

How Planning for Self-Driving Technology Can Help All People

Frank Douma and Adeel Lari,

State and Local Policy Program



HUMPHREY SCHOOL
OF PUBLIC AFFAIRS
UNIVERSITY OF MINNESOTA



Presentation Overview

1. Self-Driving Vehicle (SDV) Technologies and Equity Implications

- Where is the technology going?
- How can communities effectively prepare?

2. Self-Driving Vehicle equity and implementation in Greater Minnesota

- SDV Task Force and Usability Matrix
- Community outreach in Grand Rapids, MN



Self Driving Vehicles

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The PASSING of the HORSE

THE silent horse power of this runabout is measurable, dependable and spontaneous. The horse power generated by supplies of hay and oats is variable, uncertain and irresponsible. There is *"Nothing to watch but the road"* when you drive

The Oldsmobile

"The best thing on wheels"

You see them everywhere—Doctors, Lawyers and Merchants find the Oldsmobile the most practical vehicle for business purposes. Ladies and children can readily understand its mechanism. Unvarying reliability proves it is built to run *and does it*.

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Selling agencies are established in all the larger cities, where you will be gladly accorded the privilege of trying the Oldsmobile on the road. Write for illustrated book to Dept. G.

Olds Motor Works

OFFICES, Detroit, Mich.
FACTORIES—Detroit and
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- Question is not “if” but “when”



Race is on, Everybody is in the Race

- FORD
 - Fully autonomous vehicles (no steering or brakes) by 2021, initially for ride hailing and ride sharing.
- BMW
 - Fully Autonomous vehicles by 2021. partnering with Intel and Israeli firm Mobileye
- Nissan/Renault/Mitsubishi Alliance
 - Fully autonomous electric car by 2022. Goal for driverless taxis
- Google
 - Many modified Lexus SUVs and pod like small car have driven more than 3 million miles in California, Arizona, Nevada and Texas. Deal to add 100 Chrysler Pacifica minivans



- General Motors/LYFT
 - Invested \$500 million in LYFT and bought Cruise Automation to develop driverless taxis
- Tesla
 - Introducing various autonomous technology to eventually build autonomous Vehicles
- Baidu
 - Testing Autonomous cars in USA starting this year
- Apple
 - In Typical Apple way, very secretive but hiring staff and \$1 billion investment in Didi Chuxing (Uber of China)



- OTTO

- Startup by former Google Engineers to upgrade Large Trucks into autonomous vehicles

- Mercedes-Benz

- Mothership Van with delivery robots and drones

- Car2Go

- Mercedes-Benz

- Highway Pilot Connect system



Maybe above is too Conservative

- GM planning to conduct Level 4 or 5 Demo in New York in 2018
- Waymo (Goggle) planning to do Demonstrations in 2018
- Both companies believe Level 3 is a "No Go"
- Car Sharing (Taxi) first application
- RethinkX: 95% of all VMT through self driving cars by 2030
 - Facebook, smartphone like adoption curve



Equity Implications - Federal

- Americans with Disabilities Act
 - Requires public transit service to people with disabilities
- “United We Ride”
 - Multi-agency initiative providing resources for improving access for low-income, seniors and disabled
- Olmstead Decision
 - Set standards for services. Services cannot be different from those available to those without disabilities



Equity Implications - Minnesota

- MCOTA

- Minnesota's Olmstead Plan:

- People with disabilities will have access to reliable, cost-effective, and accessible transportation choices that support the essential elements of life such as employment, housing, education, and social connections. They will have increased access to transit options and transportation modes.

- 50% increase in Greater MN Transit trips by 2025 (Goal 2)

- Expand transit coverage so that 90% of the public transportation service areas in Minnesota meet minimum service guidelines for access by 2020 (Goal 3)

