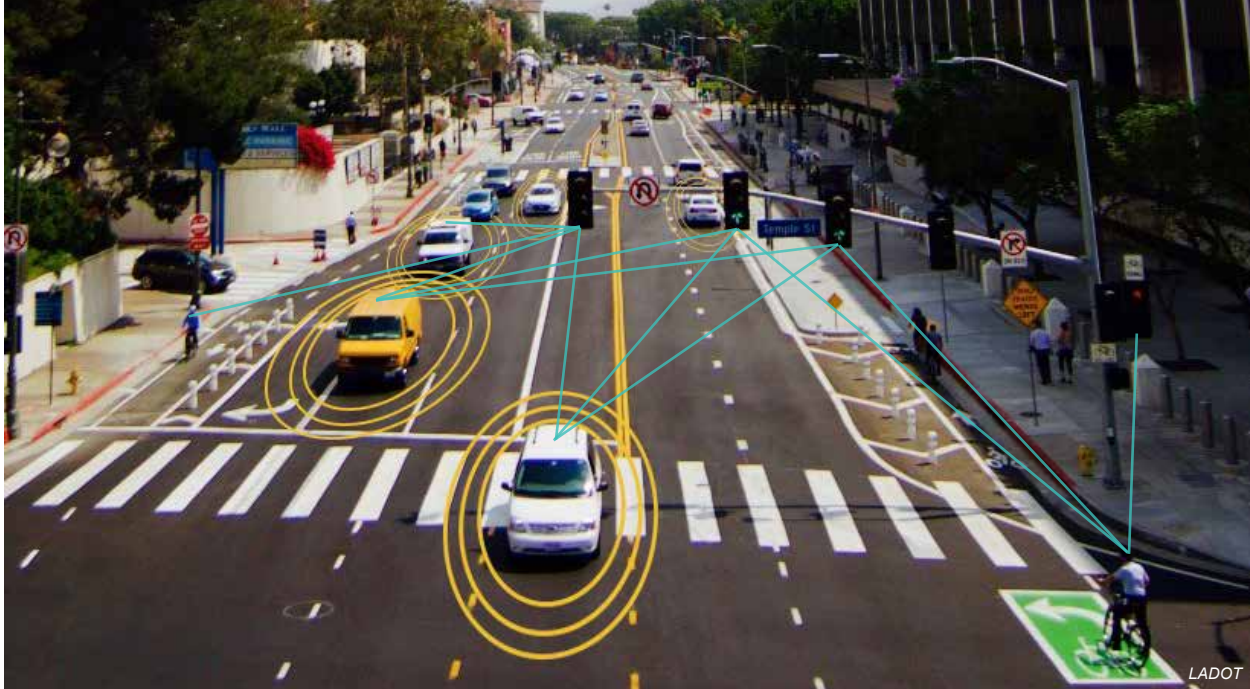
Develop an automated vehicle road network along transit and enhance vehicle networks.

Humans adapt very quickly to new technologies but there is a definite period of adoption. With the arrival of connected and automated vehicles, there will be a period of transition as human and "robot" drivers must co-exist while older technologies either become obsolete or regulated out of existence. Consequently, this period of transition introduces the most risk as has been demonstrated by the Google self-driving vehicle experiment: the majority of the traffic incidents involving their test vehicles have involved a human driver running into these cars. Creating networks where these vehicles can drive within a dedicated lane will help raise visibility but also offer a platform for testing this technology in an urban setting. It will create visibility for these new vehicles and technologies while also creating a limited buffer from human drivers.

This network should be an extension of a shared mobility network, rather than a completely separate network, which can be planned and designed today for faster implementation. Like HOV (high occupancy vehicle) lanes on the highway and freeways surrounding Los Angeles, these urban streets would have designated rights-of-way for shared mobility during peak hours to help encourage more people to share rides to bypass congestion. As these networks are tested, it is possible they could be expanded from a single lane to multiple lanes or even entire roadways to help move more people more efficiently.

By establishing a network or path of travel for these automated vehicles, the City of Los Angeles can focus its investment in digital infrastructure improvements to support connected vehicle capabilities. Ubiquitous broadband, low-cost wireless such as WiFi, 4G and 5G mobile communications, and other technologies can help enable the transmission of larger sets of data at faster, more reliable speeds. The faster these technologies are implemented across the city, the greater the pace and volume of data is likely to accelerate (Integrated Transport Planning, 7).

NEXT STEPS

1. Pursue funding for investment in smart city infrastructure to complement the proposed AV roadway.

2. Work with community stakeholders to target street(s) for infrastructure investment to support connected and automated vehicles along the enhanced vehicle network and High Injury Network.

3. Engage auto manufacturers and technology companies to define potential opportunities for partnership to test and pilot.

Launch a Data as a Service program to provide real-time infrastructure data to connected vehicles.

Data as a service is the rapid exchange of real-time condition and service information between customers, service providers, government and the supporting infrastructure to optimize safety, efficiency and the transportation experience. LADOT should work towards providing real-time infrastructure data to connected public transit vehicles and then establish a more widely-available program for providing Data as a Service to all connected vehicles. This will enable the City the flexibility to understand the challenges and opportunities of providing reliable, real-time information, the costs associated with these services, and the benefits to travel efficiency and safety.

To provide Data as a Service, LADOT will need to expand the capabilities of ATSAC to not only capture real-time contextual information but will need to build out the capacity to quickly communicate this information with limited latency or delay. Building on previous recommendations to establish a data inventory and solid data baseline, to deploying connected transit technologies, to integrating more connected infrastructure in capital project improvements and vetting the feasibility of monetizing real-time data, this recommendation focuses on creating a viable marketplace platform to enable other public transit providers, auto manufacturers and others developing AV technologies, and goods movement companies to connect in and consume this data. This will likely require investment in software and hardware as well as creating a staff position to support this function.

NEXT STEPS

1. Begin with testing Data as a Servie to LADOT fleet vehicles.

2. Launch a marketplace where potential users can subscribe and apply to engage the City of Los Angeles to receive this data. Potential audiences could include: shared mobility services, taxis, delivery services, freight, etc.

3. Initiate a trial period (no cost assigned) to test and pilot the project and evaluate.

4. Deploy a full-scale Data as a Service implementation.

LADOT

Convert the public transit fleet to fully automated.

In Fall 2015, the County of Contra Costa, California announced an exclusive partnership with EasyMile to deploy automated shuttles at a 585-acre mixed-use business community in San Ramon, California with 10 million square feet of buildings. The shuttles, which operate at low speeds, will transport passengers short distances in a demonstration scheduled to begin in Summer 2016 (GoMentum Station). LADOT should continue to engage with the Contra Costa Transportation Authority as this demonstration is tracked to learn best practices and incorporate findings into the development of the AV business plan.

As previously stated, this strategy holds the premise that the most efficient use of AV technologies is a shared fleet model – introducing these capabilities will have the most significant impact on safety, environment and access if they are applied in a public transit model that moves multiple passengers simultaneously. Without an investment in transforming the public fleet, we may not realize the benefits of a more efficient transportation system with only private vehicles enjoying the features of automation. LADOT should move forward to become a leader in the shared automated vehicle space by transforming its fleet to fully automated as the technology comes online. With the development of the business plan, LADOT should be equipped with an actionable strategy to deploy this technology early. In the meantime, LADOT should closely monitor this evolving technology and be prepared to partner with the private sector to test and deploy new innovations in this space as they become available.

Los Angeles offers a diverse environment for the deployment of new technologies and, with the recommendations of this strategy, will continue to evolve into a platform for innovation in transportation technology. LADOT should foster private partnerships in the near term to build its capacity and understanding of how an AV fleet will improve operations, safety and transportation happiness.

LA Department of City Planning

PILOTS

Pilots

The size of Los Angeles makes it difficult to deploy new ideas at-scale but provides an unique landscape for demonstration projects and pilots. It offers a variety of neighborhood typologies, roadway conditions, socio-economic composition, etc. that provide significant opportunity to test new ideas in a real-world environment. This strategy outlines a series of pilot projects to meet goals of Data, Mobility and Infrastructure as a Service. LADOT understands the importance of incremental change but has proven receptive to exploring new technologies as a transportation thought leader. In order to help LADOT focus these efforts, however, this strategy recommends concentrating these efforts on either a specific geography or market to see how these various pilots can shape the built environment, influence behavior change, and make our public right-of-way safer and more efficient for all modes of transport.

Focus: Corridors

High Injury Network (HIN): LADOT has already been engaged across all city departments on the Vision Zero initiative, focused on eliminated traffic related fatalities in Los Angeles by 2025. LADOT has been undertaking a technical collisions analysis as part of the initial steps towards a Vision Zero work plan. This analysis seeks to find patterns among the various collisions along the HIN to better inform approaches to engineering, education, and enforcement. However, while the HIN represents only 6% of the city's street network, at roughly 450 miles there is still need for additional location prioritization.

The Vision Zero team then developed a series of six location-based priorities for developing a "intersection score" to further prioritize locations along the HIN:

- **Severity**: Locations with the highest amount of severe or fatal injury (KSI) collisions
- **Vulnerability**: Locations with KSI collisions that involve older adults or children
- **Social Equity**: Locations within traditionally underinvested in or underserved communities
- **Geography**: Locations that have the most collisions
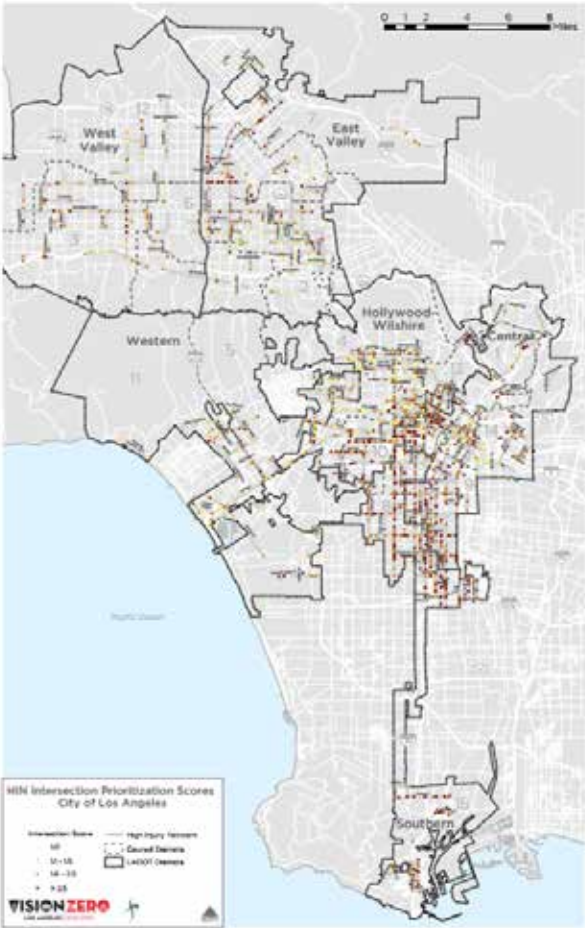
Vision Zero High Injury Network (HIN) Prioritization.

in an Area Planning Commission, Council District, or other zones
- **Dangerous Behavior**: Focus on locations that involve KSI collisions resulting from dangerous behavior
- **Low-Cost, Low-Complexity**: Focus on locations that can be easily fixed through low-cost and low-complexity countermeasures (Vision Zero Los Angeles).

As the Vision Zero team develops its action plan, LADOT should focus on deploying transportation technologies in these prioritized areas to leverage the safety benefits of tools such as pedestrian detection and automated vehicles to help meet this program's goals.
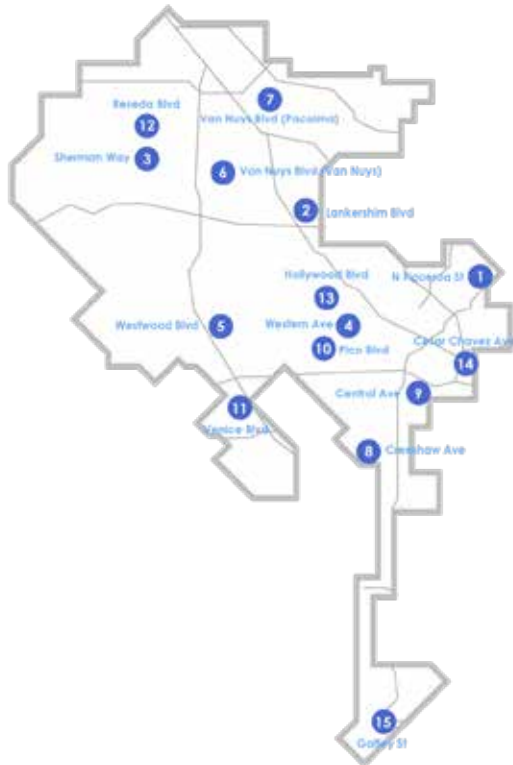
Los Angeles Great Streets

Great Streets: The City of Los Angeles has also prioritized improvements to the public right-of-way through its Great Streets Program. Focusing on the main streets in our neighborhoods, the goals are: Increased Economic Activity; Improved Access and Mobility; Enhanced Neighborhood Character; Greater Community Engagement; Improved Environmental Resilience; Safer and More Secure Communities; and Improved Public Health. Fifteen main streets have been identified across Los Angeles for design and program improvements to truly make these corridors a center for community.

Vehicle + Transit Enhanced Networks: The Mobility Plan 2035 identifies a series of corridors as part of either the Vehicle Enhanced Network (VEN) or Transit Enhanced Network (TEN). To accommodate regional traffic to and from the freeways on city streets, the VEN includes corridors that will remain to vehicle circulation and balance regional and local circulation needs. This incorporates 79 miles of arterials that carry between 30,000 and 80,000 vehicles per day, traverse more ten miles or more through the City of Los Angeles and provide access to freeways and critical facilities. Working in collaboration with the

transit operators, combined with street improvements of city managed enhancements, the Transit-Enhanced streets outlined in the Mobility Plan strive to: provide reliable and frequent transit service that is convenient and safe; increase transit mode share; reduce single-occupancy vehicle trips; and integrate transit infrastructure investments with the identity of the surrounding street. These corridors were selected based on a data-driven analysis of factors such as ridership, destinations, employment, and population. Transit enhanced streets may receive a number of enhancements to improve line performance and/or the overall user experience for people who walk and take transit. Enhancements may range from streetscape improvements to make walking safer and easier, to transit shelters, or bus lanes (LA Mobility Plan).

Focus: Districts

An alternative approach to locating where to deploy pilot projects is to focus in on a few specific districts within Los Angeles that provide a variety of conditions and opportunities for understanding how transportation technologies can improve livability, efficiency, safety and the environment.

The Promise Zones: Promise Zones are high poverty communities where the federal government partners with local leaders to increase economic activity, improve educational opportunities, leverage private investment, reduce violent crime, enhance public health and address other priorities identified by the community. The City of Los Angeles now has two designated promise zones (see graphic on the next page). Both of these areas include several transportation hubs, include many of the HIN corridors, and are home to a highly transit-dependent population. In addition, the Promise Zone designation is an advantage when competing for federal funding for projects. Because of the socio-economic composition of these zones, careful consideration should be given for the digital divide which may make access to technology and digital literacy an additional barrier to success if not addressed.

