DRIVING CHANGE: A GUIDE TO Collaborative strategies For av deployment

Project Background

Throughout 2023, MITRE conducted research to compare characteristics of autonomous vehicle (AV) operational design domains (ODDs) across disparate environments to support cities and AV developer organizations in evaluating readiness and safeguards for safe AV deployment. In the initial research phase, cities often highlighted feeling left out of the AV conversation. Cities must handle the outcomes of AV testing and deployments, along with state-and federal-level regulations, without commensurate influence over AV operations.

Having captured an understanding of the collective pain points and broad variation across the emerging landscape, this document aims to provide a resource to support education, collaboration, and an understanding of the levers available in support of both safe testing and deployment of AVs, along with near-and long-term city planning efforts. For both cities with multiple AV companies currently deployed and cities with AV testing and deployment on the horizon, this document may serve as a guide in support of safety and readiness in your communities.



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Key Takeaways

Impacts to AV Operations

Cities are at varying levels of maturity regarding their organizational processes and infrastructure readiness for AVs, with some cities having both personnel and processes in place, and other cities at the early stages of understanding what their approach to AVs should be.

• Curb management and infrastructure design appear to be two ways in which cities can directly influence AV operations.

Some infrastructure is more amenable to AVs than others and some infrastructure promotes safe AV operations more than others (e.g., buffers between roads and sidewalks, road and bike lanes, clear and reflective lane markings, and designated pick-up/dropoff areas).

Cities' impacts on and interactions with AV deployments also vary depending on the AV use case—

- Rideshare AV companies tend to generate revenue directly through ridership and establish large geofences within a city. These companies may be more insulated from cities' influence through regulatory preemption or may be more hesitant to deploy in a city that is not preempted by the state and requires data reporting and a slow ramp-up to driverless operations.
- Transit AV companies tend to fund deployments through grants or public funding and complement existing public transit options by operating on a fixed route or an on-demand micro-transit service in a smaller area. Even in cities that are preempted by their states, Transit AV companies have historically been more amenable to close collaboration with the city in which they're deploying.

Preemption, and a general lack of clarity regarding the AV regulatory environment, limit the opportunities for cities to impact AV testing and deployments.



Critical Pain Points

- AV interactions with law enforcement and emergency responders are areas of concern for both cities and AV developers.
- AVs have historically had issues with recognizing construction areas and other temporary road closures.
- AV developers often have difficulty understanding local road rules, driving expectations, and driving patterns, and turn to in-person reconnaissance to find this information.





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Data Sharing and Collection

While some cities and AV developers appear to have better relationships than others, across the board cities do not have the data they need to assess readiness, safety, or performance of AVs in their city.

Evaluating performance can take on a variety of meanings, from understanding the safety impacts on the rest of the system, to understanding passenger use patterns, deadheading, or efficiency of goods delivery.

AV developers' historical reluctance to share data with cities comes from concerns over how sensitive information will be used and whether it will lead to additional, difficult to navigate constraints. The reluctance could potentially be mitigated through clear and upfront communication of:

- the data requests,
- the key performance indicators (KPIs) the requested data will support,
- and how those KPIs will be used to prioritize resources to support safe and effective autonomy

Using a trusted third party for data sharing between the city and AV developers can also assist by ensuring safe data handling and privacy protection.

Cities can collect some data themselves on critical issues such as crashes, interactions with law enforcement and first responders, stopped vehicles, etc., and can readily begin using this data to prioritize resources and educate the public.

Additionally, it is important to have a plan in place for communicating road closures and detours, both planned and unplanned, temporary and long-term. AV developers are often reliant on their own encounters with road closures to modify their geofence and routing, which can lead to dangerous interactions, particularly when a road is closed due to an emergency response.



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Recommendations

NEAR-TERM



Engagement Structures

Explore becoming a <u>member city</u> of the <u>National Association of City Transportation</u> <u>Officials (NACTO)</u>, and joining its AV Working Group, which is a group of cities coming together to share lessons learned across cities and develop resources to better understand how cities should be addressing AV testing and deployment in their jurisdictions. For more information, please contact <u>membership@nacto.org</u>.

Explore membership with Partners for Automated Vehicle Education (PAVE), which is a coalition of industry, nonprofits, academics, and public sector organizations focused on educating the public and policymakers about autonomous vehicles.

In addition to their industry and nonprofit members, PAVE operates two advisory councils that assist in its mission to raise public awareness of AV technology. One of these councils consists of academic researchers across disciplines, and the second consists of public institutions who work together to consider AV effects on public sector entities, including topics around infrastructure, law enforcement, and public transit. The public sector council is made up of cities, counties, state DOTs, and DMVs with varying levels of experience with autonomous vehicles that come together as a community to provide advice to each other and PAVE's membership on this technology and its societal impacts.

