AUTOMATED VEHICLES

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INTRODUCTION

With the help of sensors, computers, and machine learning, automated vehicles are navigating increasingly complex driving environments. Eventually, human operators will be optional, and this capability could have dramatic implications for personal mobility, public transportation, and the movement of goods.

As a result, experts anticipate that automated vehicles (AVs) will present major benefits and opportunities including:

- Improved safety by reducing or removing human driving errors, which cause at least 94% of automobile crashes in the United States;
- Increased efficiency of the transportation system by reducing traffic incidents, allowing vehicles to travel closer together, and encouraging car sharing;
- Reduced carbon emissions and improved sustainability of the transportation system;
- Improved mobility for special populations such as the elderly, disabled individuals, and those who are transit-dependent or do not have access to a private vehicle; and
- Potential new roles and service models for bus and paratransit operators due to significantly reduced operational costs.

Figure 1: Automated Vehicles by the Numbers (Source: S&P Global)

Yet, there are also questions about the impact of AVs on a wide array of important policy issues. For instance, how will AVs impact vehicle miles traveled (VMT)? Will AVs promote or discourage active modes of transportation? How will the adoption of AVs change the built environment? Could AVs spark a new wave of development further away from urban centers, or will they catalyze the revitalization of existing neighborhoods and downtowns? What will happen to jobs in the transportation and warehousing sector, a significant sector for San Joaquin County, as AVs displace jobs behind the wheel? How will the transportation system be funded?
once traditional revenue sources become obsolete (e.g. parking revenue, moving violation fees, tax revenues related to vehicle purchase, registration, gasoline consumption, etc.)?

Technological innovation will undoubtedly have significant and transformative impacts on the transportation system. How will AVs shape the future of transportation in San Joaquin County?

To begin addressing this question for the 2022 Regional Transportation Plan and Sustainable Communities Strategy, this briefing packet includes:

- Detailed information about automated vehicle testing;
- Highlights of the policy and planning implications of AVs in the transportation system;
- A menu of potential short- and long-term strategies to consider at the local and regional level; and
- An overview of what is happening throughout San Joaquin County regarding policy and planning for transportation innovation and technology infrastructure.

This briefing is the first in a series that staff will bring to committees and board. The intent of the series is to build understanding and dialogue on emerging issues in regional planning that will help to inform policy recommendations and investments for adoption in the next regional plan.
AUTOMATED VEHICLE TESTING

Definitions and Descriptions

An automated vehicle (AV) can perform some, or all, functions of a human driver. The simplest functions are controlling speed or lane position on the highway. A fully automated vehicle, or a self-driving car, can operate without any human control or even monitoring under certain conditions. The Society of Automotive Engineers (SAE) and the National Highway Traffic Safety Administration (NHTSA) created a standard framework defining six levels of automation (see Figure 2). In brief:

■ Level 0 – No automation. The driver is in complete control of the vehicle at all times.
■ Level 1 – Driver assistance. The vehicle can assist the driver or take control of either the vehicle’s speed, through cruise control, or its lane position, through lane-keeping assistance, in some situations. The driver must monitor the vehicle and road at all times, with hands on the steering wheel and feet on or near the pedals and must be ready to take control at any moment.
■ Level 2 – Partial automation. The vehicle can take control of both the vehicle’s speed and lane position in certain conditions, for example on controlled access highways. The driver may disengage, with hands off the steering wheel and feet away from the pedals but must monitor the vehicle and road at all times and be ready to take control quickly at any moment.
■ Level 3 – Limited self-driving (conditional automation). The vehicle can be in full control in certain conditions, monitors the road and traffic, and will inform the driver when he or she must take control. When the vehicle is in control, the driver need not monitor the vehicle, road, or traffic but must be ready to take control quickly when informed.
■ Level 4 – Full self-driving under certain conditions (high automation). The vehicle can be in full control for the entire trip in these conditions and operates without a driver.
■ Level 5 – Full self-driving under all conditions (full automation). The vehicle can operate without a human driver and need not have human occupants.