High Density Nodes: Los Angeles has multiple fringe urban areas of higher density commercial and mixed use development outside of its downtown core which could be another focus area for pilot projects such as car-free streets, connected infrastructure, automated vehicle deployment, etc. These areas tend to include a convergence of active transportation, vehicle traffic and goods movement. The taxi and ride-hailing industries are prime opportunities for the deployment of private automated vehicle fleets and LADOT can help support these potential initiatives by understanding roadway utilization, the impact of roadway design on congestion, and other proposed pilots. Downtown Los Angeles has also become the launch point for the regional bikeshare system and will have one of the first planned mobility hubs as well.
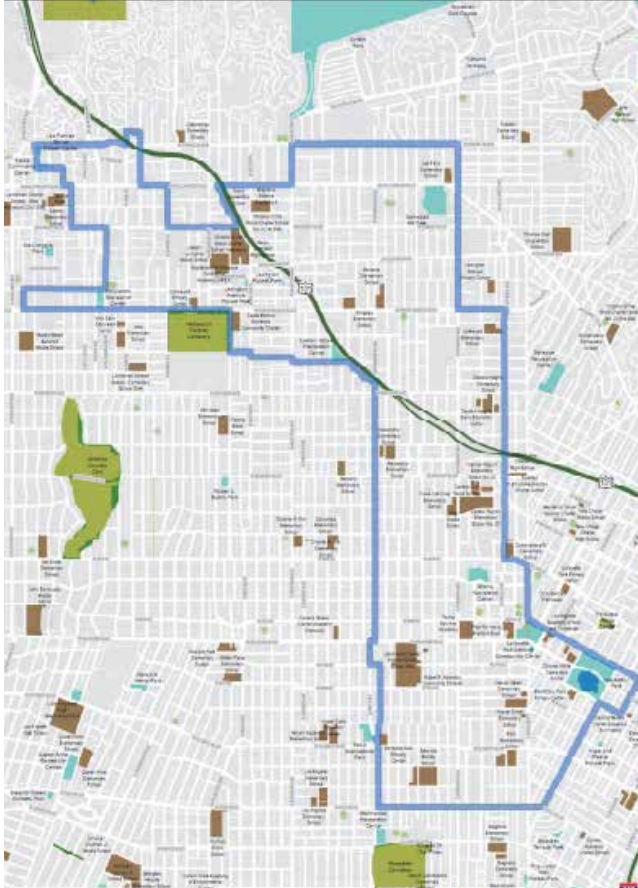
ACCESS + OPPORTUNITY

LA's First Promise Zone (left image)

The first Promise Zone includes culturally diverse neighborhoods west of Downtown including Hollywood, East Hollywood, Koreatown, Westlake, and Pico Union where 35% of residents live in poverty (HUD). There are 91 signalized intersections within this zone.This area, rich with transit services, has 49 DASH buses and 157 and two DASH routes. The on-time performance for the two routes is 65 percent for Wilshire Koreatown and 45 percent for Hollywood due to congestion in this area. This poor on-tie performance makes it difficult to provide residents with reliable transit connections (LADOT).

South LA Transit Empowerment Zone

A second zone was recently designated in Los Angeles where the poverty rate is 45.59% and includes portions of neighborhoods including Vernon-Central, South Park, Florence, Exposition Park, Vermont Square, Leimert Park and a small portion of Baldwin Hills/Crenshaw. This area is poised to take advantage of regional investments in the Blue Expo and Crenshaw light rail lines and transit-oriented development projects around the 15 stations planned within the zone (HUD).

Focus: Markets

Customer Groups: Angelenos have different needs - as diverse as the neighborhoods across our city. Identifying user groups for pilots can be another approach to understand the impact of technological innovation on mode shift, transportation happiness and connectivity within the system. LADOT should consider targeting different user groups as it designs pilot programs as not all applications will work for everyone; it is important to understand who the potential customer is before bringing something to market and this can serve as a valuable exercise in establishing metrics for project evaluation. Los Angeles is a major tourism destination with 44.2 million visitors reported in 2014 (Martin), for example, which is a potential target as visitors will require transportation services to get from the airport to their hotel and around the city. Targeting an audience such as this can help improve efficiency and safety while making a more pleasurable visit (which is good for our economy). Other potential audiences include seniors; youth; first-time users of public transit; commuters; etc.

Mode Types: Another approach for organizing pilot projects is to focus on specific modes - such as bus transit; bikeshare; carpooling; carshare; etc. This can help give further focus to several pilots by understanding the interrelationship between technology and mode choice. With the launch of mobility hubs, for instance, LADOT will want to better understand how the mix of services works at each location and develop a template that can be scaled and tailored to future locations. In addition, with the launch of an electric vehicle carsharing program, a relatively nascent market in Los Angeles, it will be important to understand customer preferences and barriers to adoption. Focusing in on this specific mode will provide LADOT with valuable insight when incorporating shared mobility into future planning efforts.

To create a true mobility marketplace will take time as the City of Los Angeles is a large city in a complex region. By focusing the pilot initiatives on a specific geography or market, LADOT will be better positioned to understand how the future of transportation technology may improve equity, access and sustainability. It is recommended that LADOT adopt one of these focus strategies for the following pilot proposals; establish clear metrics for project evaluation; and report back to learn from the application of new technologies.

Data as a Service

Data as a service is the rapid exchange of real-time condition and service information between customers, service providers, government and the supporting infrastructure to optimize safety, efficiency and the transportation experience. These pilots are opportunities to move LADOT towards Data as a Service by giving the staff experience in managing and optimizing data-sharing partnerships, exploring the value of analytics, and testing new tools.

Analyze crowdsourced data for roadway design impacts on congestion.

With the addition of protected bike lanes, such as the one in Downtown Los Angeles, and road diets to make our roads safer, how can LADOT better understand the true impacts of these changes on congestion by evaluating crowdsourced data? Through existing data sharing agreements with Google Waze and Xerox's Go LA application, LADOT has access to crowdsourced information about congestion and trip planning preferences that could offer a valuable planning and project evaluation resource over time. This data should be included in the data inventory.

Google Waze is a crowdsourced application that relies on sensors in users' smartphones to relay speed of travel and location while driving. In addition, a passenger may input additional conditions such as crashes, objects in the roadway, vehicles on the shoulder, police officer presence, and other relevant details that might cause delay or be of concern to drivers on the road. Google Waze claims that one in four Angelenos have downloaded and used the application to plan their trip by car. In late 2014, the City of Los Angeles was among the first cities to begin sharing information about planned road closures via the app.

While this data is available on city-hosted websites, more drivers were likely to get access to this information in a tool they were already using to plan their trip. Through data sharing, LADOT is able to extend its reach to a broader audience.

Congestion on the road wastes time, increases pollution and is costly to society. By providing road closure information, ranging from planned construction to permitted events that take place in the streets of Los Angeles, the City of Los Angeles was able to provide critical information to enable Google Waze to direct traffic around closures, providing information to improve user experience. As part of the Vision Zero effort, LADOT also provided information about the most dangerous intersections in Los Angeles to help warn drivers to be more cautious in these areas. In turn, Google Waze provides LADOT with a data feed that includes incident reports, congestion reports and anonymized messaging strings. Google Waze data could provide LADOT with insight into how road diets and protected bike lanes, for instance, impact traffic flow and even the perception of congestion. LADOT should partner to analyze this data and report on the potential opportunities (and potential limitations) that crowdsourced data offers to project evaluation.

While both parties have been willing partners, there is still considerable opportunity to improve upon the value of the relationship. LADOT recently partnered with Data Science to identify a pathway for capturing the Google Waze data feed and storing it to enable future access and analysis. Identifying a potential pilot to analyze before and after a change in roadway design would be an important starting point to understanding how to structure this type of evaluation. The City of Boston has already done some preliminary analysis on Google Waze data and the impacts of changes to roadways which LADOT might be able to leverage to do the same.

LADOT Bike Blog

With improvements to roadway design, such as the installation of a protected bike lane measuring the impact on local traffic can help LADOT planners and engineers understand one aspect of how these changes work.

GOOGLE WAZE DATA PARTNERSHIP

Google Waze is improving and adding new features to improve getting around Los Angeles and will continue to work closely with the City of Los Angeles to identify shared priorities and opportunities for innovation. Waze currently hosts monthly meetings and a biannual summit to share its latest developments and LADOT must continue to advocate for the safe routing that limits intrusion on neighborhoods while preparing route information for an emergency evacuation, if needed. Recently, LADOT designated a traffic engineer as the dedicated pilot project manager to facilitate this relationship and ensure it is as effective as possible. Cultivating relationships that gets real-time information in the hands of users, to improve their experience, should be a primary business goal for LADOT.

1. Automate the process of sharing road closures (and add new datasets) to eliminate the need to generate an email and ensure instant updates are available upon status change;

2. Compare crowdsourced data from Waze with the remote sensor data generated by ATSAC's loop detectors and incident report databases to validate either or both data sets in a side-by-side comparison;

3. Evaluate on a macro-level input from Waze users to better understand public perception of congestion as compared with evaluations by LADOT of traffic conditions;

4. Provide parking data such as locations, rates, and possible availability as Waze expands its functionality;

5. Identify other types of sharable data could potentially add value to the Waze user;

6. Publish what data is shared and what is received anonymously (or aggregated) via the partnership agreement; and

7. Collaborate with other Waze partners such as the City of Boston, MA to leverage analytics capacity.

8. Engage in the Waze partner network collaboration to identify how to provide 311 with updates on reports of potholes and other information provided by Waze users.

Test customer feedback tools on public services.

In the digital age, there is a plethora of accessible feedback tools and platforms that would give LADOT better insight into how satisfied Angelenos are with their mobility experience - whether walking, biking or taking public transit. For example, private transportation services, such as ride-hailing services, provide the means for customers to rate service and access this information in advance of taking a trip. LADOT should test new digital channels and establish a model to measure transportation effectiveness and happiness. For examples, the Go LA application, developed by Xerox, could potentially capture feedback from users on how they enjoyed different segments of their trip and ask for input on different modes used. This data could be helpful in identifying challenges in connectivity or quality of service among this user base.

Once LADOT establishes metrics for quantifying and qualifying transportation happiness, the department should identify potential tools and standardize the type of questions and prompts that will be used to solicit feedback. Potential tools include a text-based survey at bus stops which would give LADOT a few multiple choice questions to pose to riders; partnerships with navigation and trip planning apps to pilot a customer input function; adding feedback capabilities to the existing City of Los Angeles 311 app; adopt a web "bot" that can provide automatic customer service online and request feedback; standardized email follow-up surveys/links for any transaction-based processes with the department; etc.

Additional tools could be considered for unsolicited feedback as well, including data mining of existing LADOT social media channels to understand at a macro level how Angelenos are responding to services. Several government agencies have used tools to identify key words as it relates to public health, for example, to help identify potential trends. LADOT could collaborate with an academic institution or other partners to examine available channels and build a model to understand how people respond to their transportation experience. It would be worthwhile to consider partnering with Metro and other agencies in the region as the lines between jurisdictions are often blurred from the perspective of the customer.

Key considerations when setting up these tools should include: equity and accessibility; public acceptance; privacy concerns; and lack of personal contact (Watkins). It is important to understand the limitations of each feedback channel as there is no single solution that will provide a comprehensive and fully inclusive picture.

Partners: Proposed user experience working group; LADOT Communications Team; Xerox Go LA team; local universities

Resources: May require subscription to a service but could be developed through existing rules

Proposed Timeline: 2017

Develop + test an online project dashboard for the transportation technology strategy implementation.

There is a lot of innovative work underway, but timelines varies because of how a project is funded, who is executing the work, what is being analyzed, etc. It can be challenging to keep track of what is underway and, from the community's perspective, difficult to know where to go to get an update during the various project phases: planning and development; funding; design; construction; opening (etc.). One of the proposed actions recommends creating a project dashboard to make this work more transparent to stakeholders by providing a single resource where current project status is available, project contacts are listed, and any metrics for project evaluaton are posted.

In the meantime, LADOT should pilot an online project dashboard for this transportation technology strategy to publicly update status and report on the effectiveness of these projects as they meet overall Department and City strategic and policy goals. While not all recommendations may be adopted, it is important to track the outcomes of those that LADOT elects to implement. This will not only improve communications with Angelenos but serve as a resource for other cities incorporating these strategies and considerations into their own policies and actions.

Outlining the work underway, funded or planned would simultaneously serve as a valuable internal exercise for LADOT while creating a new channel for the community and potential partners to engage with its government.
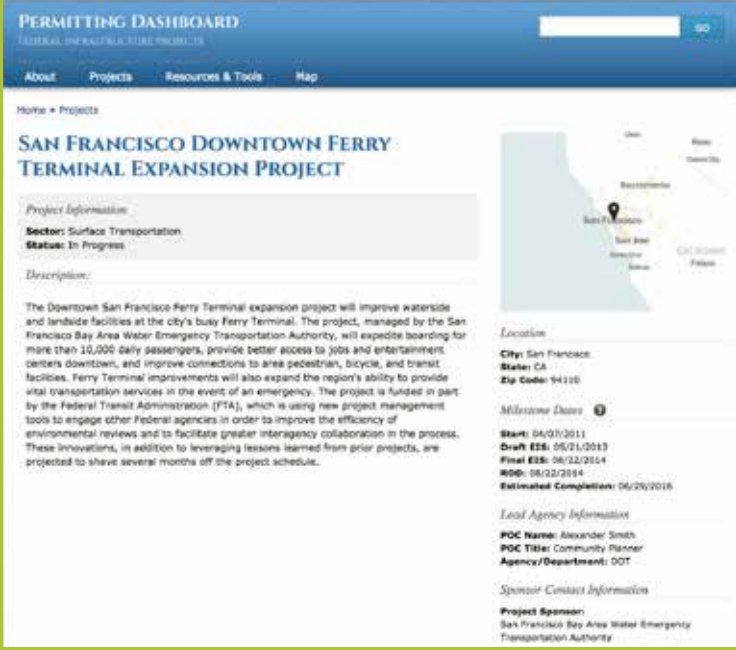
As recommended, LADOT should streamline its online presence and the development of this dashboard should be integrated into the department website, rather than be established as a standalone URL.

One such means to measure success is by monitoring web traffic to the dashboard.

Partners: Office of the Chief Data Officer/Office of the Mayor; LADOT Communications Team

Resources: Requires internal staff time and web development resources. May be outsourced if necessary.

Proposed Timeline: Fall 2016

PROJECT DASHBOARDS
LEARNING FROM OTHERS

Federal Infrastructure Projects Permitting Dashboard

There are several examples of public-facing project dashboards, including one managed by Metro. Establishing a template and methodology for updating the information on a regular basis makes the information more useful and transparent to the general public, stakeholders, and potential partners. Dashboards can also serve a valuable function for internal management of projects. This federal dashboard requires tracking for all new infrastructure projects, meeting a certain size and other requirements, that started since January 2016.

https://www.permits.performance.gov/

Deploy connected infrastructure technologies in the Promise Zones.

Technology makes it possible to relay critical real-time information from our infrastructure to vehicles, smartphones and other receivers to make our public right-of-way safer, smarter and more efficient. Sensors at crosswalks can detect waiting pedestrians and automatically change signals; buses can sense bicyclists and pedestrians in blind spots and stop the vehicle to avoid a collision; streetlights and traffic signals can be programmed to detect when a vehicle is rapidly approaching an intersection and hold a change of lights to avoid a crash. LADOT should deploy a pilot of these sensors and other real-time communication technologies to better understand how this data can be integrated into its traffic management center operations. By focusing on the Promise Zones within Los Angeles, communities with at least a third of the population living and poverty and proportionally more dependent on public transit and active transportation, LADOT will be better positioned to leverage potential funding from the federal government and benefit from the deployment of multiple technologies in a limited geographic area.

