Automation & Sharing: Transforming Land Use, Transportation and Safety

Susan Shaheen, PhD
Email: sshaheen@berkeley.edu
Twitter: SusanShaheen
LinkedIn: Susan Shaheen
Overview

- Shared Mobility & Impacts
- Role of Automation
- Shared Mobility & Built Environment
- AV Policy Development
- AV Opportunities & Challenges
- Upcoming & Recent Research
What is Shared Mobility?

**Core & Incumbent Services**
- Car Rental
- Liveries/Limos
- Paratransit
- Pedicabs
- Public Transit
- Shuttles
- Taxis

**Innovative Services**
- Carpool
- Vanpool
- Casual Carpool
- Bikesharing
- Carsharing
- Courier Network Services
- e-Hail
- High-Tech Company Shuttles
- Microtransit
- P2P Bikesharing
- P2P Vehicle Sharing
- Ridesourcing/TNCs
- Scooter Sharing

Shaheen et al., 2016
Shared Mobility Impacts

Environmental Effects
• Can yield lower GHG emissions via decreased VMT, low-emission vehicles, carbon offset programs
• Can reduce vehicle ownership

Social Effects
• Offers “pay-as-you-go” alternative to vehicle ownership
• Reasonable for college students and low-income households
• Can increases mobility of low-income residents, disabled, and college students
• Provides car use without bearing full ownership cost

Transportation Network Effects
• Takes cars off the road via reduced VMT, forgone/delayed vehicle purchases or sale of vehicle
• Reduced parking demand
• Can complement/complete with alternative transportation modes, e.g., public transit, walking, biking, etc., and can help address first and last mile issue

Shaheen, 2017
Recent Study of One-Way Carsharing

**ONE-WAY CARSHARING IMPACTS**

**Member Vehicle Holdings**

- **2% - 5%** sold a vehicle
- **1 - 3** vehicles sold per car2go vehicle
- **7% - 10%** postponed a vehicle purchase
- **4 - 9** vehicle acquisitions suppressed per car2go vehicle

1 car2go vehicle replaces 7-11 vehicles

or 28,000 vehicles across 5-city study

**Reduction of VMT and GHG emissions**

- **6% - 16%** Average reduction of VMT per car2go household
- **4% - 18%** Average reduction of GHG emissions per car2go household

Martin et al., 2016
## Vehicle and GHG Impacts from Free-Floating One-Way Carsharing

<table>
<thead>
<tr>
<th>City</th>
<th>Vehicles Sold</th>
<th>Vehicles Suppressed (foregone purchases)</th>
<th>Total Vehicles Removed per Carsharing Vehicle</th>
<th>Range of Vehicles Removed per Carsharing Vehicle</th>
<th>% Reduction in VMT by Car2go Hhd</th>
<th>% Reduction in GHGs by Car2go Hhd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calgary, AB (n=1,498)</td>
<td>2</td>
<td>9</td>
<td>11</td>
<td>2 to 11</td>
<td>-6%</td>
<td>-4%</td>
</tr>
<tr>
<td>San Diego, CA (n=824)</td>
<td>1</td>
<td>6</td>
<td>7</td>
<td>1 to 7</td>
<td>-7%</td>
<td>-6%</td>
</tr>
<tr>
<td>Seattle, WA (n=2,887)</td>
<td>3</td>
<td>7</td>
<td>10</td>
<td>3 to 10</td>
<td>-10%</td>
<td>-10%</td>
</tr>
<tr>
<td>Vancouver, BC (n=1,010)</td>
<td>2</td>
<td>7</td>
<td>9</td>
<td>2 to 9</td>
<td>-16%</td>
<td>-15%</td>
</tr>
<tr>
<td>Washington, D.C. (n=1,127)</td>
<td>3</td>
<td>5</td>
<td>8</td>
<td>3 to 8</td>
<td>-16%</td>
<td>-18%</td>
</tr>
</tbody>
</table>
Key Considerations for Replacing Private Vehicles

