Planning for Autonomous Vehicles

Transportation Policy Committee
November 15, 2017
### Important Facts About the Current State of Travel

**Source:** "On the Road to Fully Self Driving – Waymo Safety Report", Waymo, Inc., October 2017

#### SAFETY

- **94%** of U.S. crashes involve human error. [1]
- **1.2 million** deaths worldwide due to vehicle crashes in 2013. [2]
- **37,461** road deaths in the U.S. in 2016 and 2.4 million injuries in 2015. [3]
- **2 out of 3** people will be involved in a drunk driving crash in their lifetime. [4]

#### SOCIETY

- **$594 billion** in harm from loss of life and injury each year. [5]
- **$277 billion** in annual economic costs. [6]
- **$160 billion** in gas burned and time lost each year. [7]

#### MOBILITY AND QUALITY OF LIFE

- **3 million** Americans age 40 and older are blind or have low vision. [8]
- **79%** of seniors age 65 and older living in car-dependent communities. [9]
- **42 hours** wasted in traffic each year per person. [10]
<table>
<thead>
<tr>
<th>Human driver monitors the road</th>
<th>Automated system monitors the road</th>
<th>Steering and acceleration/deceleration</th>
<th>Monitoring of driving environment</th>
<th>Fallback when automation fails</th>
<th>Automated system is in control</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 NO AUTOMATION</td>
<td></td>
<td></td>
<td></td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>1 DRIVER ASSISTANCE</td>
<td></td>
<td></td>
<td></td>
<td>SOME DRIVING MODES</td>
<td></td>
</tr>
<tr>
<td>2 PARTIAL AUTOMATION</td>
<td></td>
<td></td>
<td></td>
<td>SOME DRIVING MODES</td>
<td></td>
</tr>
<tr>
<td>3 CONDITIONAL AUTOMATION</td>
<td></td>
<td></td>
<td></td>
<td>SOME DRIVING MODES</td>
<td></td>
</tr>
<tr>
<td>4 HIGH AUTOMATION</td>
<td></td>
<td></td>
<td></td>
<td>SOME DRIVING MODES</td>
<td></td>
</tr>
<tr>
<td>5 FULL AUTOMATION</td>
<td></td>
<td></td>
<td></td>
<td>SOME DRIVING MODES</td>
<td></td>
</tr>
</tbody>
</table>

Levels of Automation

GM “Super Cruise”

Tesla Model S

Waymo (Google)
Automated Vehicle (AV) Technology

The Nuts and Bolts of a Connected and Autonomous Vehicle

- **Central Computer**
- **Cellular Connectivity**
- **Ultrasonic Sensors**
- **Video Cameras**
- **Radar Sensors**
  - Helps track spatial positioning.
- **Laser Mapping (Lidar)**
  - Creates a map of area adjacent to the vehicle.
- **GPS**
- **Dedicated Short Range Communications (DSRC) Radio**
- **Infrared**

Distance: 650 ft.
How will autonomous vehicles arrive?

- **Fully Autonomous**
  - Personal Automation
  - Shared Automated/Platooning

- **Semi-Autonomous**
  - Business as Usual

- **Driver**
  - Personally Owned
  - Shared Mobility

- **Mobility Fleets**
50% Penetration for Partial AV by 2030 or Not

Source: HDR Engineering, Inc.

- **Scenario 1**: Early AV Adopters
- **Scenario 2**: Rise of the AVs
- **Scenario 3**: Limited AV Adopters
- **Scenario 4**: AV Domination

© 2017, All Rights Reserved.
Why does this matter?

How does this effect us?
Where Self-Driving Cars Go to Learn

Arizona’s promise to keep the driverless car industry free of regulations has attracted dozens of companies, including Uber, Waymo and Lyft.

By CECILIA KANG. NOV. 11, 2017.

A Unique Opportunity . . .

- New Travel Choices
- Ridesharing
- Reduced Car Ownership

- Repurposed Parking
- Space for Housing
- Public Space

- Safer Streets
- Improved User Experience
- Efficient Network Management

- Higher Efficiency Transit
- Lower Operating Costs

...but not without risks.