LADOT has recently applied for federal funding for a fully-integrated deployment of connected vehicle and infrastructure technologies in the first Promise Zone (as of this printing, LADOT is still awaiting notification of application status). The strategies, which should constitute a new standard for connected infrastructure by the City of Los Angeles, include the following applications:

- **Transit signal priority** (TSP) that may use either advanced DSRC/Cellular/GPS technology to improve DASH service on-time performance;

- **Green light assist** that includes on-board displays that recommend a safe driving speed and response by the bus operator (speed up, slow down) to optimize signal synchronization and travel time;

- **Red light delay/crash avoidance** to detect any vehicle entering the dilemma zone and hold an all-red interval longer to avoid conflict;

- **Wireless pedestrian signal activation** that may use DSRC/cellular/Bluetooth/RFID sensors and advanced activation at signalized intersections that allow for a more responsive crosswalk and communicate to ATSAC in real-time pedestrian demand so that traffic signals can be coordinated;

- **Integration of advanced technologies into ATSAC** to ensure real-time conditions can be incorporated more comprehensively into traffic management;

- **Real-time arrival signs and bluetooth low energy (BLE) beacons** to help notify riders of bus arrivals and delays; these technologies can also provide wayfinding assistance to the visually impaired;

- **Interactive digital kiosks** at mobility hubs located at Metro Rail stations to provide access to city services and information and can help provide assistance to those without a smartphone.

LADOT should actively engage partners and seek further funding opportunities to implement these various services to understand how it can improve safety, access and system efficiency.
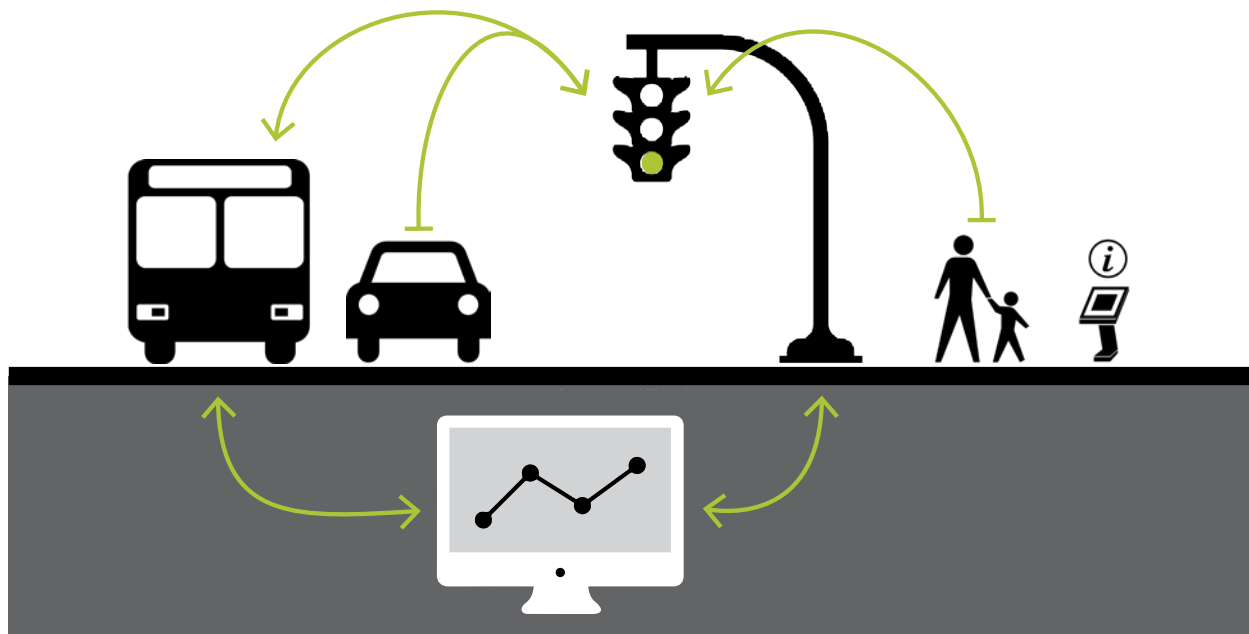
What other parking data might be useful? In addition to the availability of standard parking spots and the cost to park, data on accessible spaces, EV charging station parking (and availability), carpool parking, mother and child parking could all be useful for Angelenos as they navigate Los Angeles.

Experiment with parking inventory technologies.

Trip planners typically account for the estimated time of travel from Point A to Point B, and often factor historical congestion data into their algorithms. However, the cruising time and distance traveled to find parking - estimated to cause 30% of congestion (Shoup) - is not factored into these tools. What if it were possible to evaluate your trip plans and include the estimated time to park and how much it will cost before you even leave for your destination? How might that compare to the total cost and trip time for driving alone and would that lead you to consider alternatives or simply plan a more efficient drive?

LA Express Park is a smart parking program now in Westwood and Downtown Los Angeles that uses sensors and other technologies to provide real-time parking availability. Sensors placed in parking spaces report occupancy data to the parking management platform and pricing, time limits and hours of operation is adjusted to reflect demand. This strategy recommends that a dynamic smart parking tool such as LA Express Park be expanded citywide to help the City of Los Angeles not only better manage parking demand but to make it easier for Angelenos to find parking when they are driving.

LADOT has data on where all of its meters are located and this information is already available on the open data portal. However, there are is still a lot of unmetered parking throughout Los Angeles and a variety of rules (permit only, limited hours, limited days, etc.) which is not fully documented. This information will be an essential component of the Code the Curb recommendation but traditional manual surveys of roads are an expensive way to capture this data. LADOT will be partnering with Sidewalk Labs to pilot a new inventory tool that scans Google imagery data for parking spots along the curb. The preliminary scope will be to simply test the algorithm and LADOT will be providing support through validating the findings of the algorithm that "reads" this information from Google images. Eventually, this pilot may be expanded to include data on parking rules in 2017.

LADOT should continue to seek out pilot opportunities to efficiently inventory parking, parking rules and even real-time parking availability to help make it easier to find what they are looking for, help set a better pricing strategy, reduce congestion and incentivize consideration of alternative modes of travel by more accurately reflecting total trip time through a trip-planning application API.

LADOT should also adopt a standard practice for integrating parking data and availability information to enable privately owned parking information to be shared more seamlessly. Google is reportedly developing a parking data standard but this has not yet been released.

Partner: Sidewalk Labs

Resources: Google Parking Data Standard (under development); City of Santa Monica, CA Parking Data API

Timeline: Fall 2016

Mobility as a Service

*Mobility as a Service centers on the customer;
it provides a suite of transportation mode choices through a single platform and payment system to simplify access to mobility choices. While many elements to deploy a true Mobility as a Service model in the region are beyond LADOT's jurisdiction, these pilots can demonstrate how more shared mobility options, better connectivity, and improved interoperability between modes can shift travel behaviors for Angelenos.*

Launch mobility hubs to integrate + connect modes.

LADOT, in partnership with Metro, is piloting a federally funded project to develop ten (10) mobility integrated hubs and dozens of satellite hubs. The vision is to create seamless connectivity between various modes of transportation through a single, integrated platform (LADOT Bike Blog). Mobility hubs, to be located at transit stations and new private developments, are a physical translation of the Mobility as a Service model. These hubs will provide first-last mile connectivity and on-demand services such as bikeshare, carshare, bike repair and storage, fare payment, etc.

LADOT should establish an open toolkit for implementing context-sensitive mobility hubs and the City of Los Angeles should seek to implement this model at strategic public facilities - to serve both Angelenos and City staff and create opportunities with the Department of City Planning for these hubs to be integrated in new developments (e.g. integrate these into the revised Transportation Demand Management Ordinance as proposed earlier). LADOT should identify non-mobility services that could be co-located within the mobility hub model. In Washington D.C., for example, a pilot with the online grocer Peapod is being tested at three stations. This allows transit riders to pick-up fresh groceries on their way home from an on-site attendant between the hours of 4PM to 7PM.

Shifting to new shared modes requires an understanding of the available options and access. While integrating the mobility hub model in private developments will be incredibly valuable to driving adoption, LADOT should identify potential locations at recreation centers, community centers, libraries and other public buildings where it would be appropriate to locate mobility hubs and various shared mobility services such as bikesharing and carsharing for access by the community. This may break down perceptions that private properties (and therefore services) might not be as accessible as a public building.

LADOT should launch an engagement strategy around the preliminary mobility hubs under development and for future expansion to public facilities to understand what people might want to have conveniently co-located at these nodes. Creating a model that can be flexible to different parts of the city - since each neighborhood may have unique requirements - will help establish a model of success (Anzilotti).

Timeline: Request for Proposals Late 2016

LADOT Bike Blog

TRANSPORTATION HAPPINESS
PROVIDE THE ESSENTIALS

El Monte Bike Hub

The El Monte Station, the busiest transit center in the San Gabriel Valley, launched high-capacity bike storage services in September 2015 to make it for cyclists to connect to transit. This full-service center offers secure access, folding bike rentals, repair services, accessory sales and even bicycle education. This is the first of five bike stations planned for the Metro system (Sotero).

Pilot on-demand transit.

LADOT DASH is an affordable neighborhood circulator bus service. Resources are limited, however, to extend this fixed-route, fixed-schedule service to new neighborhoods and limited hours of operation may impede adoption by new riders. For lower density neighborhoods seeking new transportation choices, LADOT should explore a public-private partnership to deploy microtransit services, on-demand shared shuttles, and assess how this might improve connectivity to other transportation modes, shift travel behavior, reduce single occupancy vehicle trips, and ultimately improve customer satisfaction.

LADOT DASH services provide a well-used local bus to help move people quickly around neighborhoods but resources are limited to extend this fixed route, fixed schedule service to cover the entire City of Los Angeles - particularly in areas that are also covered extensively by Metro bus and rail services. DASH also has limited hours of operation which can further limit opportunities to encourage adoption by new riders. If people are not sure the service will be available, they may not seek it out at all.

LADOT should issue a request for proposals to pilot an on-demand microtransit service with a private provider as operator to understand and evaluate its impact on addressing first-last mile connectivity. Microtransit has demonstrated success in less dense neighborhoods and it would be beneficial to LADOT to understand how these operations improve connectivity, how to communicate new service options to the community to encourage adoption, and measure citizen satisfaction and vehicle miles traveled saved with shared mobility. It is recommended that LADOT leverage existing assets as much as possible to support this trial to save on upfront costs while enhancing work already underway. Leveraging platforms such as mobile pay and even trip planning applications such as Go LA could be options for consideration.

A couple of next steps could include: Understand how the City of Santa Monica recently structured its request for proposals to provide first-last mile connectivity; Develop a feasibility study and identify a potential community for the pilot; Launch a request for proposals to identify a platform solution and partner provider; Engage and launch a pilot, supported by community outreach and education wherever possible.

Partners: Microtransit service providers; Metro; other cities in the region (where people may be traveling between two cities, for example); City of Los Angeles staff for vanpool program

Resources: LADOT can learn from the recent deployment by the City of Kansas City, Missouri/Kansas City Area Transportation Authority Bridj Pilot launched in 2015.

Timeline: Could coincide with the launch of mobility hubs.

LADOT

Expand shared services to low-income neighborhoods citywide.

The City of Los Angeles is working to deploy the City's first carsharing fleet of electric vehicles. This initial pilot is already funded by a $1.6 Million California Air Resources Board (CARB) grant. In addition to EV and hybrid fleet vehicles, the program will provide 100 Level 2 charging stations to support the pilot neighborhoods of Downtown Los Angeles, Westlake, Pico-Union, South Los Angeles and Koreatown. LADOT must evaluate regulatory constraints to expanding carsharing services citywide; potential access issues for communities that are "unbanked" or have limited access to technology; and, the challenges of behavior change when introducing a new transportation choice to a population. LADOT will benefit immensely from tracking the progress of this pilot initiative and evaluating how this could potentially be scaled across other disadvantaged neighborhoods.

Shared mobiity can offer households a more cost effective way to move - allowing access as-needed to different modes of transportation in lieu of vehicle ownership. However, there are some barriers as a result of the technology foundation which not only requires access to the Internet, availability of a smartphone, but also requires a bank account and/or credit card. According to a 2013 survey by the FDIC, 9.6% of Angelenos in the greater metropolitan region are unbanked and 17.5% of the population is underbanked (have a bank account, but have also obtained financial services and products from non-bank, alternative financial services (AFS) providers) (FDIC). This can present a challenge when trying to access these platforms and LADOT will need to examine opportunities to extend these services equitably to communities where alternative means of payment and access is necessary.

There are a few ways that have already been tested in other markets to make access to shared services in low-income communities more readily available: permit requirements for equal distribution of shared services across the city (e.g. Washington, D.C.); cash payment options for services like bikeshare and carshare (e.g. Philadelphia); call-in dispatch services to get around the lack of access to a smartphone; nonprofit carsharing models (e.g. Buffalo, NY); subsidies to make the cost of services more affordable. Capturing data and regularly evaluating how these services are meeting the needs of neighborhoods will be essential to identifying the right mix of services, incentives and requirements. Upon completion of the Shared Mobility Action Plan, LADOT should support the expansion of shared mobility services to communities across Los Angeles.

Partners: Shared-Use Mobility Center; National Resources Defense Council; Metro; Private Sector Transportation Service Providers

SlashGear.com

The City of Los Angeles has made a considerable commitment to converting its fleet vehicles to electric vehicles with plans to install more publicly available charging stations. The deployment of an EV carsharing service in low-income communities in Los Angeles will provide valuable insight and opportunity to learn best practices for expansion citywide.

Test smart fares.

Modern fare structures are based on the old systems of tokens and tickets. Today's payment system technology makes it possible to structure fare systems to different market segments, offering greater customization and flexibility in the fare structure. Transportation fares can be customized to the customer as there are different types of riders and system users. This would make buying transportation services more like a cellphone plan where services can be bundled and data purchased as appropriate to the needs of the customer. Smart fares empower the customer to choose from a menu such as off-peak usage, trip chain, frequency of use, and willingness to share their plan with a family member (Davidson), and affords LADOT and other agencies greater flexibility in pricing services.

Understanding how to price services requires greater flexibility in the overall fare structure. One approach is to price transit fares (and therefore revenue) on ridership projections rather than set actual fare prices. This will allow transportation agencies and their marketers to create many price points based on other pricing models, such as the one used by the cell phone industry to encourage the adoption of cell phones (Davidson).

LADOT should establish a framework for testing smart fares by first developing a market segmentation strategy and whitepaper. There are two approaches to market segmentation: pre-determined and market-defined. Pre-determined market segmentation involves the creation of different groups of customers based on known characteristics - often derived from historical data or instinct. Examples of this type of segmentation may include:

- Frequent transit riders, occasional transit riders, and non-transit riders;
- Commuters; non-commuters
- Urban riders; suburban riders;
- Low, moderate and high income riders;
- Geographic or transit analysis zone, etc.

Market-defined segmentation, on the other hand, is created through a survey of market conditions that seeks to predict market responses. In contrast to pre-determined market segmentation, market-defined incorporates patterns of usage, attitudes and perceptions to define segments. This approach can be challenging as it is hard to understand the complexity of segmentation but this approach can be very powerful (Elmore-Yalch). It builds upon aforementioned strategy recommendations to establish both active and passive customer feedback loops to understand the response to existing services. LADOT should collaborate with regional partners, including other transportation agencies and academic institutions, to explore the best approach and launch a pilot to test smart fare strategies for public transit and other modes of shared mobility.

Partners: Academic institutions; bench contractors; LA Mobile program; Metro

Timeline: 2018-2019

Metro/The Source

A special design for the TAP card was created for the launch of bikeshare in Los Angeles in July 2016.

Infrastructure as a Service

Infrastructure as a Service is the idea that the use and access of public infrastructure should be subject to pay-as-you-go user fees that more closely aligns the costs associated with providing the infrastructure itself to how the infrastructure is being used. Since full-scale implementation of this model is contingent on state legislation and requires standardization, these pilots introduce interim ways to deploy technologies to respond more efficiently to changing infrastructure demand while testing public appetite for new approaches.