Vehicles from Levels 3 to 5 are referred to as having Automated Driving Systems (ADSs). The conditions in which a Level 3 or 4 ADS can operate without a human driver are called the vehicle’s Operational Design Domain (ODD). The boundaries of an ODD may include physical limits (for example, within specified geographic areas), road type (only on limited access highways), road conditions (not on icy or snow-covered roads), light conditions (only in daylight), weather (not in heavy rain or snow), and more. These AV level definitions raise two important points. First, the public and the popular press probably assume that the terms “self-driving cars” or “automated vehicles” refer to a full Level 5. However, most AVs for the foreseeable future will be Levels 2 through 4. Perhaps a more appropriate term would be “occasionally self-driving.” Next, the boundaries between Levels 2, 3, and 4 are not well understood outside of the expert community (Roy, 2018). Some AVs on the road or in development have been informally called Level 2.5.
Designated Testing Sites

Testing sites have been established across the United States with locations on both coasts and the Midwest. The U.S. Department of Transportation has designated ten testing sites as “proving grounds” to encourage safe testing of automated vehicles. The purpose of the designation is to provide an area for the cars to be tested safely. These spaces are also available to test operations as they are being developed, enabling the participants and the general public to learn at a more accelerated rate. Designees were selected from a competitive group that had over 60 applicants. These applicants included academic institutions, state Departments of Transportation, cities, and private entities and partnerships. The selected designees have proving grounds equipped with different facilities that may be used to gauge safety, manage various roadways and conditions, and to handle various types of vehicles.

The designated sites include:

- City of Pittsburgh and the Thomas D. Larson Pennsylvania Transportation Institute
- Texas AV Proving Grounds Partnership
- U.S. Army Aberdeen Test Center
- American Center for Mobility (ACM) at Willow Run, Michigan
- Contra Costa Transportation Authority (CCTA) & GoMentum Station
- San Diego Association of Governments
- Iowa City Area Development Group
DOT initiated a Federal Register Notice soliciting proposals for a pilot program to designate automated vehicle proving grounds in November 2016. The solicitation included broad criteria for selections including a demonstration of capable safety planning, willingness and ability to share and disseminate information, and an ability to show that all applicable laws, regulations, and policies are adhered to at all times. The solicitation also requested information on the types of facilities and research capability that are available to applicants to test automated vehicle technologies.

More details about the designations may be found at www.transportation.gov/AV.

Connected and Automated Vehicles

What is the definition of a connected car? It changes as more and more products are launched.

Connected Car (definition) - the presence of devices in an automobile that connect the devices to other devices within the car/vehicles and or devices, networks and services outside the car including other cars, home, office or infrastructure. Internet access is usually connected to a local area network. Many experts are saying that connected cars are part of the giant Internet of Things.
Connected vehicles have been around since General Motors began working with Motorola Automotive to produce OnStar in 1996. It was created as a safety product that connected cars to emergency responders in the case of an accident. These technologies have developed over time and began to include features such as GPS capabilities and the ability to produce both voice and data at the same time. As technology progressed, its purpose began to morph into other features such as remote diagnostics (diagnosing problems from a distance), vehicle health reports with turn-by-turn directions, and eventually offering 4G LTE Wi-Fi hotspots in the 2014 deployment of the Audi A3. What it means today and what it will be in the future is less certain, but will probably be a mix of 5G networking, car to car communication, and safety features including data privacy and security certificates.

Connectivity enables communication among vehicles, the infrastructure, and other road users. Communication both between vehicles (V2V) and with the surrounding environment (V2X) is an important complementary technology that is expected to enhance the benefits of automation at all levels but should not be and realistically cannot be a precondition to the deployment of automated vehicles. Throughout the nation there are over 70 active deployments of V2X communications utilizing the 5.9 GHz band. U.S. DOT currently estimates that by the end of 2018, over 18,000 vehicles will be deployed with aftermarket V2X communications devices and over 1,000 infrastructure V2X devices will be installed at the roadside.

Current connected and automated vehicle (CAV) testing activities focus on technical assessments, traffic modeling, and proof of-concept/prototype tests to understand how to improve safety, smooth traffic flow, and reduce fuel consumption. Automated driving system (ADS) developers are testing technologies at test tracks, on campuses, and on public roadways across the United States. Pilots on public roads provide an opportunity to assess roadway infrastructure, operational elements, user acceptance, travel patterns, and more.
Testing in the United States; Real Life Examples

Nevada was the first state to authorize the operation of AVs in 2011, since then 21 other states have passed legislation related to AVs. Those states include: Alabama, Arkansas, California, Colorado, Connecticut, Florida, Georgia, Illinois, Indiana, Louisiana, Michigan, New York, North Carolina, North Dakota, Pennsylvania, South Carolina, Tennessee, Texas, Utah, Virginia and Vermont—and Washington D.C. Governors in Arizona, Delaware, Hawaii, Idaho, Maine, Massachusetts, Minnesota, Ohio, Washington and Wisconsin have issued executive orders related to autonomous vehicles.