SHORT-TERM

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Data Sharing and Collection

Define the KPIs for AVs operating in your city. These may be the same as the KPIs for other passenger vehicles, other Transportation Network Companies (TNCs), or other goods delivery vehicles, or they may be specific safety performance indicators (SPIs) for understanding autonomy.

For example, a KPI may be related to:

- the number of incidents (e.g., crashes, blocking, curb strikes)
- the number of disengagements and the reason for those disengagements

An SPI may consider:

- the number of hard braking events the autonomous vehicles incur (e.g., decreasing speed 8+ mph in 1 second
- the number of times a remote operator must intervene

Determine what data is needed to evaluate the KPIs, and what values can be collected directly by the city, versus what values would need to be retrieved from AV developers.



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- Some cities mentioned collecting data through law enforcement and first responders who write citations or encounter AVs during incident response, through 911 and 311 calls, and by viewing social media posts. To start, include the fields: Time, Date, Location, Description, and Categorization (e.g. collision, near miss, blocking traffic, others determined relevant to your city), along with the speed of the vehicle, or a qualitative representation of the speed, if possible. Use this to pinpoint geographic hotspots of AV issues and prioritize first responder resources at those locations or consider infrastructure upgrades that could alleviate problems in those areas.

Additionally, work with a local representative from the AV developer to walk the area where the incident occurred, discuss the report, and utilize their insight on why the incident took place and what may be done to collaboratively mitigate future issues.

Consider the KPI performance levels where the city might feel comfortable supporting an expansion of service or removal of safety drivers, and what levels of performance would lead the city to request intervention from the state to limit operations. Although AV operations are generally regulated at the state level, it is valuable to understand what conditions would prompt the city to explore smaller-scale changes within their span of control that would promote safer driving for both AVs and humans. These changes could include reducing speed limits in certain areas, adding pylons between bike lanes and drive lanes, or prioritizing the deployment of law enforcement to monitor activities.



Engagement Structures

Host a collaborative event with AV developers, law enforcement, and first responders to share your community's expectations for these interactions, as well as the specific procedures for interacting with each AV developer's vehicles.

 Utilize the initial event as the foundation for a standing committee with representatives from AV developers operating in your jurisdiction, law enforcement, first responders, and local transportation officials, to understand and workshop solutions collectively via an ongoing dialogue.

Check-in with your state DOT to understand the state's approach to autonomy and how each city can take steps to complement that approach. Set up regular check-ins, particularly if active testing or deployment is occurring, to continue to communicate both successes and opportunities for improvement.

• This channel can also be used to communicate data needs for the defined KPIs so that the state can push for reporting of that data and align performance metrics across the state.





MEDIUM-TERM



Data Sharing and Collection

Develop and share expectations for communication related to ongoing AV testing or deployment in your city. This could include AV developers sharing infrastructure issues or curb usage needs they encounter via a designated submittal process (e.g., location, picture, timestamp; via 311 or a more direct method). This may also include cities sharing road closures and construction zones back to AV developers through methods that are compatible with how companies can disseminate information out to their fleets. Helpful methods might be a text or call update that the companies can quickly retrieve and send out to their vehicles over the air, or publishing the updates to a website that vehicles can retrieve information from directly.

It is important to have coordinating mechanisms in place as the source of the information may be handled and tracked by different groups (e.g., first responders, construction permitting, and events planning). One approach currently in use in multiple cities is the use of the Mobility Data Specification (MDS) from the Open Mobility Foundation (OMF), which has capability to provide direct, over-the-air updates. Note that these updates may also benefit TNCs, micromobility providers, or public transit operators, if processes are not already in place to communicate with these groups.



Engagement Structures

Create a standard process for engagement with new AV developers as they prepare to test or deploy in your city. Ensure details of this process are public facing and contain a point of contact, so that AV developers can meet expectations as they explore opportunities for deployment in your city. Include, for instance, any nuances to driving in your city (e.g., driver behaviors, road markings, street sweepers, other rules of the road), expectations for law enforcement and first responder interactions, the city's KPIs, and suggested collaboration and communication mechanisms and topics. Use the protocol to drive conversation with AV developers and work toward a collaborative approach to data sharing, which supports evaluating city-identified KPIs and bolsters future planning efforts. Additionally, ensure the city has a local point of contact from each AV developer to enable timely responses to incidents, blockages, and other issues that may arise.

Develop a plan for conveying community needs and transportation opportunities to AV developers deploying in your city. Consider local communities that could benefit from improved access to commercial centers, congested transit routes that could improve through ridesharing, times of day when other transit options don't appear to meet local needs, etc.