Deploy temporary car-free zones across the city.

Dense commercial centers could offer opportunities to introduce more car-free streets that limit access for single occupancy vehicles on either a partial (road diet), temporary or permanent basis. LADOT should leverage planned and new infrastructure services such as LED streetlights, protected bike lanes, sidewalks, and roadway resurfacing and painting to expedite road closures and visibly communicate these zones around Los Angeles. CicLAvia, for example, is the largest open streets event in North America (CicLAvia). The CicLAvia Heart of LA route connects six miles of roadway through the neighborhoods of Boyle Heights, the Arts District, Little Tokyo, Civic Center, Chinatown, the Historic Core and Macarthur Park, and could be a potential partner to test implementing infrastructure enhancements to support this regular road closure event making it less costly to host. LADOT should partner with the event organizers and other city departments to develop an implementation plan to quickly execute these changes.

Context: Cities around the world have been piloting initiatives to restrict vehicle access to city centers while others have been successful at it for decades (Miller). Hamburg is creating a "green network" of connected pedestrian areas with no car access which will cover 40% of the city by 2035. While Los Angeles does not have a single city center like many of the cities where these strategies are being implemented, it has increasingly embraced participation in car-free events such as CicLAvia where cyclists and pedestrians take over the public right-of-way for a day of community activities and entertainment. How might LADOT make it easier to host this type of event more regularly and could it potentially inform a longer term policy to adopt permanent car-free zones in some of more transit-rich, denser communities across the city and region?

LADOT should assess and identify potential dense commercial centers for car-free zones in Los Angeles and the available technologies to make it easier and more cost effective to close roads. Areas served by existing public transit networks such as rail or bus, located along bicycle networks and further supported by complete pedestrian infrastructure would be a great place to focus. LADOT should also focus on areas that are frequently closed for large public events in the public right-of-way such as parades, CicLAvia, festivals, and other activities and establish a streamlined process for creating these closures.

As the City of Los Angeles plans for road resurfacing and other infrastructure improvements, LADOT should propose potential digital and physical infrastructure enhancements to make it easier to close down roads for temporary car-free zones. CicLAvia is the largest open streets event in North America (CicLAvia). The CicLAvia Heart of LA route connects six miles of roadway through the neighborhoods of Boyle Heights, the Arts District, Little Tokyo, Civic Center, Chinatown, the Historic Core and Macarthur Park and could be a potential partner to test implementing infrastructure enhancements to support this road closure and make it less costly to host this event regularly. LADOT should partner with the event organizers and other city departments to develop an implementation plan to quickly execute these changes.

LADOT

Ciclavia transforms the public right-of-way in neighborhoods across Los Angeles into car-free streets that are vibrant and engaging.

Test assumptions around roadway capacity + utilization.

Traffic congestion on urban roads and highways has become increasingly problematic. Roughly 40 percent of average travel delays now occur outside normal rush-hour periods. The Texas A&M Transportation Institute studies annually traffic conditions and reports that they are becoming less consistent from day to day, forcing commuters to factor even more "buffer time" into their trips to ensure on-time arrival (FHWA).

Standards define how the public right-of-way is designed and new state policies are requiring new measures that will shift away from level of service (LOS) to vehicle miles traveled (VMT). LADOT is in the process of developing metrics to address this policy shift to be applied as part of the development review process. In the meantime, LADOT should launch a pilot to use available data, and partner to identify new data resources, to test existing assumptions about roadway capacity.

LADOT has access to data through ATSAC, its traffic management center, and other regional systems and partnerships that could validate our assumptions about how we use our roads during peak and off-peak periods. LADOT should capture and analyze this data around speed and traffic counts to develop an annual review of roadway capacity as a benchmark for future changes to land use, transportation modes, and roadway design. This will also provide valuable groundtruthing to the assumptions behind the synchronization of our traffic signals and create an opportunity for feedback that can

help improve ATSAC operations for better mobility.

The ATSAC team has done extensive work on signal synchronization and adaptive signal control (ASCT) which adjusts the timing of lights to accommodate changing traffic patterns. The benefits of ASCT are that it equitably distributes green light timing for all traffic movements; improves travel time reliability by progressivel moving vehicles through green lights; prolongs the effectiveness of traffic signals and their associated timing; and reduces emissions due to improved traffic flow (FHWA). Testing these assumptions through data validation will create opportunities for continuous improvement in this system.

Finally, as in the Paris example (see page 54), there are other sensors and tools available for detecting other users of the public right-of-way, such as cyclists and pedestrians, that can be permanently or temporarily installed. As the Vision Zero team establishes its action plan, for instance, the City of Los Angeles could deploy temporary smart city sensors to understand how Angelenos are using the public right-of-way around the High Injury Network.

Partners: Metro, Coalition for Transportation Technology, Vision Zero Team

Resources: LADOT could pursue grants from Metro, the South Coast Air Quality Management District or the federal government.

Timeline: 2017-2018

LADOT

Bureau of Street Lighting

Identify new infrastructure assessment tools.

The City of Boston developed a smartphone app that reports to the city when someone drives over a pothole. This model requires the participation of the broader community or even participation of city staff as they move around Los Angeles for work, but outlines a potential opportunity for a much larger network to help the City of Los Angeles understand the conditions of its expansive infrastructure. Alternatively, what if the City's fleet of service vehicles and transit buses could collect real-time infrastructure condition information to update asset inventories regularly? This data would be valuable not only for the prioritization of public right-of-way improvements, but also for future automated vehicles, which will need clear roadway striping and signage to make it easier to navigate across Los Angeles. LADOT should issue a Request for Information (RFI) to assess potential solutions and consider a pilot deployment.

As described in the parking inventory pilot proposal, Sidewalk Labs' Flow has partnered with Google Imagery, for example, to explore the development of parking data inventories which could be expanded to include other assets in the public right-of-way. In very simple terms, the technology scans the inventory of available Google images such as Google maps and Google Street View to detect and read elements. LADOT should consider expanding its parking inventory pilot to include other assets such as signage, bike and bus lanes, and other assets in the public right-of-way. In addition to the parking

inventory, Sidewalk Labs has partnered with the City of Los Angeles to do a pilot to inventory street trees, a critical amenity to providing shade for pedestrians, cyclists and people waiting for shared mobility transport, including public transit.

Since infrastructure data is essential to the operations of multiple departments, LADOT should consider partnering across departments to pool together resources and capacity to deploy this pilot. The City of Los Angeles could issue a joint-request for information to understand what capabilities are already available while also inviting partners to develop new approaches with Los Angeles as the demonstration site.

Partners: Other City of Los Angeles Departments; Sidewalk Labs

Resources: City of Los Angeles Innovation Fund

Timeline: 2017-2018

Launch an AV pilot.

Public transit as shared mobility that operates on a fixed schedule and route can provide considerable opportunity to introduce connected and automated vehicles to the public right-of-way in Los Angeles. With LADOT's commitment to addressing safety and protecting the environment, the application of automated vehicle technologies in the public transit realm could have a significant impact and should be evaluated as an opportunity to introduce this technology at scale to the community. This introduction will help LADOT understand barriers to how the public might perceive automated vehicles, explore opportunities for connecting to infrastructure and providing real-time information, create new roles for transit drivers whose roles will adapt as this technology matures, as well as promoted shared mobility by offering a novel but increasingly more important transportation technology to the public right-of-way.

Alternatively, the City has a large fleet of vehicles that support a variety of operations citywide. As a follow-up to the transportation technology strategy fellowship, LADOT will be hiring a FUSE Fellow in October 2016 to develop a business plan for the City of Los Angeles to deploy a municipal fleet of connected and automated vehicles, and will evaluate the trade-offs of either application. LADOT should plan to pilot a deployment as a test of the business plan and consider coupling the pilot with connected infrastructure.

However, LADOT does not need to wait until a plan has been established to encourage and welcome an AV pilot in Los Angeles. Ride-hailing services such as Lyft (in a partnership with General Motors) and Uber have both been moving towards deploying automated vehicles in their fleets.

Partners: Coalition for Transportation Technology; Automanufacturers and Technology Companies; Ride-hailing services; Taxi Franchises

Resources: There have been several federal funding opportunities to support test beds and pilots of conneced vehicle technology. LADOT should also seek out public-private partnerships and encourage demonstrations in Los Angeles.

Timeline: Ongoing

Pilot an AV network on city streets to incentivize shared modes.

As of 2014, Metro reported that the Los Angeles County averaged 1.4 million boardings a weekday, making it one of the largest transit agencies in the nation. Performance, convenience and comfort are key factors in improving the transportation experience. The introduction of automated vehicles affords LADOT the opportunity to think differently about system efficiency and how to incentivize shared mobility, shift in travel behaviors, and ultimately rethink how to fund infrastructure in the future. An AV network would provide supportive connected infrastructure for real-time data exchange, improved roadway conditions to support sensor detection capabilities, clear signage and prioritized signalization, and potentially a dedicated lane for shared vehicles.

The Mobility Plan 2035 outlines the development of a Transit Enhanced Network that will be developed over time with other transit providers in the region with the intent of: provide reliable and frequent transit service that is convenient and safe; increase transit mode share; reduce single-occupancy vehicle trips; and integrate transit infrastructure with the identify of the surrounding street (Mobility Plan, 82). The Vehicle Enhanced Network identifies 79 miles of arterials critical to both regional and local circulation; these roads provide access to highways and essential facilities. These streets prioritize vehicular movement with the intent to provide reliable travel times and consistent travel speeds (Mobility Plan, 84). These two networks, once completed, are optimal locations for the prioritization of connected infrastructure and deployment of an AV road network. By prioritizing a specific network, LADOT will be able to focus limited resources on the deployment of connected infrastructure to support AVs. This technology can also be helpful in providing support for early strategies in cordon pricing, local street HOV (high occupancy vehicles) lanes, and other Infrastructure as a Service pricing strategies.

Cities around the globe have implemented road pricing models to help discourage single occupancy vehicles, encourage more fuel-efficient vehicles, and promote a mode shift to more shared mobility. The peak travel periods in Los Angeles see considerable congestion, which could be mitigated by implementing a road pricing pilot on the most congested roads. This pilot will require state support but is an opportunity to test new incentives to help LADOT and the City of Los Angeles meet goals for increased mobility, lower emissions, and improved safety.

Partners: State of California, Federal Government, Private Sector

Resources: ATSAC, RIITS

LADOT

ADDITIONAL CONSIDERATIONS
MOBILITY PLAN OBJECTIVES

The Mobility Plan 2035 outlines several objectives which this proposed pilot can help to address, including:

- Provide 95% on-time arrival reliability of buses traveling on the Transit Enhanced Network by 2035. Establish an off-peak 5 minute bus frequency on 25% of the Transit Enhanced Network by 2035.

- Increase vehicular travel time reliability on all segments of the Vehicle Enhanced Network by 2035.

- Maintain the Automated Traffic Control Surveillance and Control System (ATSAC) Communications Network.

CONCLUSION

Conclusion

The advent of the smartphone, access to the Internet and the proliferation of apps will continue to radically reshape our urban transportation systems by increasing system efficiency, better connecting and expanding first-last mile options, and providing more choices to Angelenos than ever before. The accelerated advancement of connected and automated vehicle technologies in the last few years will continue to challenge how we think about our public right-of-way, safety and an entire market sector built around traditional car ownership. The rate of these technological changes far outpace the demands they will place on our physical infrastructure and built environment - leaving growing metropolises such as Los Angeles at risk of missing out on the great opportunities to create more livable communities.

LADOT proactively sought external resources through a partnership with the Goldhirsh Foundation and the Mayor's Fund of Los Angeles to develop a forward-looking transportation technology strategy with the understanding that technological innovation is reshaping transportation today and creating opportunities for tomorrow. Shared mobility and other technology-enabled private transport services are now competing with traditional public transit and taxi services, quickly evolving to meet growing demand and changing travel behaviors. As the mobility marketplace is changing - and the suit of available choices evolves - the function of a 21st Century department of transportation must quickly adapt. LADOT is reshaping itself to serve the function of a mobility manager. The city of future will require not just a service provider and infrastructure manager; LADOT will need to serve the critical function of connecting services; ensuring public safety; regulating quality and access; and providing equity where the market might otherwise leave people behind.

By looking forward and preparing now for future changes, the City can better leverage technology to make transportation more accessible, equitable, convenient, affordable, safer and better connected. LADOT must accelerate its role in planning for the impacts and benefits of shared mobility, automated vehicles and other transportation technologies by transforming into a platform for transportation innovation so to meet policy objectives and create truly great streets for all Angelenos.

The strategy has defined several core goals to evolve LADOT into a platform for Data, Mobility and Infrastructure as a Service. These goals include:

1. Build a solid data foundation.
2. Leverage tech + design for a better transportation experience.
3. Create partnerships for more shared services.
4. Establish feedback loops for services + infrastructure.
5. Prepare for an automated future.

This strategy defines a series of policies, short and long term actions and several pilot and demonstration projects that will help set a new course for LADOT to manage this new mobility marketplace. With an emphasis on understanding the user experience - and creating a metric for transportation happiness - *Urban Mobility in a Digital Age* is the genesis of an ever-evolving platform for the City of Los Angeles to use as new transportation technologies emerge; travel behaviors change; and new regulatory frameworks are established. While this strategy does not predict the future, it anticipates a future of greater choice and mobility for all residents and visitors.