- Density & built environment (e.g., urban form/walkability, higher density, land use, mixed-use, transit oriented development, etc.)
- Availability & affordability of multi-modal options
- “Network effect” and right scaling
- High reliability with both on-demand and reservation capability
- Availability of real-time information services and convenient fare payment options
- Supportive public policy (users & operators)
Convergence

Electrification

Mobile Technologies

Shared Mobility

Automation

T. Papandreou, 2016

SECA
Levels of Automation

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE) AUTOMATION LEVELS

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No Automation&lt;br&gt;Zero autonomy; the driver performs all driving tasks.</td>
</tr>
<tr>
<td>1</td>
<td>Driver Assistance&lt;br&gt;Vehicle is controlled by the driver, but some driving assist features may be included in the vehicle design.</td>
</tr>
<tr>
<td>2</td>
<td>Partial Automation&lt;br&gt;Vehicle has combined automated functions, like acceleration and steering, but the driver must remain engaged with the driving task and monitor the environment at all times.</td>
</tr>
<tr>
<td>3</td>
<td>Conditional Automation&lt;br&gt;Driver is a necessity, but is not required to monitor the environment. The driver must be ready to take control of the vehicle at all times with notice.</td>
</tr>
<tr>
<td>4</td>
<td>High Automation&lt;br&gt;The vehicle is capable of performing all driving functions under certain conditions. The driver may have the option to control the vehicle.</td>
</tr>
<tr>
<td>5</td>
<td>Full Automation&lt;br&gt;The vehicle is capable of performing all driving functions under all conditions. The driver may have the option to control the vehicle.</td>
</tr>
</tbody>
</table>
Shared Mobility & Automation Developments

Source: Data compiled by Bloomberg
Additional work: John Lippert, Keith Naughton, Cedric Sam and Kevin Tynan

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Conventional Vehicle SAV Developments

Waymo Early Rider Program, Phoenix, AZ

- Alphabet’s Waymo launched its Early Rider program in April 2017, inviting residents of certain areas of Phoenix, Arizona to ride in their autonomous vehicles.
- After a trial period in Phoenix, Waymo plans to expand its fleet from 100 to 600 autonomous Fiat-Chrysler Pacifica Hybrid minivans.
In September 2016, Uber began a pilot in Pittsburgh, PA serving around 1,000 select Uber customers with four autonomous Ford Fusions.

- There is a backup driver and engineer present in the front seats.
Conventional Vehicle SAV Developments

NuTonomy, One North Business Park, Singapore

• In August 2016, NuTonomy launched a public trial of their autonomous vehicles in a 1.5 square-mile section of Singapore, called One North.

• NuTonomy partnered with Grab, the Southeast Asia-based ridesourcing company, and vehicles can be hailed via smartphone through Grab’s platform.

Shaheen, 2017
Planned SAV Pilots - Shuttles

Low-Speed SAV Shuttle Pilots

EasyMile, Treasure Island, San Francisco Bay Area, CA

• EasyMile and the San Francisco County Transportation Authority are planning a pilot to serve first and last mile public transit trips on Treasure Island by 2020

Local Motors Olli, Miami Dade County, FL and Las Vegas, NV

• Local Motors’ Olli has been tested in National Harbor, MD and has expansion plans to serve passengers in Miami and Las Vegas

Shaheen, 2017
Planned SAV Pilots – Conventional Vehicles

Conventional Vehicle SAV Pilots

*NuTonomy and Lyft, Boston, MA*

• NuTonomy has been testing its AVs in the Seaport and Fort Point areas of Boston since April 2017

• In June 2017, Lyft and NuTonomy formed a partnership with plans to deploy a SAV pilot serving passengers sometime in the coming months

*Delphi and Transdev, Normandy and Paris, France*

• In June 2017, Delphi and Transdev announced that they will test AVs in Normandy and outside Paris in advance of building a commercial service starting in 2019, which could be deployed in other markets, including North America
Shared Mobility Ecosystem

10+ Years? 25+ Years?