- Increased VMT
- Empty Vehicle Circulation
- Fight for the Market

- Urban Sprawl
- Higher Congestion
- Longer Travel Times

- Cyber Attacks
- Privacy Concerns

- Declined in Transit Use
- Inequity

Source: Future Mobility Research Program, Metropolitan Transportation Commission, San Francisco Bay Area, October 2017. Downloaded November 1, 2017.
# Literature Review Ranges for Key Variables

## Timing
- **3 to 13 years** until fully driverless vehicles available for purchase.

## Safety
- **+40% to +90%** increase in safety.

## Capacity
- **0% to +45%** increase in roadway capacity.

## Demand
- **+5% to +40%** increase in VMT.

## Energy/Emissions
- **-50% to +100%** change in GHG emissions.

---

Source: Future Mobility Research Program, Metropolitan Transportation Commission, San Francisco Bay Area, October 2017. Downloaded November 1, 2017.
Research

The National Academies of Science, Engineering, and Medicine

Transportation Research Board

U.S. Department of Transportation • Federal Highway Administration • Federal Highway Administration • Federal Transit Administration • National Highway Traffic Safety Administration • State Departments of Transportation • American Association of State Highway and Transportation Officials • Association of Metropolitan Planning Organizations • National Association of Regional Councils • National League of Cities
### Potential Benefits


<table>
<thead>
<tr>
<th>Driving Externality</th>
<th>Connected Vehicles</th>
<th>Autonomy</th>
<th>Share Autonomy</th>
<th>Electric Fleet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety</td>
<td>😃</td>
<td>😃</td>
<td>😅</td>
<td>😞</td>
</tr>
<tr>
<td>Congestion</td>
<td>😃</td>
<td>😃</td>
<td>😅</td>
<td>😞</td>
</tr>
<tr>
<td>Emissions</td>
<td>😃</td>
<td>😅</td>
<td>😅</td>
<td>😞</td>
</tr>
<tr>
<td>Land Use</td>
<td>😃</td>
<td>😅</td>
<td>😅</td>
<td>😞</td>
</tr>
<tr>
<td>Mobility</td>
<td>😃</td>
<td>😅</td>
<td>😅</td>
<td>😞</td>
</tr>
</tbody>
</table>

- 😃: Strong
- 😃: Some
- 😅: Weakest
- 😞: Uncertain

- New Users
  - Elderly/Youth Mobility
  - ADA Mobility
  - Career Choices
  - Leisure Pursuits
  - Social
- Economic Instruments
  - Fuel Taxes
  - Value Added Taxes
  - Vehicle Age Taxes
- Regulatory Instruments
  - Insurance Requirements
  - Establish/Update Rules of the Road and License Requirements
- Structure of Private Rights
- Service Provisions
- Information/Education
- Financing/Contracting/Collaboration

When car ownership fades, this parking garage will be ready for its next life

If fewer people were to own and drive their own cars, parking lots and garages could be converted to other uses. Architecture firm Design illustrated how a parking structure might be turned into offices. (Design)

By Roger Vincent

How will these vehicles affect our planning process?
Scenario Planning
CONNECTED VEHICLE/AUTONOMOUS VEHICLE FUTURE

Uncertainty

Future - 2050

COMMON INFRASTRUCTURE NEEDS AMONG SCENARIOS

Today - 2017

High:
Wide-spread Use

Medium:
Widely Deployed

Low:
Niche Vehicles

Uncertainty

Scenarios depicted in this slide are for illustration purposes, only.
Developing **Imagine**
MAG’S NEXT REGIONAL TRANSPORTATION PLAN

- Pick a range of scenarios.
- Focus what is in our control.
- Look for collaboration opportunities.
- Constantly reassess.
- Relax!

Photo source: Fiat-Chrysler, downloaded 10/16/2017.
Roles for MAG to Consider

- Serve as an information clearinghouse.
- Evaluate a range of effects on long-range plans.
- Consider developing guidance documents, templates, etc. for use by local governments.
Planning for Autonomous Vehicles

Transportation Policy Committee
November 15, 2017