REFERENCES

References

AAA. (Retrieved 2016, July). *Lane Departure Warning Systems*. Retrieved from AAA Foundation. https://www.aaafoundation.org/lane-departure-warning-system

Adler, L. (2016, February 18). *How Smart City Barcelona Brought the Internet of Things to Life*. Retrieved from *Data-Smart City Solutions*. http://datasmart.ash.harvard.edu/news/article/how-smart-city-barcelona-brought-the-internet-of-things-to-life-789

AECOM Global Cities Institute. (2012). *Auckland, Connected*. Retrieved from AECOM. http://www.aecom.com/content/wp-content/uploads/sites/2/2015/10/AECOM_Cities_Auckland-Connected.pdf

American Petroleum Institute. (2016, April 1). *Gasoline Taxes: Combined Local State and Federal (Cents Per Gallon)*. Retrieved from API. http://www.api.org/~/media/Files/Statistics/Gasoline-Tax-Map.pdf

Andersen, M. (2015, September 22). *Massachusetts' Bikeway Design Guide Will Be Nation's Most Advanced Yet*. Retrieved from StreetsBlog USA. http://usa.streetsblog.org/2015/09/22/massachusetts-new-bikeway-design-guide-will-be-nations-most-advanced-yet/

Andersen, M. (2015, October 6). *Salt Lake City Cuts Car Parking, Adds Bike Lanes, Sees Retail Boost*. Retrieved from StreetsBlog USA. http://usa.streetsblog.org/2015/10/06/salt-lake-city-cuts-car-parking-adds-bike-lanes-sees-retail-boost/

Anderson, M. (2015, October 29). Technology Device Ownership: 2015. Retrieved from Pew Research Center. http://www.pewinternet.org/2015/10/29/technology-device-ownership-2015/

Anderson, J.M., Kalra, N., Stanley, K.D., Sorenson, P., Samaras, C., & Oluwatola, O.A. (2014). *Autonomous Vehicle Technology: A Guide for Policymakers.* Retrieved from The Rand Corporation. http://www.rand.org/content/dam/rand/pubs/research_reports/RR400/RR443-1/RAND_RR443-1.pdf

Anzilotti, E. (2016, March 4). *Your Groceries Could Meet You When You Step Off the Train*. Retrieved from CityLab. http://www.citylab.com/navigator/2016/03/now-you-can-collect-your-groceries-as-soon-as-you-step-off-the-train/472185/

METRANS Transportation Center. (2014). *Archived Data Management System (ADMS)*. Retrieved from METRANS Transportation Center. https://www.metrans.org/archived-data-management-system-adms

Arthur D. Little Future Lab. (2014, January). *The Future of Urban Mobility 2.0: Imperatives to shape extended mobility ecosystems of tomorrow.* Retrieved from Arthur D. Little. http://www.uitp.org/sites/default/files/members/140124%20Arthur%20D.%20Little%20%26%20UITP_Future%20of%20Urban%20Mobility%202%200_Full%20study.pdf

Atkinson, W. (2014, August). *Austin Turns to Crowdsourcing to Improve Traffic Congestion*. Retrieved from Government Technology. http://www.govtech.com/transportation/Austin-Turns-to-Crowdsourcing-to-Improve-Traffic-Congestion.html

Automobile Association of America. (2016, April 7). *Driving Costs Hit Six-Year Low Finds AAA*. Retrieved from AAA News Room. http://newsroom.aaa.com/auto/your-driving-costs/

Barragan, B. (2015, March 18). *How Much Does Los Angeles Have to Build to Get Out of Its Housing Crisis?* Retrieved from Curbed Los Angeles. http://la.curbed.com/2015/3/18/9979526/housing-crisis-los-angeles-construction

Bialick, A. (2015, March). *SFMTA to Install Three More Digital Bicycle Counters*. Retrieved from *StreetsBlog SF*. http://sf.streetsblog.org/2015/03/24/sfmta-to-install-three-more-digital-bicycle-counters/

Bouton, S., Knupfer, S.M., Mihov, I., & Swartz, S. (2015, September). *Urban mobility at a tipping point*. Retrieved from McKinsey & Company. http://www.mckinsey.com/business-functions/sustainability-and-resource-productivity/our-insights/urban-mobility-at-a-tipping-point

Brower, P. (2015, November 6). *Magic Pool Bus: The rise of microtransit puts public transit access at a crossroads*. Retrieved from Brown Political Review.

http://www.brownpoliticalreview.org/2015/11/magic-pool-bus-the-rise-of-microtransit-puts-public-transit-access-at-a-crossroads/

Brustein, J. (2014, May 16). Helsinki's Uber for Buses Is Stuck in First Gear. Retrieved from Bloomberg Business. http://www.bloomberg.com/bw/articles/2014-05-16/helsinkis-uber-for-buses-is-stuck-in-first-gear#p2

Campbell-Dollaghan, K. (2015, September 30). The Best Ways to Get to Work, According to Science. Retrieved from Gizmodo. http://gizmodo.com/the-best-ways-to-get-to-work-according-to-science-1733796033

Cavoukian, A. (2011, January). *Privacy by Design: The 7 Foundational Principles*. Retrieved from Information and Privacy Commissioner of Ontario. https://www.ipc.on.ca/images/Resources/7foundationalprinciples.pdf

Chasan, E. (2016, March 11). Why Your Boss Hates Your Commute More Than You Do. Retrieved from Bloomberg Business. http://www.bloomberg.com/news/articles/2016-03-11/why-your-boss-hates-your-commute-more-than-you-do

Chieppo, C. (2015, December). *What's a Fair Fare?* Retrieved from Governing. http://www.governing.com/blogs/bfc/col-public-transportation-income-based-fare-discounts.html

CicLAvia. (2015). *CicLAvia - Heart of LA*. Retrieved from CicLAvia. http://www.ciclavia.org/ciclavia_hola15

City of Cambridge, MA. (2011) *Parking and Transportation Demand Management Ordinance*. Retrieved from the City of Cambridge. http://www.cambridgema.gov/CDD/Transportation/fordevelopers/ptdm

City of Los Angeles. (2015). *EV Car Sharing Pilot for Disadvantaged Communities: City of Los Angeles*. Retrieved from California State Senate. http://sd24.senate.ca.gov/sites/sd24.senate.ca.gov/files/EV%20Carsharing%20Pilot.pdf

City of Los Angeles. (2015). *From our Mayor*. Retrieved from *Vision Zero Los Angeles*. http://visionzero.lacity.org/from-our-mayor/

City of Los Angeles. (2013, December 3). *Housing Element 2013-2021*. Retrieved from Los Angeles Department of City Planning. http://cityplanning.lacity.org/HousingInitiatives/HousingElement/TOCHousingElement.htm

City of Los Angeles. (2016, January 20). *Mobility Plan 2035: An Element of the General Plan*. Retrieved from LA2b.org. https://losangeles2b.files.wordpress.com/2012/12/mobilityplan_web_jan_2016v61.pdf

City of New York. (Retrieved 2016, August 6). *Bus Lane Camera Violations*. Retrieved from the City of New York. http://www1.nyc.gov/nyc-resources/service/1286/bus-lane-camera-violations

Cortese, A. (2015, July 10). *Putting the Public Back in Public Finance*. Retrieved from The New York Times. http://www.nytimes.com/2015/07/12/business/mutfund/putting-the-public-back-in-public-finance.html?_r=0

Davidson, A. (2014, March 10). *What If We Sold Transit Fares Like Cell-Phone Minutes?* Retrieved from Mobility Lab. http://mobilitylab.org/2014/03/10/what-if-we-sold-transit-fares-like-cell-phone-minutes/

D'Costa, K. (2013, April). *Choice, Control, Freedom and Car Ownership*. Retrieved from Scientific American. http://blogs.scientificamerican.com/anthropology-in-practice/choice-control-freedom-and-car-ownership/

Dopart, K. (2015, July). *U.S. DOT Automation Program*. Retrieved from U.S. Department of Transportation. http://www.its.dot.gov/presentations/AVS2015/AVS15_Dopart.pdf

Drevs, F., Tscheulin, D.K., Lindenmeier, J., Renner, S. (2014, January). *Crowding-in or crowding out: An empirical analysis on the effect of subsidies on the willingness-to-pay for public transportation*. Retrieved from Science Direct. http://www.sciencedirect.com/science/article/pii/S0965856413002115

Duarte, A., Garcia, C., Giannarakis, G., Limão, S., Polydoropoulou, A., Litinas, N. (2009, May 9). *New approaches in transporttion planning: happiness and transport economics*. Retrieved from Netnomics: Economic Research and Electronic Networking. http://link.springer.com/article/10.1007/s11066-009-9037-2

Ecola, L. (2015, July 22). *Pay as You Go*. Retrieved from the Rand Corporation Blog. http://www.rand.org/blog/2015/07/pay-as-you-go.html

Eidlin, E. (2010, Fall). *What Density Doesn't Tell Us About Sprawl*. Retrieved from Access Magazine. http://www.accessmagazine.org/articles/fall-2010/density-doesnt-tell-us-sprawl/

Elmore-Yalch, R. (1998). *Report 36: A Handbook: Using Market Segmentation to Increase Transit Ridership*. Retrieved from the Transit Cooperative Research Program. http://www.tcrponline.org/PDFDocuments/TCRP%20RPT%2036-A.pdf

Engel, E., Fischer, R., Galetovic, A. (2011, February). *Public-Private Partnership to Revamp U.S. Infrastructure*. Retrieved from The Brookings Institute. https://www.brookings.edu/research/public-private-partnerships-to-revamp-u-s-infrastructure/

Eno Center for Transportation. (2013, October). *Preparing a Nation for Autonomous Vehicles: Opportunities, Barriers and Policy Recommendations.* Retrieved from Eno Center for Transportation. https://www.enotrans.org/wp-content/uploads/2015/09/AV-paper.pdf

FDIC. (2014, October). *2013 FDIC National Survey of Unbanked and Underbanked Households*. Retrieved from EconomicInclusion.gov. https://www.economicinclusion.gov/

Federal Highway Administration. (Retrieved 2016). *Transportation and Housing Costs. Retrieved from FHWA*. http://www.fhwa.dot.gov/livability/fact_sheets/transandhousing.pdf

Federal Highway Administration. (2014, September). *The FHWA 2015 R&T Story: Improving the Mobility of People and Goods*. Retrieved from FHWA. http://www.fhwa.dot.gov/publications/research/general/14091/003.cfm

Frank L.D., Anderson, M., Schmid, T. (2004). *Obesity relationships with community design, physical activity, and time spent in cars*. Retrieved from American Journal of Preventive Medicine. http://www.sciencedirect.com/science/article/pii/S074937970400087X.

Galbraith, K. (2015, December 14). *Gas tax in California ranks among highest in country; but its roads are among the worst in America*. Retrieved from The Orange County Register. http://www.ocregister.com/articles/state-696048-gas-tax.html

Galbraith, K. (2015, December 14). *On crowded roads, technology offers hope*. Retrieved from The Bakersfield Californian. http://www.bakersfield.com/News/2015/12/14/On-crowded-roads-technology-offers-hope.html

Gao, P., Kaas, H.W., Mohr, D., Wee, D. (2016, January). *Disruptive trends that will transform the auto industry*. Retrieved from McKinsey & Company. http://www.mckinsey.com/industries/high-tech/our-insights/disruptive-trends-that-will-transform-the-auto-industry?cid=other-eml-alt-mip-mck-oth-1602

Garfield, L. (2015, October 30). *8 cities that are starting to go car-free*. Retrieved from Tech Insider. http://www.techinsider.io/cities-starting-to-ban-cars-2015-10

Gattis, T. (2016, February 16). *How to fix Houston traffic? Let's talk MaX Lanes*. Retrieved from Houston Chronicle. http://www.houstonchronicle.com/local/gray-matters/article/How-to-fix-Houston-traffic-Let-s-talk-MaX-Lanes-6832229.php

Gelt, J. (2015, September 9). *'Hopscotch,' the world's first mobile opera will take to L.A. streets in 24 cars*. Retrieved from The Los Angeles Times. http://www.latimes.com/entertainment/arts/la-ca-cm-fall-arts-hopscotch-opera-la-20150913-story.html

GoMentum Station. (2015, October 15). *EasyMile and GoMentum Station Announce Exclusive Agreement*. Retrieved from GoMentum Station. http://gomentumstation.net/wp-content/uploads/2015/10/Press-Release-Easymile-Gomentum-Station-Announce-Exclusive-Agreement-October-5-2015-1.pdf

GovTech. (2016, January 14). *Lyft Looks to Open Services to Seniors Without Smartphones*. Retrieved from GovTech. http://www.govtech.com/fs/Lyft-Looks-to-Open-Services-to-Seniors-Without-Smartphones.html

GovTech. (2016, January 14). *U.S. DOT to Release Model Policy for Regulating Self-Driving Cars, Fund $4B in Research*. Retrieved from GovTech. http://www.govtech.com/fs/US-DOT-to-Release-Model-Policy-for-Regulating-Self-Driving-Cars-Fund-4B-in-Research.html

Great Streets. (Retrieved 2016). *A Message from Mayor Eric Garcetti*. Retrieved from LAGreatStreets.org. http://www.lagreatstreets.org/letter-from-mayor

Green Parking Council. (Retrieved 2016). *What is Shared Parking?* Retrieved from Green Parking Council. http://www.greenparkingcouncil.org/featured/shared-parking/

Greenfield, A. (2014, January). *Helsinki's ambitious plan to make car ownership pointless in 10 years*. Retrieved from The Guardian. http://www.theguardian.com/cities/2014/jul/10/helsinki-shared-public-transport-plan-car-ownership-pointless

Gurley, G. (2016, January 12). *Bridj revs up: Private bus company looks to supplement, not replace, MBTA service*. Retrieved from Commonwealth Magazine. http://commonwealthmagazine.org/transportation/bridj-revs-up/

Haj-Assaad, S. (2014, August 19). *Lane Departure Safety Systems: What you Need to Know*. Retrieved from AutoGuide. http://www.autoguide.com/auto-news/2014/08/lane-departure-safety-systems-passive-vs-active.html

LADOT/Michael Dinh

Hamilton, D. (1987, July 9). *Pedestrian Tunnels Become Dangerous, Dank*. Retrieved from the Los Angeles Times. http://articles.latimes.com/1987-07-09/news/gl-2888_1_tunnels

Hartgen, D.T., Fields, M.G., & Feigenbaum, B. (2014) *21st Annual Report on the Performance of State Highway Systems (1984-2012)*. Retrieved from The Reason Foundation. https://reason.org/files/21st_annual_highway_report.pdf

Hathaway, O.A. (2003). *Path Dependence in the Law: The Course and Pattern of Legal Change in a Common Law System*. Retrieved from John M. Olin Center for Studies in Law, Economics, and Public Policy Working Papers. http://digitalcommons.law.yale.edu/lepp_papers/270

Hertz, D. (2016, March 16). *Subsidizing Uber for the 'Last Mile'? An Orlando Suburb Is Trying It*. Retrieved from *Streetsblog USA*. http://usa.streetsblog.org/2016/03/16/subsidizing-uber-for-the-last-mile-an-orlando-suburb-is-trying-it/

HUD Exchange. (Accessed 2016, August 1). *Los Angeles Promise Zone: City of Los Angeles, California*. Retrieved from HUD Exchange. https://www.hudexchange.info/onecpd/assets/File/Promise-Zones-Designee-Los-Angeles.pdf

HUD Exchange. (Accessed 2016, August 1). *South Los Angeles Transit Empowerment Zone: Third Round*. Retrieved from HUD Exchange. http://portal.hud.gov/hudportal/documents/huddoc?id=South_Los_Angeles_Zone_3rd.pdf

Huet, E. (2016, February 16). *Can These New Startups Convince Americans to Carpool?* Retrieved from Bloomberg Businessweek. http://www.bloomberg.com/news/articles/2016-02-16/can-these-new-startups-convince-americans-to-carpool

Integrated Transport Planning Ltd. (2015, March). *The Transport Data Revolution: Investigation into the data required to support and drive intelligent mobility.* Retrieved from Catapult Transport Systems. https://ts.catapult.org.uk/documents/10631/169582/The+Transport+Data+Revolution/99e9d52f-08a7-402d-b726-90c4622bf09d

Intelligent Transportation Society of Virginia. (2016) *Connected and Automated Vehicle Program Manager*. Retrieved from ITVA. https://www.itsva.org/job/the-virginia-department-of-transportation-richmond-va-321-connected-and-automated-vehicle-program-manager/

Isaac, L. (2015, July). *How Local Governments Can Plan for Driverless Cars*. TRB Automated Vehicle Symposium. http://www.auvsi.org/avs2015/program/si-posters

Jaffe, E. (2015, July 1). *18 Reasons America Should Adopt a Per-Mile Driving Fee*. Retrieved from CityLab. http://www.citylab.com/cityfixer/2015/07/18-reasons-america-should-adopt-a-per-mile-driving-fee/397331/

Jaffe, E. (2012, December 12). *Even American Drivers Like Mass Transit More Than They Think*. Retrieved from CityLab. http://www.citylab.com/commute/2012/12/even-american-drivers-mass-transit-more-they-think/4142/

LADOT

Jaffe, E. (2015, October 27). *How Panasonic Turned Car Commuters Into Transit Riders*. Retrieved from CityLab. http://www.citylab.com/cityfixer/2015/10/how-panasonic-turned-car-commuters-into-transit-riders/412417/?utm_source=nl__link3_102715

Jaffe, E. (2012, December 14). *Traffic James, Solved*. Retrieved from CityLab. http://www.citylab.com/commute/2012/12/traffic-jams-solved/4160/