Shaheen et al., forthcoming
10+ and 25+ Year Outlook?

- Deployments, modes, and propensity to sell a private vehicle will likely be asymmetric and region-specific.

- Potential bifurcation of private vehicle ownership:
  - Some may move to urban centers and use SAVs.
  - Others may move farther from urban centers and use privately owned AVs.
10- and 25-Year Outlook?

- Shared modes will likely vary based on density and built environment (e.g., urban form/walkability, higher density, land use, mixed use, transit oriented development, etc.)

- 10+ Year?: Growth of shared mobility in urban centers (highest density and most walkable/bikeable)

- 10-25: Year? – Growth of shared mobility in edge cities and “inner ring” suburbs (medium density, somewhat bikeable/walkable)

- 25 Years and Beyond?: Suburbs and other less walkable/bikeable locations (adoption contingent upon availability of affordable SAV service in lower density environments)
AV Policy Developments - Local

• Local AV policy will likely regulate AV/SAV operations, rights-of-way access, and local taxation
• A number of the CityMobil2 pilots in Europe allowed low-speed SAVs on public roads employing a local ordinance

Important in regulating SAV ops, traffic mitigation + equity implications
AV Policy Developments - State

- State AV policy will likely regulate liability and insurance, licensing, traffic laws, and infrastructure
- 18 states have enacted AV laws, 70 state bills have been considered in 2017 alone
- Different states taking different approaches to regulating AVs
  - California has been closely regulating AV testing
  - Florida and Michigan passed less stringent AV regulations
  - Some states have no enacted AV-specific legislation, allowing AV operations in some circumstances

Liability, insurance, licensing, traffic laws + infrastructure
AV Policy Developments - Federal

• Federal AV policy will likely regulate *vehicle design standards* (FMVSS), *vehicle and consumer safety*, and *exemptions*

• Federal Automated Driving Systems Guidance (September 2017) contains 12 priority safety design element (goals/approaches)

• HR 3388 (referred to Senate on 9/7/17)
  • Prohibits state/local laws or regulation regarding *design*, *construction*, or *performance* of highly automated vehicles, automated driving systems, or components unless prescribed by law
  • States/local governments may continue standards that conform to federal standards

Safety + Design Focus
Potential Future SAV Policy Developments

• SAV-specific policy is sparse, at present

• Potential adverse impacts of AVs/SAVs will have to be considered when crafting SAV regulations (e.g., induced demand)

• Both Massachusetts and Tennessee have proposed bills that consider imposing a mileage-based operating fee on AVs

• A number of USDOT Smart City Challenge proposals included access to rights-of-way regulations for AVs and SAVs
Possible SAV Impacts: Opportunities

- Enhanced safety (elimination of human factor errors)
- Increase vehicle occupancies (freed capacity, right-sized vehicles, closer spacing, etc.)
- Reduce per mile cost (over privately owned vehicles)
- Unlock urban space dedicated to parking for other uses
- Downsize number of privately owned household vehicles
- Reduce GHG emissions

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Possible SAV Impacts: Challenges

• Increased VMT (due to induced demand b/c lower costs, modal shift away from public transit, longer commutes, roaming AVs, etc.)

• Will people give up private ownership?

• Increased urban sprawl

• Congestion solved?
Future Shared Mobility Research

- Impacts Study of Lyft and Uber (Winter 2017)
  - Study will assess the impacts of travel behavior, vehicle ownership, VMT, modal shift, and GHG emissions
- P2P Carsharing Impact Study (Fall 2017)
- Bikesharing GHG Study (Fall 2017)
Innovative Mobility Highlights, Carsharing Outlook, and Latest Research

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Recent Reports


https://www.planning.org/publications/report/9107556/

Shaheen, 2017
Recent Book: Disrupting Mobility

Available at:

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Susan Shaheen, PhD
Email: sshaheen@berkeley.edu
Twitter: SusanShaheen1
LinkedIn: Susan Shaheen