One of the ten designated testing sites, the Michigan American Center for Mobility, is a highway testing facility that opened in Michigan with the American Center for Mobility. The non-profit test facility focuses on the research and development of automated vehicles. It originally opened in April 2017 but will continue to grow in 2019. This testing site is outdoors and is subject to all four seasons that Michigan experiences, allowing the cars to be tested in harsh winter conditions. It is expected that this year the testing site will have an urban portion that simulates residential streets with road hazards, pedestrians, bike lanes, crosswalks, roundabouts, and other obstacles (see Figure 4).
Arizona continues to compete to be a pioneer in AV technology research and development. Governor Doug Ducey signed an executive order in late August 2015 directing various agencies to “undertake any necessary steps to support the testing and operation of self-driving vehicles on public roads within Arizona.” In October 2018, Governor Doug Ducey and Intel Corporation announced that they were launching an Institute for Automated Mobility to bridge the government and private industry. The purpose of this Institute will be to foster collaboration and innovation between the three Arizona state universities, the Department of Transportation, the Department of Public Safety, Commerce Department and the companies that are developing AV technologies (including automated cars, trucks, and drones).

After welcoming Uber self-driving vehicles into the state, Waymo expanded their self-driving car operations in Chandler, Arizona late in 2018. The company has built out and is using 68,000 square feet in a warehouse in Chandler to continue their testing. This space services and houses several dozen Chrysler Pacifica minivans that provide rides for more than 400 people. These are the people that are participating in the company’s Early Rider Program, which allows the participants to use the vehicles to get around town. They currently have more than 600 cars in their fleet nationwide. Waymo reports that their vehicles have driven more than 8 million miles in 25 different cities. The company also uses simulated technology to test how the vehicles...
react to traffic situations. The cars have driven more than 5 billion simulated test miles in this situation. Waymo is now testing in the Phoenix metro area.

Image: Chrysler Pacifica hybrid minivan in Waymo’s fleet

In October 2018, Waymo won the industry’s first approval to test driverless vehicles on public roads in California. This was the state’s first permit to begin testing the driverless vehicles on public streets and highways. Permitted testing is ongoing in parts of Mountain View, Sunnyvale, Los Altos, Los Altos Hills and Palo Alto in northern California.

As of January 28, 2019, there are 62 “Autonomous Vehicle Testing Permit Holders” in the state. This list includes Honda, Ford, Volkswagen Group of America, Waymo, Tesla, AAA, and several other well-known companies.
Another example that is much closer to home is GoMentum. GoMentum, one of the ten designated AV testing facilities, is the largest in the United States. They recently expanded a previous partnership with AAA to test in Concord at the Concord Naval Weapons Station. It has 20 miles of paved roadways, as well as under-crossings, over-crossings, tunnels, railroad tracks, and a mini city.

The GoMentum acquisition is just one of the ways that the AAA Northern California chapter is building its innovation portfolio. For example, the AAA Northern California chapter launched a driverless shuttle pilot program in late 2017 in Las Vegas, Nevada, which it recently wrapped up. The goal of the one-year program was to expose the public to autonomous vehicles and gather ridership information.

At the end of the one-year program, 30,083 passengers had ridden on the shuttles, of which 98 percent said they would recommend the experience to a friend. And when comparing riders' reactions before and after the shuttle ride, there was a 30 percent increase in those who had a positive attitude towards the technology, according to data gleaned by the chapter. AAA Northern California also owns and operates GIG Car Share, which is a fleet of electric vehicles that can be picked up in one location and dropped off in another. GIG Car Share operates in Oakland and is expanding into Sacramento in 2019.

AUTOMATED VEHICLE PROJECTIONS

Forecasting the Future

Fully automated vehicles (Level 4) are expected on the market by 2020 but consumption should be minimal because of high prices in a small market. Usage is predicted to be limited to a few types of commercial trucking and shuttle services. Further, it will be restricted to dedicated lanes and controlled settings depending on the state's restrictions. Consumer expenditures on semi-automated vehicles is expected to grow and introduce fully driverless vehicles (Level 5) by 2030.
Between 2030 and 2040, fully automated vehicles for both individual use and shared mobility could make up 20% to 30% of the urban roadway network. Fully automated vehicles for commercial use are also expecting continued growth. Once infrastructure expands, AVs will go beyond high-density metropolitan areas into suburbs and then into rural regions. By 2040, AVs are predicted to represent 50% of all new car sales and comprise 35% of the total U.S. car fleet based on S&P Global’s high disruption scenario (see Table 1). High disruption implies AVs are quickly implemented and quickly grow in number after 2030.