Build an engagement plan for the public in your community before any driverless operations occur. Focus on educating the public about AVs, including communicating what their expectations should be and how to interact with them safely. Ideally, create an event in coordination with an AV developer so the community members can see the vehicle up close and learn about the technology behind it. Consider local groups that will be particularly impacted by AV operations such as schools, cyclist advocacy groups, individuals with disabilities, and older adults, and set up consistent lines of communication with representatives from those organizations.



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LONG-TERM



Data Sharing and Collection

Build out digital assets of infrastructure features, updated on a regular cadence, to assist future transportation technologies and mobility service providers, including AVs, in safely deploying in your jurisdiction through better up-front knowledge of local infrastructure. Digital assets could also be used for evacuation and disaster response planning, sharing near real-time work zone updates, and dynamically adjusting routing around high-traffic events (such as concerts), among other uses.

• Determine gaps in monitoring infrastructure and engage with AV developers about how the data collected by their vehicles could feed into these inventories.



Engagement Structures

Develop robust collaboration structures between your city and associated AV developer organizations, leveraging lessons learned to improve digital assets, exploring and modeling future infrastructure improvements (e.g., low-speed zones, lane markings, dedicated pick-up/drop-off locations), and supporting safe autonomy deployment.

Outcomes

- Improved collaboration between local governments and AV developers to create a safe transportation system, rather than independently focusing on the infrastructure and the vehicles. This will enable safer interactions with AVs, especially in situations that require both local knowledge and autonomy solutions, such as law enforcement and first responder interactions, construction zones, and road closures.
- Move beyond anecdotal understanding of AV outcomes leveraging data shared between local governments and AV developers. Local transit authorities gain the ability to quantify AV performance while AV developers gain an understanding of the impacts of their technology on the broader transportation system to promote safe, equitable mobility.
- Data-driven analysis conducted in collaboration across cities, states, and AV developers illuminates core trends and defines opportunities for growth and long-term planning needs.
- Data-driven planning processes and decision making to inform future infrastructure development or modifications to support safe deployment of autonomy while keeping pedestrians, cyclists, and other drivers safe.
- Modernized access to, and analysis of, infrastructure data through digitization, frequent monitoring, and near real-time updating. This builds toward a transportation future where all vehicles can be notified of, and appropriately navigate, road closures, construction zones, and dynamic right of way. Digitized infrastructure also enables improved analysis of local and regional evacuation routes, first responder routes, and transportation safety.





Glossary of Terms

Autonomous Vehicle (AV)	A vehicle having the ability to drive by itself using onboard sensors, without the need for intervention from a human driver. Advanced control systems on board the vehicle interpret the sensor information to identify the appropriate navigation paths and obstacles and interpret the relevant signs.
AV Test Areas	Geographic areas in which AV developers evaluate their technology. Early testing may involve closed testing facilities and builds up to testing on public roads, typically with a safety operator in the vehicle.
AV Deployment Areas	Geographic areas in which AV developers offer their service. For ridesharing this could be within a particular geofence within a city or neighborhood, for transit this might be a specific route that the vehicle follows, and for trucking this might be a highway corridor.
Geofence	A virtual perimeter around an area. An AV will only operate within this pre-defined area.
Key Performance Indicators (KPI)	A quantifiable measure used to evaluate the success of a system in meeting objectives.
Operational Design Domain (ODD)	A description of the specific conditions under which a given automated driving system or feature is intended to function, in the automated driving environment. An area that is limited by either geography or operating conditions under which a vehicle or autonomous features may be intended to work. Examples includes freeways, downtown areas, roadways with speed limits < 35 mph.
Preemption	A higher authority of law can prevent a lower authority of law from regulating a certain issue or area. For AVs, this occurs when states mandate that AVs can only be regulated at the state level and cannot be regulated by any other governing authority within the state.
Safety Operator	Supervises AV driving (testing or deployment) to avoid crashes and difficult driving situations. May be remote or physically present in-vehicle.
Safety Performance Indicator (SPI)	A quantifiable measure used to evaluate the success of a system in meeting operational safety objectives.
Technological Fit	The match between an AV's ODD and a given environment. For example, if an AV is not equipped to operate faster than 10 mph, there would be a poor technological fit between that AV and a rural deployment area, where speeds are likely higher.
Transportation Network Companies (TNCs)	Companies that provide prearranged transportation services for compensation using an online-enabled application or platform to connect drivers using their personal vehicles with passengers (e.g., Uber, Lyft, Zipcar).



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Other Resources

- Primer of Definitions for AV Infrastructure and Related AV/CV Terms
- What Do Automated Vehicles Mean for Law Enforcement **Officers?**
- AVs and the City: Co-evolving AVs and Urban Policy
- What Could AVs Mean for State DOTs?

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