Jones, S.T. (2014, May 23). *Does carsharing really reduce overall driving? (SFBG)*. Retrieved from Shared-Use Mobility Center. http://sharedusemobilitycenter.org/news/does-carsharing-really-reduce-overall-driving-sfbg/

Kelly, E. (2016, February 4). *Helsinki's ambitious Uber for buses experiment has failed. What went wrong?* Retrieved from Science Business. http://www.sciencebusiness.net/news/77416/Helsinki%E2%80%99s-ambitious-Uber-for-buses-experiment-has-failed.-What-went-wrong

Kinney, J. (2015, July 29). *Forget Yards, Metro Homebuyers Are Looking for Good Sidewalks*. Retrieved from Next City. https://nextcity.org/daily/entry/metro-homebuyers-want-sidewalks-walkable-communities

Kong, K. (2016, December 14). *Helping commuters 'Shift' their commute in San Diego*. Retrieved from Steer Davies Gleave. http://na.steerdaviesgleave.com/news-and-insights/helping-commuters-Shift-their-commute-in-San-Diego

LADOT. (2016) *LA Mobile - LA Mobile Ticketing*. Retrieved from LADOT Transit. http://www.ladottransit.com/lamobile

LADOT. (2012) *Live Traffic Information: About Us*. Retrieved from TrafficInfo. http://trafficinfo.lacity.org/about-atsac.php

LADOT Bike Blog. (2015, October 21). *Mobility Hubs in Los Angeles: Emerging Nodes of Transportation*. Retrieved from LADOT Bike Blog. https://ladotbikeblog.wordpress.com/2015/10/21/mobility-hubs-in-los-angeles-emerging-nodes-of-transportation/

Leber, J. (2016, February 16). *Uber's CEO Wants to Reshape Cities Through Carpooling, If Only Cities Would Let Him*. Retrieved from Co.Exist. http://www.fastcoexist.com/3056770/ubers-ceo-wants-to-reshape-cities-through-carpooling-if-only-cities-would-let-him

Lelinwalla, M. (2015, January 12). *Lyft to Give Rides to Seniors So They Can Make Their Physician Appointments*. Retrieved from Tech Times. http://www.techtimes.com/articles/123907/20160112/lyft-give-free-rides-seniors-make-physician-appointments.htm

Linton, J. (2015, August 24). *Garcetti Signs Vision Zero Director to End L.A. Traffic Deaths by 2025*. Retrieved from StreetsBlog LA. http://la.streetsblog.org/2015/08/24/garcetti-signs-vision-zero-directive-to-end-traffic-deaths-by-2025/

Linton, J. (2016, January 29). *What Factors Are Causing Metro's Declining Ridership? What Next?* Retrieved from StreetsBlog L.A. http://la.streetsblog.org/2016/01/29/what-factors-are-causing-metros-declining-ridership-what-next/

Ly, K., Mažar, N., Zhao, M. & Sonam, D. (2013, March 15). *A Practitioner's Guide to Nudging*. Retrieved from Rotman School of Management, University of Toronto. https://www.utoronto.ca/news/practitioners-guide-nudging

Manville, M., Shoup, D. (2004) *People, Parking, and Cities*. Retrieved from UCLA.edu. http://shoup.bol.ucla.edu/People,Parking,Cities.pdf

MaaS Alliance. (2015). *The European Mobility-as-a-Service Alliance has been launched*. Retrieved from MaaS Alliance. http://maas-alliance.eu

Madans, J. (2013, June 23). *If these walls could talk: The case for open housing data*. Retrieved from Code for America Blogging for America. http://www.codeforamerica.org/blog/2013/06/23/if-these-walls-could-talk-the-case-for-open-housing-data/

Marshall, A. (2016, February 25). *Mapping the Real Cost of Public Housing - Transportation Included*. Retrieved from CityLab. http://www.citylab.com/commute/2016/02/mapping-the-real-cost-of-public-housingtransportation-included/470904/

Martin, E., Shaheen, S. (2016, July). *Impacts of Car2Go on Vehicle Ownership, Modal Shift, Vehicle Miles Traveled, and Greenhouse Gas Emissions: An Analysis of Five North American Cities*. Retrieved from InnovativeMobility.org. http://innovativemobility.org/wp-content/uploads/2016/07/Impactsofcar2go_FiveCities_2016.pdf

Martin, E., Shaheen, S.A., & Lidicker, J. (2010). *Impact of Carsharing on Household Vehicle Holdings: Results from North American Shared-Use Vehicle Survey*. Retrieved from SF Park. http://sfpark.org/wp-content/uploads/carshare/Impact_of_Carsharing_on_Household_Vehicle_Holdings.pdf

Martin, H. (2015, May 5). *Los Angeles and California break tourism records in 2014*. Retrieved from The Los Angeles Times. http://www.latimes.com/business/la-fi-los-angeles-california-tourism-2014-20150505-story.html

McCollom, B.E. (2004). *Traveler Response to Transportation System Changes: Chapter 12 - Transit Pricing and Fares*. Retrieved from the Transportation Research Board. http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_95c12.pdf

McGuffin, K. (2013, April 3). *A Practitioner's Guide to Nudging: Rotman School offers some tips*. Retrieved from University of Toronto News. https://www.utoronto.ca/news/practitioners-guide-nudging

Metropolitan Transportation Commission. (2016, April 6). *There's an App for That: MTC Partners With Private Sector to Expand Carpooling*. Retrieved from MTC News. http://mtc.ca.gov/whats-happening/news/theres-app-mtc-partners-private-sector-expand-carpooling

Metz, C. (2015, September 3). *Laser Breakthrough Could Speed the Rise of Self-Driving Cars*. Retrieved from Wired Magazine. http://www.wired.com/2015/09/laser-breakthrough-speed-rise-self-driving-cars/

Miller, B. (2015, October 7). *5 Tech Tools Governments Can Use to Alleviate Traffic Troubles*. Retrieved from GovTech. http://www.govtech.com/fs/5-Tech-Tools-Governments-Can-Use-to-Alleviate-Traffic-Troubles.html

Miller, J. (2013). *Infrastructure 2013: Global Priorities, Global Insights*. Retrieved from Ernst & Young. http://www.ey.com/Publication/vwLUAssets/Infrastructure_2013/$FILE/Infrastructure_2013.pdf

Mitchell, A. (2015, July 22). *World Economic Forum: Multi-Stakeholder Cooperation on Self-Driving Vehicles*. Retrieved from TRB Automated Vehicle Symposium. http://www.auvsi.org/avs2015/program/wednesday

Mondschein, A. (2014, August). *Re-Programming Mobility Literature Review*. Retrieved from Re-Programming Mobility. http://reprogrammingmobility.org/wp-content/uploads/2014/09/ReProgrammingMobility-LitReview-08.04.2014.pdf

Montgomery, C. (2014, September 28). *Commuting for Happiness.* Retrieved from Happy City. http://thehappycitylab.com/commuting-happiness/

Morozov, E. (2016, January 30). *Cheap cab ride? You must have missed Uber's true cost*. Retrieved from The Guardian. http://www.theguardian.com/commentisfree/2016/jan/31/cheap-cab-ride-uber-true-cost-google-wealth-taxation

Muharemovic, I. (2015, July 22). *Automated Driving*. Retrieved from TRB Automated Vehicle Symposium. http://www.auvsi.org/avs2015/program/wednesday

Muoio, D. (2015, December 21). *Why Europe might get driverless cars before the US*. Retrieved from Tech Insider. http://www.techinsider.io/citymobil2-brings-driverless-cars-to-eu-2015-12

National Association of City Transportation Officials. (2016, June). *Ride-Hailing Services: Opportunities & Challenges for Cities*. Retrieved from NACTO. http://nacto.org/policy-2016/ride-hailing-services-opportunities-and-challenges/

National Association of City Transportation Officials. (2016, June). *NACTO Policy Statement on Automated Vehicles*. Retrieved from NACTO. http://nacto.org/wp-content/uploads/2016/06/NACTO-Policy-Automated-Vehicles-201606.pdf

National Highway Traffic Safety Administration. (2013, May 30). *U.S. Department of Transportation Releases Policy on Automated Vehicle Development*. Retrieved from NHTSA. http://www.nhtsa.gov/About+NHTSA/Press+Releases/U.S.+Department+of+Transportation+Releases+Policy+on+Automated+Vehicle+Development

National League of Cities. (2013) *Parking and Transportation Demand Management*. Retrieved from the NLC Sustainable Cities Institute. http://www.sustainablecitiesinstitute.org/topics/transportation/traffic-calming-and-traffic-management/parking-and-transportation-demand-management

Neumann, C. (2015, July). *Big data versus big congestion: Using information to improve transport*. Retrieved from McKinsey & Company. http://www.mckinsey.com/industries/infrastructure/our-insights/big-data-versus-big-congestion-using-information-to-improve-transport

Newcombe, T. (2014, June 4). *Beyond Congestion Pricing: Reducing Traffic Problems by Changing People's Commuting Habits*. Retrieved from *Governing*. http://www.governing.com/news/headlines/beyond-congestion-pricing-reducing-traffic-problems-by-changing-commuting-habits.html

O'Brien, T.M. (2015, October). *Peak Academy Performance Audit*. Retrieved from the City and County of Denver, Office of the Auditor. https://www.denvergov.org/content/dam/denvergov/Portals/741/documents/Audits_2015/PeakAcademyAuditReport_10-15-15.pdf

O'Sullivan, F. (2016, March 8). *A Finnish City Is Giving Drivers Free Fares to Take the Bus*. Retrieved from CityLab. http://www.citylab.com/cityfixer/2016/03/turku-finland-free-bus-fare-drivers-transit/472746/?utm_source=nl__link5_030816

O'Sullivan, F. (2015, December 16). *Milan's Quick Fix for Bad Smog: Cheap Public Transportation*. Retrieved from CityLab. http://www.citylab.com/cityfixer/2015/12/milan-public-transportation-pollution-smog/420639/

O'Sullivan, F. (2015, December 23). *Stockholm's 'Reverse' Congestion Charge Would Pay Cyclists With Driving Fees*. Retrieved from CityLab. http://www.citylab.com/cityfixer/2015/12/stockholm-reverse-congestion-charge-cyclists-driving/421767/

Perch, J. (2015, March 2). *Smart Roads Can Help Fix America's Crumbling Infrastructure*. Retrieved from DMV.com. https://www.dmv.com/blog/smart-roads-can-help-fix-US-crumbling-infrastructure-520930

Port of Los Angeles. (2016, April 12). Facts and Figures. Retrieved from Port of Los Angeles FAQ. https://portoflosangeles.org/about/facts.asp

Reger, G. (2016, June 24). *A New Frontier for Analytics in Denver City Government*. Retrieved from Denver Peak Academy Peak Events. https://denpeakacademy.com/2016/06/24/advanced-analytics-class-1/

Rocky Mountain Institute. (2015, October). *Interoperable Transit Data: Enabling a shift to mobility as a service*. Retrieved from Rocky Mountain Institute. http://www.rmi.org/RMIMobilityInteroperableTransitData

Rowe, D., McCourt, R.S., Morse, S., & Haas, P. (2013, February). *Do Land Use, Transit, and Walk Access Affect Residential Parking Demand?* Retrieved from King County. http://metro.kingcounty.gov/up/projects/right-size-parking/pdf/ite-journal-feb-2013-drowe.pdf

Roy, M.M., Liersch M.J. (2014, August 28). *When It Comes To Driving, Most People Think Their Skills are Above Average*. Retrieved from Association for Psychological Science. http://www.psychologicalscience.org/index.php/news/motr/when-it-comes-to-driving-most-people-think-their-skills-are-above-average.html

Sattell, J.B. (2016). *SAIC artists and designers are forging community technology with the Array of Things project*. Retrieved from School of the Art Institute of Chicago. http://www.saic.edu/highlights/paststories/opendataopencity/

Schlosser, N. (2013, November 18). *Montreal transit app rewards riders with personalized offers*. Retrieved from Metro Magazine. http://www.metro-magazine.com/management-operations/article/211834/montreal-transit-app-rewards-riders-with-personalized-offers

Schmitt, A. (2016, March 10). *It's True: The Typical Car Is Parked 95 Percent of the Time*. Retrieved from Streetsblog Network. http://www.streetsblog.net/2016/03/10/its-true-the-typical-car-is-parked-95-percent-of-the-time/

Schmitz, M. (2015, September 29). *Study: Car Sharing, Technology Will Drive the Future*. Retrieved from cars.com. https://www.cars.com/articles/study-car-sharing-technology-will-drive-the-future-1420681278616/

Science Daily. (2016, March 3). *Finnish electric buses serve as mobile testing platforms in the Helsinki region*. Retrieved from Science Daily. http://www.sciencedaily.com/releases/2016/03/160303084353.htm

Shaheen, S., Cohen, A., Zohdy, I. (2016, April). Shared Mobility: Current Practices and Guiding Principles. Retrieved from U.S. Department of Transportation, Federal Highway Administration. http://www.ops.fhwa.dot.gov/publications/fhwahop16022/index.htm

Shaheen, S., Cohen, A., Zohdy, I., & Kock, B. (2016, March). *Smartphone Applications to Influence Travel Choices: Practices and Policies*. Retrieved from U.S. Department of Transportation, Federal Highway Administration. http://www.ops.fhwa.dot.gov/publications/fhwahop16023/index.htm

Shaheen, S., Chan, N., Bansal, A., & Cohen, A. (2015, November 3). *Shared Mobility: A Sustainability and Technologies Workshop: Definitions, Industry Developments, and Early Understanding*. Retrieved from Innovative Mobility. http://innovativemobility.org/?project=shared-mobility-definitions-industry-developments-and-early-understanding

Shared-Use Mobility Center. (2015). *Shared-Use Mobility Reference Guide*. Retrieved from Shared-Use Mobility Center. http://sharedusemobilitycenter.org/wp-content/uploads/2015/09/SharedUseMobility_ReferenceGuide_09.25.2015.pdf

Shared-Use Mobility Center. (2015, March 6). *What Can Paratransit Learn from Uber and Lyft?* Retrieved from Shared-Use Mobility Center. http://sharedusemobilitycenter.org/news/what-can-paratransit-learn-from-uber-and-lyft/

Shoup, D. (2007). *Cruising for Parking*. Retrieved from UCLA. http://shoup.bol.ucla.edu/CruisingForParkingAccess.pdf

Shoup, D. (2011, April 4). *Free Parking or Free Markets*. Retrieved from CATO Unbound. http://www.cato-unbound.org/2011/04/04/donald-shoup/free-parking-or-free-markets

Sklar, D.L. (2014, October 6). *Metro Rail stations: Not so great for local neighborhoods*. From mynewLA.com. http://mynewsla.com/government/2015/10/06/las-metro-transportation-authority-rail-stations-get-c-rating/

Smart Card Alliance. (2016, May). *EMV and Parking: A Smart Card Alliance Transportation Council White Paper Developed in Partnership with the International Parking Institute*. Retrieved from Smart Card Alliance. http://www.smartcardalliance.org/downloads/EMV-and-Parking-White-Paper-FINAL-062215.pdf

Smith, B.W. (2015, July 21). *Automated Vehicle Liability*. Retrieved from TRB Automated Vehicle Symposium. http://www.auvsi.org/avs2015/program/breakoutsessions/breakoutsession11

Smith, M., Austin, R.L. (2015, May 15). *Launching the Police Data Initiative*. Retrieved from the White House Blog. https://www.whitehouse.gov/blog/2015/05/18/launching-police-data-initiative

Sotero, D. (2015, September 14). *El Monte Bike Hub opens, featuring Metro's first secure parking station*. Retrieved from The Source. http://thesource.metro.net/2015/09/14/el-monte-bike-hub-opens-featuring-metros-first-secure-bike-parking-station/