Since AV integration relies on myriad factors such as regulations, demographics, public perception, and supporting infrastructure, forecasts generally have several different scenarios. S&P’s projections have three different scenarios: low disruption, medium disruption, and high disruption.

*Table 1: AVs Full Automation (Level 4-Level 5) Growth Scenarios (Source: S&P Global)*

<table>
<thead>
<tr>
<th>Phase I: 2020 - 2030</th>
<th>Low Disruption</th>
<th>Medium Disruption</th>
<th>High Disruption</th>
</tr>
</thead>
<tbody>
<tr>
<td>AV sales as % of total light vehicle sales by 2030</td>
<td>~2%</td>
<td>~15%</td>
<td>~30%</td>
</tr>
<tr>
<td>AV fleet share of U.S. car fleet by 2030</td>
<td>&lt;1%</td>
<td>&lt;5%</td>
<td>&lt;10%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Phase II: 2030 - 2040</th>
<th>Low Disruption</th>
<th>Medium Disruption</th>
<th>High Disruption</th>
</tr>
</thead>
<tbody>
<tr>
<td>AV sales as % of total light vehicle sales by 2040</td>
<td>~10%</td>
<td>~30%</td>
<td>~50%</td>
</tr>
<tr>
<td>AV fleet vs U.S. car inventory by 2040</td>
<td>&lt;5%</td>
<td>&lt;15%</td>
<td>&lt;35%</td>
</tr>
</tbody>
</table>

S&P Global Ratings projects AVs will approach 10% share of U.S. light vehicles by 2025. Once Level 5 AVs are rolled out around 2030, AVs share of the U.S. fleet is expected to rise exponentially.
Both the medium and high disruption scenarios in Figure 5 show AVs as a share of the total U.S. fleet rising significantly around 2030.

Roadways in Transition

Because the gradual rise of AVs as a share of the total fleet will occur over an extended period of time, it will be important to address safety as roadways transition from primarily human-driven vehicles to AVs. Some of the safety considerations raised in the literature include the following:

1. During the transition, AVs may introduce new safety risks linked to the rapid introduction of new technology such as equipment malfunctions, machine error, difficult driving situations, and difficult road conditions.

2. Traffic safety risks may increase in the near-term as human drivers interact with semi-autonomous technology. Ironically, as semi-automated systems make cars safer, they may also reduce driver awareness. More generally, Yerkes-Dodson law demonstrates how too little stimulation can make people complacent while too much stimulation can be overwhelming. A distracted driver may be unable to sufficiently respond to a hazardous situation or an automated-systems failure. Autopilot flight systems offer a helpful case study. The FAA and other agencies have expressed concern that pilots are over-reliant on automation. Fully-automated vehicles will make roadways safer, but that transition will come with some risks.

3. Miscommunication between the AV and human operators. Many of the early AVs are expected to possess Level 2, 3, or 4 automation instead of Level 5. This would require the operator to retake control of the vehicle in certain situations, leading to a set of
problems related to vehicle-to-operator miscommunication in the early stages of adoption.

4. Vehicle hacking may pose a new cause of traffic incidents and injuries, particularly in the early years when cybersecurity systems may not be as robust.

AV BENEFITS, CHALLENGES, AND OPPORTUNITIES

Despite uncertainties around how AV technology will evolve, consumer behavior, as well as legal and regulatory barriers, the potential impact of automated vehicle (AV) technology will be vast, with both positive and negative implications. Government has a role in identifying, anticipating, and responding to negative consequences. Therefore, planners and policy makers have the responsibility of striving to capitalize on the opportunities while mitigating the challenges. This section highlights important considerations to be made in planning and policy making around the benefits, challenges and opportunities presented by AVs in the following areas:

- Safety
- Transportation System Efficiency
- Environment
- Social Equity
- Transit
- Active Transportation
- Built Environment
- Land Use
- Jobs & Economy
- Transportation Funding
- Community Engagement

Safety

In 2015, 6.3 million automobile crashes occurred in the United States. Of these crashes, 94 percent were attributable to human error. While AVs will not eliminate traffic accidents, their ability to reduce or remove human driving errors, such as mistakes made while drowsy, distracted, or intoxicated, may significantly reduce traffic crashes and traffic-related fatalities.

While the sample of AV testing in real-world environments remains too small to draw definitive conclusions, early testing has provided promising indications of AV’s potential to reduce traffic accidents and traffic-related injuries. However, additional testing will be necessary to verify whether AVs will improve the safety of users in real-world conditions.

It is worth noting that the Stockton-Lodi metropolitan area was recently named the worst region in California to drive, according to an index composed of several driving-related factors including average commute time, traffic fatalities, car thefts. While unfortunate, such a designation could be steered in the direction of tech companies looking to test the most challenging real-world conditions.
Transportation System Efficiency

The adoption of AVs is expected to improve the efficiency of the transportation system in several ways:

- Reducing congestion caused by traffic incidents
- Allowing vehicles to travel closer together
- Allowing vehicles to travel in harmony
- Improving throughput through intersections
- Reducing vehicle size
- Encouraging car sharing and ride sharing

It is estimated that the full market penetration of AVs could more than double vehicle throughput in the transportation system. However, these benefits may not be realized if AVs increase VMT, which could, depending on other variables, increase congestion and carbon emissions. In fact, a survey of experts in the field estimated that VMT could increase anywhere between 5 and 40 percent (MTC 2018).

Environment

Closely related to AVs’ traffic efficiency benefits is their potential to reduce carbon emissions and improve the sustainability of the transportation system. AVs are capable of reducing vehicle emissions by:

- Improving fuel efficiency through more efficient traffic patterns and driving behavior
- Converging automated and electric vehicle technology in the future. It has been estimated that a fully automated fleet of electric vehicles could reduce emissions by as much as 90 percent.
- Increasing traffic efficiency and throughput

Yet, whether these efficiencies will lead to a decline in congestion and total emissions will ultimately depend on how AV technology affects travel demand. Consequently, the planner and policy maker roles regarding AVs’ impacts on emissions will remain similar to what they have been since the introduction of the automobile. They will need to continue to seek creative ways to address traffic congestion, promote the use of transit and active modes of transportation, mitigate potential increases in VMT, and promote the development and use of EVs.

Social Equity

Automated vehicle technology presents the chance to improve mobility for special populations. This population includes children, elderly, disabled individuals, as well as those who are transit-dependent or do not have access to a private vehicle. In today’s transportation system, those who are unable to drive are often left with few transportation options. It will be important for planners and policy makers to recognize the needs of these special populations and work toward unlocking potential mobility benefits of AVs.
Transit

The introduction of AV technology could have a significant effect on the roles and service models of bus networks and paratransit. One of the most exciting opportunities for transit agencies is the potential to significantly reduce operational costs by removing labor costs (e.g. bus operator). Cost savings could be used to make significant improvements in service by increasing route coverage or frequency.

Active Transportation

Another pressing question is whether AVs will ultimately promote or discourage the use of active modes of transportation. On one hand, AVs may require less space than human-driven vehicles, opening up new opportunities to retrofit vehicular infrastructure into bicycle and pedestrian facilities. On the other hand, AVs could reinforce an auto-oriented transportation system and new infrastructure could fragment bicyclist and pedestrian networks. Ultimately it will be up to planners and policy makers to find a way to balance these issues.

Built Environment

Maximizing the benefits of automated vehicles will in part, depend on the re-purposing of roadways and neighborhoods to maximize efficiency. The adoption of AVs is expected to change many areas of the built environment, including:

- **Right-of-way:** Narrower pavement widths will be possible because of increased safety so there will be increased throughput for AVs and wider pedestrian spaces.
- **Signage and Signalization:** Vehicle to vehicle and vehicle to infrastructure technology can substitute the usage of most signage. The only necessary signage will be for pedestrians and bicyclists.
- **Bike Lanes:** If adequately invested, separate and protected bike lanes will create high quality riding space but AVs are still expected to become the dominant mode of transportation.
- **Parking:** With the introduction of shared fleet business models, the need for proximate parking may decrease. AVs will be able to drop off passengers at their destination and either drive to the next passengers, find parking in a consolidated location, or return to a home base. However, it is important to note that there is an ongoing debate about whether this model could potentially increase VMT, especially with the introduction of zero occupancy vehicles.
- ** Redevelopment Opportunities:** Reducing parking could free up space for community use, or residential and commercial developments (see Figure 6).
AVs represent the most significant advancement in personal mobility since the mass production of the automobile and will affect the location decisions of both residents and businesses. There is an ongoing debate over whether AVs will spark a new wave of development further away from urban centers or the revitalization of urban centers.