Sotero, D. (2016, May 25). *Metro and city of L.A. to launch bike sharing in DTLA on July 7*. Retrieved from The Source. http://thesource.metro.net/2016/05/25/metro-city-of-l-a-to-launch-bike-sharing-in-downtown-l-a-on-july-7/

Southern California Association of Governments. (2016, April). *2016-2040 Regional Transportation Plan/Sustainable Communities Strategy: A Plan for Mobility, Accessibility, Sustainability and a High Quality of Life*. Retrieved from Southern California Association of Governments. http://scagrtpscs.net/Pages/FINAL2016RTPSCS.aspx

St. Louis, E., Manaugh, K., van Lierop, D., El-Geneidy, A. (2014, August 12). *The happy commuter: A comparison of commuter satisfaction across modes*. Retrieved from Science Direct. http://www.sciencedirect.com/science/article/pii/S1369847814001107

State of California. (2016). *California Road Charge Pilot Program - Resources: Exploring an Option for Replacing California's Gas Tax*. Retrieved from State of California. http://www.dot.ca.gov/road_charge/resources/index.html

Steinman, P. (2015, July 23). *State and City Level Issues*. Retrieved from TRB Automated Vehicle Symposium. http://www.auvsi.org/avs2015/program/thursday

Stone, B. (2015, January 29). *The Future of Uber and Lyft: A Crowded Back Seat*. Retrieved from Bloomberg Businessweek. http://www.bloomberg.com/news/articles/2015-01-29/uber-lyft-bet-big-on-carpool-services

Strauss, S. (2015, November 6). *As the age of autonomous vehicles nears, why are policy wonks focused on the past?* Retrieved from The Los Angeles Times. http://www.latimes.com/opinion/op-ed/la-oe-1108-strauss-autonomous-vehicles-20151108-story.html

Suson, M. (2016, February 9). *Daily funding roundup - February 9, 2016*. Retrieved from Vator News. http://vator.tv/news/2016-02-09-daily-funding-roundup-february-9-2016

Temperton, J. (2016, July 13). *London's contactless Tube payment systems is going global*. Retrieved from Wired UK. http://www.wired.co.uk/article/london-underground-contactless-payments-licensing-deal

Thomas, K.E. (2016, July 13). *More Cities Could Soon Adopt London's Contactless Transit Payment System*. Retrieved from NextCity. https://nextcity.org/daily/entry/london-contactless-transit-fare-payment-system-global

Thompson, C. (2015, December 17). *Google is not happy about the new driverless car rules in California*. Retrieved from Tech Insider. http://www.techinsider.io/google-vs-california-dmv-2015-12

Thorton, S. (2015, June 8). The Internet of Things Changes Chicago's Approach to Urban Design. Retrieved from *Data-Smart City Solutions*. http://datasmart.ash.harvard.edu/news/article/the-internet-of-things-in-chicago-collaborative-action-for-smarter-cities-6

Townsend, A. (2014). *Re-Programming Mobility: The Digital Transformation of Transportation in the United States.* Retrieved from Re-Programming Mobility. http://reprogrammingmobility.org/wp-content/uploads/2014/09/Re-Programming-Mobility-Report.pdf

Transit Center. (2016, February 11). *Expanded Transit Tax Incentive Doesn't Relieve Impact of Subsidized Parking*. Retrieved from TransitCenter. http://transitcenter.org/2016/02/11/transit-parking-subsidy/

Transit Center. (2016, July). *Who's On Board 2016: What Today's Riders Teach Us About Transit That Works*. Retrieved from TransitCenter. http://transitcenter.org/publications/whos-on-board-2016/

Transportation Research Board. (2015). *Between Public and Private Mobility: Examining the Rise of Technology-Enabled Transportation Services*. Retrieved from Transportation Research Board. http://onlinepubs.trb.org/onlinepubs/sr/sr319.pdf

U.S. Department of Health & Human Services. (2012, March 14). *User Experience Basics*. Retrieved from Usability.gov. http://www.usability.gov/what-and-why/user-experience.html

Wassom, B.D. (2015, July 21). *Privacy in Social Media and eCommerce - an Overview*. Retrieved from TRB Automated Vehicle Symposium. http://www.auvsi.org/avs2015/program/breakoutsessions/breakoutsession11

Weikel, D. (2015, November 29). California Commute: Driverless vehicles and the future of L.A. transportation. Retrieved from Los Angeles Times. http://www.latimes.com/local/california/la-me-california-commute-20151130-story.html

Ungureanu, H. (2015, November 20). *Self-Driving Cars Should Roam US Streets Within Four Years, Says Ford CEO*. Retrieved from Tech Times. http://www.techtimes.com/articles/108567/20151120/self-driving-cars-should-roam-us-streets-within-four-years-says-ford-ceo.htm

U.S. Department of Transportation. (2016, February 2). *VMT Per Capita*. Retrieved from Transportation.gov. https://www.transportation.gov/mission/health/vmt-capita

U.S. Department of Transportation Federal Highway Administration. (2016, July 13). *State & Urbanized Area Statistics*. Retrieved from the FHWA website. https://www.fhwa.dot.gov/ohim/onh00/onh2p11.htm

U.S. Department of Transportation Federal Transit Administration. (2007, October 1). *Part 37 - Transportation Services for Individuals with Disabilities*. Retrieved from Federal Transit Administration http://www.fta.dot.gov/12876_3906.html

U.S. Department of Transportation Intelligent Transportation Systems Joint Program Office. (Accessed 2016, July). *Automated Vehicle Research*. Retrieved from http://www.its.dot.gov/automated_vehicle/index.htm

U.S. Department of Transportation Intelligent Transportation Systems Joint Program Office. (2015, October). *Connected Vehicle Research Frequently Asked Questions*. Retrieved from USDOT. http://www.its.dot.gov/connected_vehicle/connected_vehicles_FAQs.htm

U.S. Department of the Treasury Office of Economic Policy. (2014, September). *Expanding our Nation's Infrastructure through Innovative Financing*. Retrieved from the U.S. Department of the Treasury. https://www.treasury.gov/resource-center/economic-policy/Documents/3_Expanding%20our%20Nation's%20Infrastructure%20through%20Innovative%20Financing.pdf

UUTISET. (2015, November 17). *HSL order Kutsuplus shutdown*. Retrieved from UUTISET. http://yle.fi/uutiset/hsl_orders_kutsuplus_shutdown/8462055

Vision Zero Los Angeles. (2015, August). *Vision Zero Los Angeles 2015-2015: Eliminating Traffic Deaths in Los Angeles by 2025*. Retrieved from City of Los Angeles Vision Zero. http://visionzero.lacity.org/wp-content/uploads/2015/09/VisionZeroLosAngeles.pdf

Watkins, D.E. (2015, November 11). *TCRP B-43: Use of Web-Based Customer Feedback to Improve Public Transit Services*. Retrieved from APTA ITS Workshop. http://www.apta.com/mc/its/previous/2015november/presentations/Presentations/Watkins%20-%20TCRP%20B-43%20Use%20of%20Web-based%20Customer%20Feedback%20to%20Improve%20Public%20Transit%20Services.pdf

Watson, T. (2016, March 2). *Technology & the future of urban infrastructure*. Retrieved from The Examiner. http://www.examiner.com/article/technology-the-future-of-urban-infrastructure

Wattenhofer, J. (2016, January 6). *What Would It Look Like If All of Los Angeles's Parking Was in One Giant Blob?* Retrieved from Curbed Los Angeles. http://la.curbed.com/2016/1/6/10849122/los-angeles-parking-how-much-space

Wilson, M. (2015, January 19). *Emerging Transit Trends in 2015. Retrieved from Mass Transit.* http://www.masstransitmag.com/blog/12035945/emerging-transit-trends-in-2015

Zmud, J. (2015, July 23). *Texas A&M Transportation Institute: Road Markings for Road Readiness*. Retrieved from TRB Automated Vehicle Symposium. http://www.auvsi.org/avs2015/program/thursday
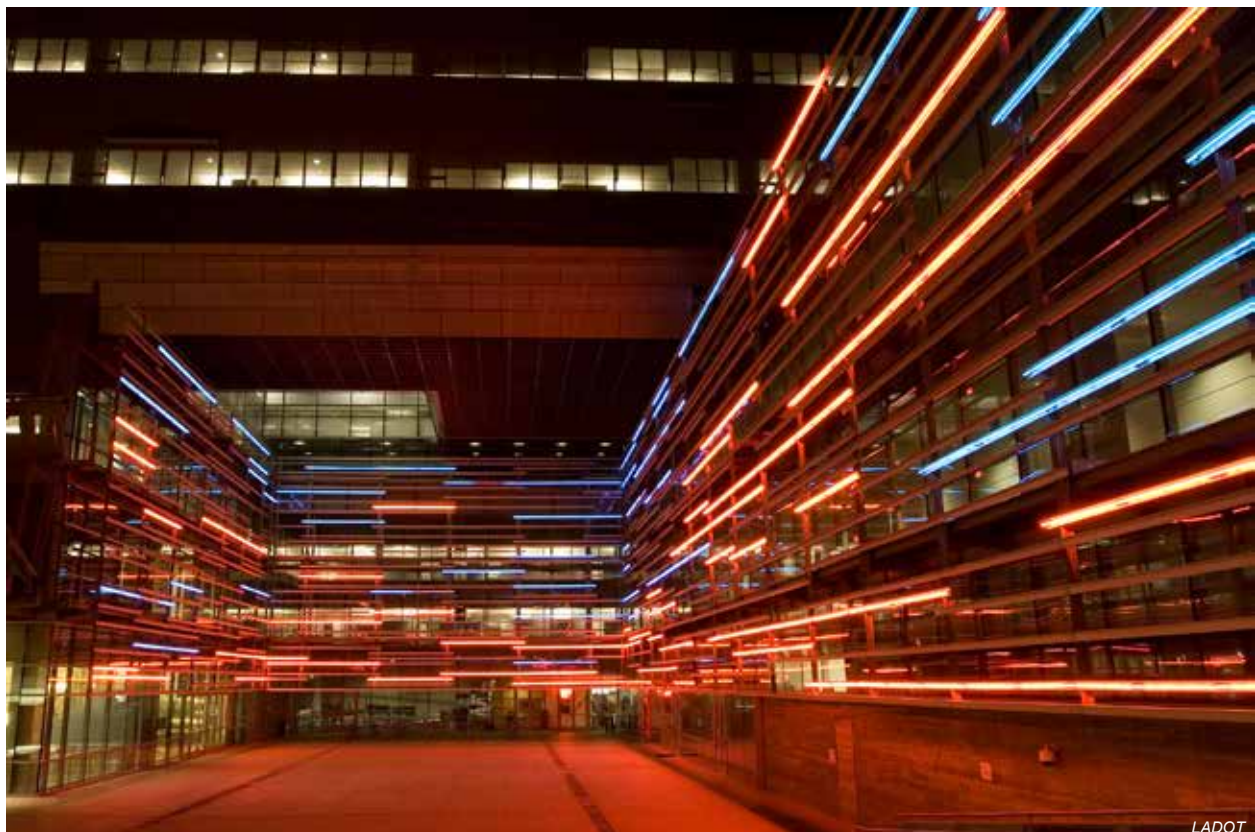
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APPENDIX

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Appendix

The following additional references and resources have been included in this Appendix:

- Mobility Data Wishlist

- Letter to the State of California Department of Motor Vehicles

- Fuse Fellowship Job Description for the City Automated Vehicle Business Plan

- List of Interviews + Idea Exchanges

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Mobility Data Wishlist

Here are some sample datasets LADOT should consider for its data wishlist:

THEME	DEFINITION	EXAMPLE DATASETS
PLACE + SPACE	Anything tangible that can be seen, touched or found	• Speed limits • Rail station / bus stop locations • Emergency evacuation routes • Map information, including fuel infrastructure • Accessibility information (elevators, ramps, etc.) • On and off-street parking
ENVIRONMENT	Data relating to environmental trends and natural occurences	• Real-time weather, sunrise/sunset times • Rainfall, tides and marine conditions • Floods • Earthquake monitoring • Air quality • Droughts • Temperature
PEOPLE, THINGS + MOVEMENT	Data generated by individuals and things as they move around	• Location history from cell/smartphones • Employment / health / education data • Road incident data • Bike journey counters
DISRUPTION + EVENT-RELATED DATA	Dynamic datasets related to physical events that impact transport networks	• Sporting events, concerts • Parades, Ciclavia • Live and planned road closures • Real-time traffic incident reports • Real-time road conditions • Roadwork locations
PUBLIC TRANSPORT SERVICES	Scheduled and real-time data relating to the movement of public transport vehicles and their characteristics	• Public transit schedules and routes • NextBus real-time arrival data • Live departure boards • Trip planning
PERSONAL AUTOMOBILITY	The spatial movement of powered personal vehicles (e.g. cars, motorcycles, taxis).	• Live traffic information • Waze/Google traffic speed data • Live traffic camera images • On-street parking data • EV charging stations
FREIGHT CONNECTIONS	Data related to the movement of goods by road, rail, sea, air	• Shipfinder • Road and port freight logistics • Freight train movements • Freight truck movements
INTERNATIONAL CONNECTIONS	International travel outside of the U.S. by air, rail, or sea	• Flight radar • Scheduled departures from airports • Port schedules • Include travel within California
CONSUMPTION + TRANSACTION DATA	Individual preferences and retail choices - both directly and indirectly related to mobility	• TAP card derived travel data (future) • Credit card spend-data • Domestic energy consumption • Gas and fare prices • Loyalty card purchases • Restaurant reservations

Adapted from *The Transport Data Revolution*, Pages 15-16.

CITY OF LOS ANGELES

CALIFORNIA

Seleta J. Reynolds
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February 18, 2016

Mr. Bernard Soriano
Deputy Director
Department of Motor Vehicles
2415 First Avenue
Sacramento, CA 95818
bernard.soriano@dmv.ca.gov

Subject: **CALIFORNIA DEPARTMENT OF MOTOR VEHICLES DRAFT AUTONOMOUS VEHICLES DEPLOYMENT REGULATIONS**

It is an exciting time in California with the potential of autonomous vehicle technology to make our public roads safer. Action by the State to create a framework for testing and operating these vehicles is essential to meeting the various policy goals for safer, cleaner transportation options and will set the trajectory for market development for generations to come. Without government action, this technology may not meet its potential promise for improved mobility or have devastating impacts on our cities - from increased vehicle miles traveled to urban sprawl. The City of Los Angeles Department of Transportation (LADOT) applauds the leadership of the California Department of Motor Vehicles (DMV) to address this issue in a timely manner.

As the DMV considers regulations for autonomous vehicles, safety should remain as the primary focus with an understanding of the benefits that this technology could potentially bring to California's public roads. However, it is also important to understand the unintended consequences early regulations will have in the development of these capabilities. In response to the draft regulations that were issued on December 16, 2015, the LADOT would like to provide the following input in advance of the rulemaking process:

Shared versus Private Vehicles: These regulations are focused exclusively on a status quo model of privately operated vehicles with no accounting for a shift towards more shared mobility. California can help encourage market advancement towards more shared vehicles if it structures these regulations around both models while providing a framework to test shared autonomous vehicles. In particular, the DMV should prioritize testing and deployment of vehicles intended for public transit and other shared mobility models that would serve more than a single household and increase capacity of our roadways by maximizing the capacity of the vehicles themselves.