Some of the ways AVs may encourage auto-oriented development include:
- Making travel less stressful
- Allowing commuters to travel farther in the same amount of time
- Reducing the monetary cost of travel

Some of the ways AVs may promote more compact development patterns:
- A shared-AV system could enable people to discard their private vehicles and move into more walkable communities

Land Use
Jobs and Economy

According to the U.S. Department of Commerce, 15.5 million of jobs behind the wheel could be affected by the introduction of AVs for commercial use. However, the American Trucking Association which estimates trucking employs over 3 million people, predicts a shortage of 75,000 truck drivers by 2024 because of a limited candidate pool. One estimate suggests that economic gains from driverless vehicles in the trucking industry could range from $100 billion to $500 billion a year mainly by eliminating the cost of driver wages. It is possible that some of these positions would shift from actual driving to technical monitoring of the systems that control the trucks (Clements & Klockelman 2017).

Jobs in the warehousing and e-commerce industries are on an upward growth curve, and the future of AVs for commercial use in this capacity is a highly likely scenario. In San Joaquin County alone, Stockton-Lodi metropolitan statistical area (MSA) became the third area in the nation to see its employment in the transportation and warehousing sector exceed employment in the retail sector. Since 2014, transportation and warehousing employment has seen nationwide growth due to services like ridesharing and growth in e-commerce (Figure 7) (CBPR, 2019). More online goods being delivered to your doorstep means more delivery trucks on the road. However, AV delivery trucks are the future; in fact, Budweiser beer successfully delivered 51,744 cans in 2016 through a startup Uber automated truck service, Otto. This automated truck completed a 120-mile trek in Colorado. The companies have called this the first commercial delivery using a self-driving truck (Mcfarland, 2016), and that was merely the beginning of the future of automated deliveries.

Figure 7: Comparative Employment Shares of the Transportation and Warehousing Sector
(Source: UOP CBPR)
The technology of AVs allows delivery trucks to become intelligent, efficiency maximizing transportation of goods. This ultimately is expected to increase economic development by reducing costs through eliminating labor costs and minimizing transportation times. However, these impacts will not be immediate, and benefits are not predicted to materialize until 2030 once a more significant share of vehicles are automated (S&P Global Ratings Report).

Transportation Funding

The introduction of connected and automated vehicle technology on the one hand presents opportunities for municipal services to be delivered more cost-effectively. On the other hand, many of the traditional revenue sources funding the transportation system may need to be reconsidered. Example of items to consider include:

- Transit operating agency costs and revenues
- Parking revenues
- Speed ticket violation fees
- Tax revenues related to vehicle purchases, registration fees, gasoline consumption, and/or VMT
- Insurance costs
- Incident management costs

Community Engagement

The introduction of automated Uber cars has received mixed reactions from the public. In fact, in San Joaquin County, 45% of residents who participated in the 2018 Regional Transportation Needs Survey do not think planning for this technology is important. Continued outreach, education, and dialogue with residents will be important to respond to varying levels of acceptance, to ensure the public fully understands the benefits and challenges of AV technology, and to address concerns around the safe integration of AVs in communities.
DEVELOPING A POLICY FRAMEWORK FOR THE REGION

The Role of Government in the Deployment of Connected and Automated Vehicles

There are many benefits that connected and automated vehicle (CAV) technology promises, including reduction in traffic deaths, increased mobility for the disabled and seniors, reduced congestion, and enhanced connectivity for all. Like the changes already brought by shared mobility and digital ride-hailing services, CAVs will change the way that we travel and how businesses operate.

Figure 8: Proposed Government Role in Driverless Vehicles (Source: WSP/Parsons Brinckerhoff)
Involvement now and in the future of CAV deployment will maintain the government’s role in protecting individuals’ safety and improving mobility (see Figure 8). The federal government will need to update, establish and enforce policies and regulations related to safety, privacy/data sharing and cyber security, as well as establish and enforce vehicle and safety standards. On the other hand, state and local governments will need to update, establish and enforce policies and plans for mobility, infrastructure, transit and financials.

At the regional level, various entities will have jurisdiction over driverless vehicles, including transit operators, the metropolitan planning organization, the air quality district, departments of transportation, highway departments, departments of motor vehicles, departments of insurance and departments of public works. Ongoing discussion, planning and coordination amongst these stakeholders can help to shape thoughtful policies.

Potential Local and Regional Strategies for Consideration

Because emerging technologies will have significant and transformative impacts on the transportation system, local and regional agencies will need to start planning for these impacts now. The following is a compilation of potential local and regional action developed by reputable sources (Table 2). The chart includes the following suggestions for local and regional agencies and decision-makers:

- Short-term planning activities
- Medium- to long-term activities, including planning and infrastructure modifications
- Policy development
- Miscellaneous activities

Short-term planning activities need not be time consuming or labor intensive. In fact, some of the jurisdictions in the region have already taken action on suggested short-term planning activities (See San Joaquin County AV Policy & Projects Inventory). However, policy development and medium- to long-term activities will require significantly more resources and political will. Through a proposed San Joaquin County Transportation Innovation Study, SJCOG intends to address the more intensive policy development discussions with member agencies and key stakeholders.
<table>
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<th>Table 2: Potential Local and Regional Planning and Policy Activities</th>
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<tr>
<td><strong>Near-Term Activities</strong></td>
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<tr>
<td><strong>Local</strong></td>
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<tr>
<td>Incorporate CAV into city goals and/or policies</td>
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<td><strong>Regional</strong></td>
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<td>Establish communications and/or committee with CAV stakeholders</td>
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<tr>
<td><strong>Both Local &amp; Regional</strong></td>
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<tr>
<td>Stay educated on the development and progress of CAV technology</td>
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<td>Establish policies and plans with consideration for the future</td>
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<td>Support and facilitate safe testing and operation of automated vehicles on streets</td>
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<td>Encourage open data sharing</td>
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<td>Engage with citizens</td>
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<tr>
<td><strong>Medium to Long-Term Activities</strong></td>
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<tr>
<td><strong>Local</strong></td>
</tr>
<tr>
<td>Consider how land use, including curb space and parking, will be affected</td>
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<tr>
<td>Consider how to integrate connected and automated vehicle technology in the built environment (e.g. what are needed updates to traffic signalization, road markings, lane widths, posted speed limits, etc.)</td>
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<tr>
<td><strong>Regional</strong></td>
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<tr>
<td>Update travel demand model</td>
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<tr>
<td>Work with local jurisdictions to evaluate and coordinate future road capacity needs</td>
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<td>Work with transit operators to assess transit service delivery plans and fleet requirements</td>
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<tr>
<td><strong>Both Local &amp; Regional</strong></td>
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<tr>
<td>Develop capacity to process, store, and utilize large amounts of data</td>
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<tr>
<td>Forecast financial implications</td>
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<tr>
<td>Plan and implement electric vehicle charging infrastructure</td>
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<tr>
<td>Develop new predictive models for pavement maintenance</td>
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<tr>
<td>Develop and/or certify roads for driverless and/or manual operation</td>
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<tr>
<td><strong>Policy Activities</strong></td>
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<tr>
<td><strong>Local</strong></td>
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<tr>
<td>Adjust land use policies to integrate connected and automated vehicles</td>
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<tr>
<td><strong>Regional</strong></td>
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<tr>
<td>Work with local agencies to adjust land use policies to integrate connected and</td>
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<td><strong>Both Local &amp; Regional</strong></td>
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<tr>
<td>Update roadway policies and infrastructure to manage the VMT impact</td>
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<td>That support sustainable communities</td>
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<tr>
<td>Alter parking policies to facilitate the integration of connected and automated vehicles</td>
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</tbody>
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**Miscellaneous Activities**

- Update enforcement function within government
- Update incident management function within government
- Incorporate driverless technology into government services
- Update government workforce to match needs
SAN JOAQUIN COUNTY AV POLICY & PROJECTS INVENTORY

AV language from existing planning and policy documents across San Joaquin County¹


To encourage “real world” testing of automated vehicle technology, the Board of Supervisors adopted a proclamation essentially opening up streets and roads under the jurisdiction of San Joaquin County for collaboration opportunities with software and technology firms pioneering the development of passenger and freight vehicles with automated functionality.


At the request of the Regional Innovation for Sustained Excellence (RISE) committee, along with San Joaquin County Supervisors Chuck Winn and Bob Elliott, the City of Lodi Council Members adopted a resolution in support of automated vehicle testing over roads within the City’s jurisdiction as a means to encourage advancement of this technology and to create economic benefit.


Goals and Policies related to automated Vehicles:

Goal TR-3: Sustainable transportation. Design transportation infrastructure to help reduce pollution and vehicle travel

Policy TR-3.2 Require new development and transportation projects to reduce travel demand, support electric vehicle charging, and accommodate multi-passenger automated vehicle travel as much as feasible.

Action TR-3.2C Respond to the implications and opportunities associated with connected vehicles and automated vehicles by monitoring technological

¹ No policy language regarding connected and self driving vehicles found while searching general plans and recent city council agendas in the cities of Escalon, Lathrop, Manteca, Ripon, and Tracy.
advances and adjusting roadway infrastructure and parking standards to accommodate automated vehicle technology and parking needs.

Goal LU-2: Strong downtown. Strengthen the Downtown to reinforce it as the region’s center for government, business, finance, arts, entertainment, and dining

Policy LU-2.3 Encourage more Downtown community and regional entertainment venues.