Manufacturer Safety Certifications: The proposed rule 227.58 requires third-party vehicle demonstration testing which is above and beyond the requirements for traditional automobile technology. If the manufacturer is willing to certify the technology and assume liability for any errors, the additional requirement for independent verification could further delay the introduction of this

technology and benefits while increasing costs. Rather than requiring a third-party testing organization, the DMV should consider defining performance specifications for key driving maneuvers and a process for review and updating these specifications as the technology continues to improve.

Licensed Driver Requirement: The regulations are currently limited to Level 3 autonomous vehicles and LADOT supports the inferred requirement that a human is present in the autonomous vehicle while it is operating until more experience in testing has been achieved. However, the proposed requirement for a licensed driver with an autonomous vehicle operator certificate stymies the potential of this technology to make mobility more accessible to the disabled and aging populations while taking vehicle control out of the hands of distracted drivers. The benefits of this technology to these populations will also help drive adoption and help move towards a safer future with fewer human drivers on the road.

LADOT fully supports the proposal to require that manufacturers develop and implement a consumer education plan to help prepare riders for this new technology but recommends that consideration is given to educating all drivers on the road as the hybrid period of both human and robot drivers will require behavior changes and better understanding by all users of public roads. The DMV should consider certifying users of autonomous vehicle technologies but not base this certification on the traditional model of licensure.

As an additional measure to ensure manufacturers prioritize safety, the DMV should reconsider resting the responsibility for traffic violations on the operator and shift this responsibility to the manufacturer. Autonomous vehicles will have a major impact on the insurance industry and approaches to liability which needs to be factored into these preliminary rules.

According to section 227.52(5), vehicles that are already capable of operating at Level 4 are excluded from approval for testing at this time. Rather than limit this testing, the DMV should require a human operator be present to allow for further development of this technology. With the NHTSA recently designated Google's self-driving car artificial intelligence as a "driver," LADOT recommends this section be reconsidered in this context and encourages the DMV to not limit its preliminary regulatory framework to just Level 3.

Provisional Deployment: While LADOT appreciates the intent of developing a limited term for deployment, it is not clear why three years is the proposed deployment permit period so further clarification as to why this arbitrary time period has been designated is necessary. LADOT supports the reporting and data sharing requirements as this will be essential for cities to also understand the impact of this technology and regulatory action at the local level.

Thank you for the opportunity to provide this preliminary feedback. We look forward to the official launch of the rulemaking process for autonomous vehicles.

Sincerely,

Seleta J. Reynolds
General Manager

c: Barbara Romero, Deputy Mayor of City Services
   Borja Leon, Director of Transportation of City Services

"Optimizing Mobility and Safety with Autonomous Vehicle Technology"
Department of Transportation
City of Los Angeles, CA

PROJECT CONTEXT

Transportation throughout the world is on the cusp of a revolution from advances and growing interest in autonomous vehicle technology. While some have written off self-driving vehicles as a trendy concept that is many decades from becoming a reality, many others realize that this technology is already in use to varying degrees – whether it be automatic bus docking or sensors to detect pedestrians and avoid accidents. In fact, most new vehicles sold today include some kind of autonomous driving capabilities. Visionaries in the transportation industry – both in the private and public sectors – recognize that this rapidly evolving technology holds the promise of completely transforming the way people move around and significantly increasing the level of safety they can expect. Additionally, connected and autonomous vehicles offer infrastructure efficiencies, environmental benefits and greater access for residents who are unable to drive themselves.

The City of Los Angeles is poised to be a leader in this emerging technology and one of the first cities in the world to reap the many benefits of autonomous driving. Its large public transportation system and municipal fleet can help the City attract pilot projects to explore this technology. The recently created Coalition of Transportation Technology is designed to prepare the City, region and transportation infrastructure for the onset of autonomous vehicles. The City's efforts to create safer streets (e.g., its "Vision Zero" initiative) and a cleaner environment (e.g., the Sustainable City pLAn and the switchover to battery-electric vehicles) demonstrate the City's commitment at all levels of government to embracing this new technology so it can achieve its goals.

It is, however, a challenging and complex endeavor to reconfigure a city's transportation infrastructure to embrace a major new development such as autonomous vehicles. Not only does it involve technology that is still in the early stages of development, but it also involves many different cross-sector agencies, institutions and stakeholders. The Los Angeles Department of Transportation (LADOT) is partnering with FUSE Corps to host an executive-level Fellow for one year who will undertake the task of creating a comprehensive business plan to address the increasingly important need for investment in autonomous vehicles and the infrastructure to support them. A successful Fellow will work with stakeholders to develop a roadmap that guides the way toward an actionable plan and helps Los Angeles bring this incredible technology to all of its residents, not just to those who can afford it.

ROLE DESCRIPTION

Starting in September 2016, the Fellow will begin by developing an understanding of the landscape of public transportation pilots with autonomous vehicle technologies – both in the United States and throughout the world. This research will cover different vehicle types, environments, vehicle limitations, infrastructure requirements, and regulatory constraints. The Fellow will define best practices, assess the

feasibility of deploying such technology in Los Angeles, and identify potential public-private financing and procurement models.

The Fellow will then work with Department of Transportation leaders and other stakeholders to develop two or three potential business models for deploying a publicly owned and/or operated autonomous fleet. The models will address how the City can introduce this technology to the City, including detailed plans to roll out pilot projects within specific timetables and budgets. The Fellow will engage with project stakeholders both inside and outside of government to evaluate the models and ultimately coalesce around a final plan of action.

A successful plan will focus on the idea of shared use and maximizing the benefits of autonomous vehicles for the greatest possible number of people. The plan will address the crucial issue of safety, specifically addressing the goals of the city's Vision Zero program, which aims to eliminate all traffic deaths by 2025. It will also confront the challenge of how to change people's behavior – getting them to adapt new ways of moving around and embrace new technologies.

PROSPECTIVE RESPONSIBILITIES

- *Understand the autonomous vehicle landscape and research practices in other cities* – Quickly get up to speed on work being done in other cities around the world. Conduct independent research about innovative business models and other creative public-private partnerships that have been successfully executed. When appropriate, interview the principals involved in these projects to gain an appreciation for the structure, successes, challenges and learning that emerged from each.

- *Define potential business models* – Work with stakeholders within the LADOT and other City agencies to identify two or three potential models for a publicly owned and/or operated autonomous vehicle fleet. Evaluate the potential impact for each model and define the trade-offs. Understand and define potential opportunities to leverage other investments in digital infrastructure to support such a pilot, such as upgrades to the Traffic Management Center.

- *Develop a business plan* – After careful evaluation, lead a process to help select a model and create a plan that makes a strong business case for investments in autonomous vehicle technology. The plan will include briefing documents and presentations that will be given to City staff in order to illuminate the plan's possibilities and strengths, as well as an analysis of public-private partnerships as a mechanism to advance specific projects. The plan should translate complex opportunities into clear, simple descriptions that can be understood without a background in transportation or finance.

- *Support further exploration and development of the plan* – Collaborate with City officials to further pursue the opportunities outlined in the plan. Help analyze financing alternatives, convene internal and external parties, participate in key meetings, and conduct other activities as needed to help support the actualization of specific deals.

KEY STAKEHOLDERS

- **Seleta Reynolds**, *General Manager, LADOT,* will serve as the executive champion, providing high-level guidance and support to ensure that this project achieves its full potential for impact.

- **Marcel Porras**, *Chief Sustainability Officer, LADOT,* will work directly with the Fellow on a day-to-day basis to support and oversee progress towards goals.

- Other key partners who will support and advise the Fellow will include:
    - **Jay Kim**, *Assistant General Manager, LADOT*
    - **Bridget Smith,** *Chief of Staff, LADOT*
    - **Dan Mitchell**, *Assistant General Manager, LADOT*
    - **Peter Marx**, *Chief Technology Officer, Office of the Mayor*
    - Fleet managers of other departments such as the Los Angles Police Department and the Los Angeles Department of Water and Power
    - The Coalition for Transportation Technology

QUALIFICATIONS

- At least 15 years of professional experience in a relevant field, particularly with a background in finance, business analysis, systems building and/or management consulting. Familiarity with the world of public transportation would be a plus.

- Superior critical thinking and analytical skills. Ability to get up to speed quickly about a complex, rapidly changing technology. Ability to synthesize complex information into clear and concise summaries and recommendations.

- Ability to identify best practices, understand data and evidence and use it to support a business case, and make a persuasive argument to support recommendations.

- Strong record of success engaging a variety of cross-sector stakeholders and managing cross-functional teams. Ability to relate to a variety of diverse audiences and varying interests with strong emotional intelligence and empathy. Able to connect and collaborate across a variety of disciplines.

- Interest in becoming an expert in a nascent, rapidly evolving technology.

- Exceptional written and verbal communication skills with ease in public presentations.

- Self-motivated, goal-oriented, entrepreneurial leader who is an independent worker, resourceful in creating novel solutions to complex problems, persistent in obtaining information, and able to create direction and movement within potentially ambiguous environments.

- Flexibility, adaptability, persistence, humility, inclusivity and sensitivity to cultural differences.

Interviews + Idea Exchanges

The research phase for this strategy included extensive literature review and conversations with subject matter experts, professionals and community stakeholders throughout the course of the one-year fellowship to assess where the City of Los Angeles is today, how the technology is evolving, and what are the anticipated outcomes of this period of rapid change.

Due to limited time and capacity, there was no extensive public engagement around this process although many stakeholder groups are represented. LADOT should consider developing a strategy for broader engagement as it considers these recommendations and next steps.

- Manoochehr Adhami, LADOT
- Edward G. Alegre, Los Angeles County Metropolitan Transportation Authority
- Douglas Anderson, Los Angeles County Metropolitan Transportation Authority
- Paul Backstrom, Office of Councilman Mike Bonin, City of Los Angeles
- Timothy Black, LADOT
- Nick Bowden, MySidewalk
- Claire Bowin, Department of City Planning, City of Los Angeles
- Jennifer Bradley, The Aspen Institute
- Eric Bruins, Los Angeles Bicycle Coalition
- Tomas Carranza, LADOT
- Fernando Cazares, previously with Natural Resources Defense Council
- Daniel Chamberlain, Occidental College
- Ferdinand Chan, Department of Public Works, City of Los Angeles
- Pauline Chan, LADOT
- George Chen, LADOT
- Steven J. Chen, Department of Public Works, City of Los Angeles
- Jane Choi, Department of City Planning, City of Los Angeles
- Jennifer Cohen, LADOT
- Stacey Cohen, LA2050
- Erin Coleman, Department of City Planning, City of Los Angeles
- Lilian Coral, Office of the Mayor, City of Los Angeles
- Ken Clement, Forrester
- Coalition for Transportation Technology
- Council Office Transportation Advisors (joint meeting)
- Philippe Crist, International Transport Forum

- David Cummins, Xerox
- Vicky Curry, Office of the Mayor, City of Los Angeles
- Dana Cuff, CityLab, UCLA
- Amanda Daflos, Innovation Delivery Team, City of Los Angeles
- Clay A. Dean, General Motors
- Peter Dempster, BMW Car Sharing Program
- Michael Dinning, Volpe
- Amanda Eaken, Natural Resources Defense Council
- David Edwards, Los Angeles County Metropolitan Transportation Authority
- Joyce Edson, Information Technology Agency, City of Los Angeles
- EV Working Group, City of Los Angeles
- Lauren Faber, Office of Sustainability, City of Los Angeles
- Alex Fay, Syncromatics
- Kali Fogel, Los Angeles County Metropolitan Transportation Authority
- Brian Forde, MIT
- Russell Fortmeyer, Arup
- Melanie Freeland, Gensler
- Michelle Garakian, Office of the Mayor, City of Los Angeles
- Rubina Ghazarian, LADOT
- David Goodsmith, Data Science
- Steven Y. Gota, Los Angeles County Metropolitan Transportation Authority
- Nat Gale, Great Streets Studio/LADOT
- Michael Grundmann, (Google) X
- Carlos Gutierrez, RAND
- Nick Haldane, Wejo
- Hugo Hanselmann, Wejo
- Selwyn Hollins, previously LADOT

- Rick Holman, General Motors
- Larry Hsu, Department of Public Works, City of Los Angeles
- Ken Hustig, LADOT
- Lauren Isaac, Parsons Brinckerhoff
- Verej Janoyan, LADOT
- Nidhi Kalra, RAND Corporation
- Jay Kim, LADOT
- David Koenig, formerly with Intersection
- D. Zeev Krieger, Goldman Sachs and Co.
- My La, Department of City Planning, City of Los Angeles
- LAEDC e4 Mobility Alliance
- Dean Lehman, Department of Public Works, County of Los Angeles
- Borja Leon, Office of the Mayor, City of Los Angeles
- Greg Lindsay, New Cities Foundation
- Live Ride Share Working Group
- Eric Lopez, Department of City Planning, City of Los Angeles
- Los Feliz Improvement Association
- Andreas Mai, Cisco
- Nicholas Maricich, Department of City Planning, City of Los Angeles
- Tamara Martin, LADOT
- Juan Matute, UCLA
- MISTRA, The Swedish Foundation for Strategic Environmental Research
- Daniel Mitchell, LADOT
- Mobility Hubs Planning Team
- Sam Morrissey, Iteris
- Ann Muenster-Nuiry, Xerox
- Taesang Nam, LADOT
- Rani Narula-Woods, Shared Use Mobility Center
- Craig Nelson, Steer Davies Gleeve
- Dominic Nessi, previously Los Angeles World Airports, City of Los Angeles
- Francois Nion, JC Decaux North America
- Hilary Norton, FAST
- Melanie Nutter, Nutter Consulting
- Mark O'Connor, Los Angeles World Airports, City of Los Angeles
- Office of Sustainability, City of Los Angeles
- Kelly Olson, Clark Construction
- Eva Pan, Los Angeles County Metropolitan Transportation Authority
- Chris Pangilinan, TransitCenter
- Cindy Patton, City and County of Denver
- Eleni Petrow, Global Green
- Jennifer Pope, Office of the Mayor, City of Los Angeles
- Marcel Porras, Office of the Mayor/LADOT
- Corinne Ralph, LADOT
- Jean-Francois Rheault, Eco-Counter
- Allyn Rifkin
- Carlos Rios, LADOT
- Daniel Rodman, Office of the Mayor, City of Los Angeles
- Arya Rohai, Stantec
- Ted Ross, Information Technology Agency, City of Los Angeles
- Carter Rubin, Great Streets Studio, City of Los Angeles
- Joshua Schank, Los Angeles County Metropolitan Transportation Authority
- Tony Seba, Stanford University
- Bill Shao, LADOT
- Matthew Shukaitis, BMW Car Sharing Program
- Sean Skehan, LADOT
- Gary Slater, Caltrans District 7
- Bridget Smith, LADOT
- Sylvia Smullin, (Google) X
- David Somers, Department of City Planning, City of Los Angeles
- Francie Stefan, City of Santa Monica
- Jacqui Swartz, LADOT
- Brian Swett, Arup
- Randall Tanijiri, LADOT
- USC Emergent Cities Working Group
- Julie Vazquez, LADOT
- Vision Zero Executive Steering Committee
- Valerie Watson, LADOT
- Kevin Webb, Sidewalk Labs
- Walker Wells, MISTRA, The Swedish Foundation for Strategic Environmental Research
- Marla Westervelt, Los Angeles County Metropolitan Transportation Authority
- Morgan Whitcomb, Sam Schwartz Engineering
- Jean-Luc Ygnace, Institut Français des Sciences et Technologies des Transports, de l'Aménagement et des Réseaux
- Edward Yu, LADOT
- Ali F. Zaghari, Caltrans District 7

PREPARED FOR THE CITY OF LOS ANGELES
OFFICE OF THE MAYOR AND
DEPARTMENT OF TRANSPORTATION

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AUGUST 2016