Action LU-2.3C Develop curbside management policies that are flexible to accommodate the evolving nature of ride-sharing programs and future reliance on automated vehicles in the Downtown.

San Joaquin Council of Governments, Regional Transportation Plan & Sustainable Communities Strategy: Chapter 7 - Technological Innovations (2018)

RTP/SCS language related to Connected automated Vehicles:

SJCOG is exploring ways to facilitate the adoption of infrastructure technologies and is working with its regional partners to develop the supportive policies needed to aid CAV deployment in San Joaquin County. Tools such as incentive programs and planning grants can bring innovation into the region by encouraging local jurisdictions and private companies to test pilot projects. Infrastructure such as lane width, road striping, traffic signalization, pedestrian walkways, and congestion monitoring also need to be modernized to allow for a CAV fleet.

A future regional innovation grant program will be created by SJCOG to fund infrastructure modernization projects. First steps in establishing the program will include identifying funding sources and working with a technical advisory committee to develop program criteria, project eligibility and scoring metrics. The types of projects to eventually be funded is speculative at this time; however; projects being considered for funding in other areas include:

- Transit and/or Freight Signal Priority
- Mobile Accessible Pedestrian Signal System
- Freight Dynamic Travel Planning/Performance
- Dynamic Transit Operations
- Dynamic Speed Harmonization
- Probe-Enabled Traffic Monitoring
- Probe-Based Pavement Maintenance

RTP/SCS language related to Self-Driving Cars:

- Assist local jurisdictions and transit operators in securing AFV grant programs
- Work with the Air District and partners to implement recommendations from the 2014 PEV Readiness Plan
- Actively search for regional level funding opportunities and assist local jurisdictions and transit operators in securing AFV grant funding
The San Joaquin Valley Air Pollution Control District (Air District) offers a myriad of grants, incentive programs, and resources for residents, public agencies, and businesses in the San Joaquin Valley.

In addition to passenger vehicle use, CAVs are also being developed for the goods movement sector. SJCOG encourages partner agencies and transit operators to support widespread transportation electrification by partnering with state agencies to advance California standards and goals. An existing model is the California Electric Vehicle (EV) Ready Communities Challenge grant program. This program seeks to fund the development of a “blueprint” of actions and milestones to make a community EV ready - with an emphasis on charging infrastructure deployment in disadvantaged communities.

RTP/SCS language related to technology innovations and transit:

The path forward for public transit may have transit providers take on more of a travel broker role and form strategic relationships with private companies while still providing certain traditional transit services. Logistic issues such as rider education and infrastructure changes will need to accompany any microtransit additions to a region. SJCOG will be working with local transit providers to help identify funding to pursue pilot program opportunities and find ways of making rural transit a more cost-effective service.

Current or Proposed Projects throughout San Joaquin County

San Joaquin County Automated Vehicle Testing Program

This program encourages innovative companies to bring forth technological advances in transportation to test and establish facilities for testing in San Joaquin County (SJC). This will also allow partnership between San Joaquin County and GoMentum Station, the largest automated vehicle testing facility in the nation. Link for more info: http://sanjoaquincountyca.igm2.com/Citizens/Detail_LegiFile.aspx?ID=4850&highlightTerms=autonomous%20vehicles

Shared Automated Vehicle Demonstration Project

The project will demonstrate the use of a Shared automated Vehicle (SAV) in Downtown Stockton. San Joaquin Regional Transit District (RTD), in partnership with the City of Stockton and San Joaquin County, are seeking a U.S. Department of Transportation Automated Driving System Demonstration Grant to implement the project. While the project budget and budget breakdown are currently being developed, the project cost is estimated to be between $5 and $7 million. Link for more info: https://sjcog.legistar.com/LegislationDetail.aspx?ID=3897430&GUID=443620CB-BF07-4118-B001-0EDA692C423B
San Joaquin County Transportation Innovation Planning Study

The proposed study will identify and determine transportation innovations for implementation and adoption in San Joaquin County. Specifically, the study will address the following objectives:

- Review of existing data and technology initiatives led by SJCOG and other public and private entities in the region;
- A policy framework to inform SJCOG’s regional role in advancing the adoption of transportation innovations in the region;
- An evaluation of various technology innovations using criteria and metrics developed by a working group; and
- The recommendation of one technology innovation for further planning and piloting through a sub-grant set-aside for this purpose.

The study is proposed for a SB1 Formula Planning Grant allocated to SJCOG. The study will kick off in Fiscal Year 2019-2020.

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