- However, the inability to drive still reduces access

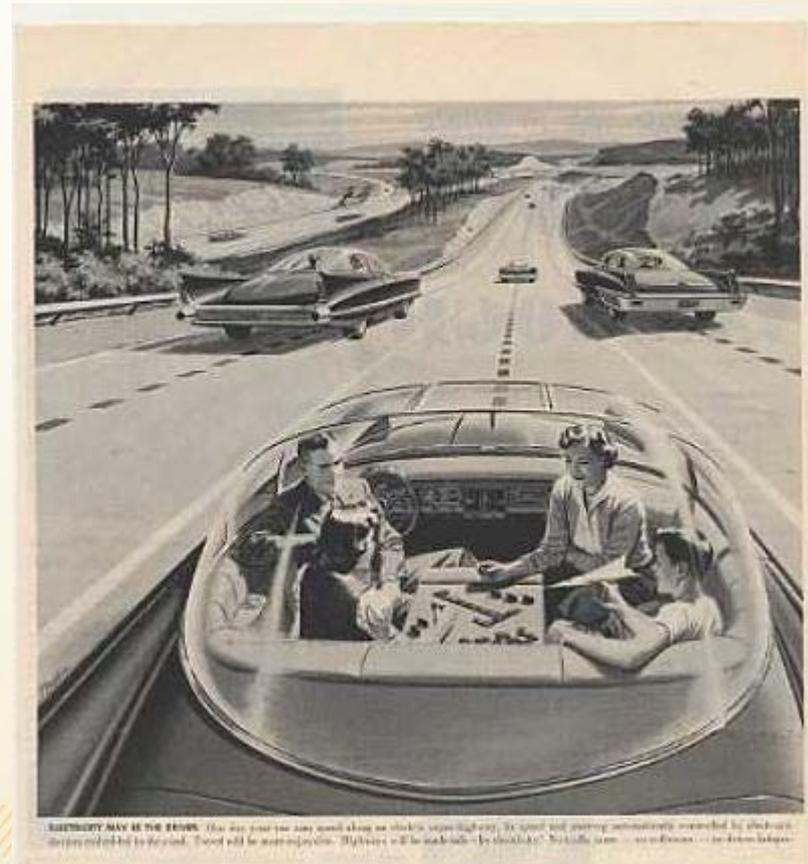
- Seniors in Minnesota. By 2030 will grow to 24% of Minnesota's population (1.2 million) U.S. Census Bureau



Where Does SDV Technology Go From Here?

Recent Progress

- Ruderman / Securing America's Energy Future
- Bill in MN Legislature
- National Council on Disabilities
- Florida DOT





How Can Communities Effectively Prepare for SDV Technologies?

Rural / Small Towns?

- Greater efficiency in low density?
- Last mile complement to existing service?
- Age in place?
- Exactly who?





The SDV Task Force & The Usability Matrix

- Convened to examine potential impacts of SDV technology on “transportation disadvantaged” populations in MN
 - Strategic group of elected officials, policy experts, social advocates, MnDOT and more
 - Identified disparities in SDV technology and helped facilitate outreach in Greater Minnesota
- A tool developed by the SDV Task Force
 - A table to analyze current and needed SDV deployment models
 - SDV Task Force identified
 - A need for outreach with Greater Minnesota
 - What SDV models can serve rural and suburban transit needs?



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TPEC researchers have convened a task force to examine the potential impacts of self-driving vehicles on a wide variety of people who are “transportation disadvantaged.” The task force will seek to identify strategies that ensure seniors, the disabled, and other disadvantaged communities fully enjoy the mobility offered by SDVs. It is made up of representatives from the Minnesota Department of Transportation, Metro Mobility, metro-area counties, non-profits, and organizations from Greater Minnesota.

Completed research

- [Self-Driving Vehicles Task Force Report and Matrix of Users \(PDF\), 2017](#)
- [Self-Driving Vehicles: Current Status of Autonomous Vehicle Development and Minnesota Policy Implications](#), *Minnesota Journal of Law, Science & Technology*, 2015
- [Self-driving cars: As revolutionary in the 21st century for public health as vaccines were in the 20th](#), University of Minnesota School of Public Health Ignite! Symposium video, Feb. 2016
- [Options for Automated Speed Enforcement Pilot Projects in Minnesota Work and School Zones](#), May 2014, Report no. CTS 14-06
- [Understanding the Economic Effects of Flexibility through Three Employer Case Studies](#), February 2013, Report no. MnDOT 2013-07
- [Investigating Deployment Potential for Automated Speed Enforcement in Minnesota \(2012\)](#)
- [Minnesota Field Test of CrashHelp \(2012\)](#)
- [Identifying Issues Related to Deployment of Automated Speed Enforcement - FY12 TechPlan \(2011\)](#)
- [ITS Data Needs: How Much Do We Really Need to Know? - FY11 TechPlan \(2011\)](#)
- [ITS and Locational Privacy: Suggestions for Peaceful Coexistence - FY10 TechPlan \(2009\)](#)

| User Groups | Geography | | | | | | | |
|--|--|--|---|---------------------------------------|---|---|--|---------------------------------------|
| | Central City | | Suburban (No Centralized Core) | | Isolated Small City (Core/Main street) | | Rural (Scattered) | |
| | Application | Who Organizes? | Application | Who Organizes? | Application | Who Organizes? | Application | Who Organizes? |
| Financial Barriers (Ex. Affordability of transportation) | High/Low speed transit, shared vehicle model | Federal, State, region, municipality, for profit | Low speed transit, shared vehicle model | For profit, subsidized by state/local | Low speed transit, shared vehicle model | County, regional with subsidy, non-profit | Driverless Rural Transit , Community car/collective ownership | Subsidized by state/local, non-profit |
| Communication Barriers (Ex. Written health promotion messages with barriers that prevent people with vision impairments from receiving the message, Auditory health messages may be inaccessible to people with hearing impairments). | High/low speed transit, shared vehicle model , with features that accommodate visual and auditory impairments | Federal, State, region, municipality, for profit | Low speed transit, shared vehicle model , with features that accommodate visual and auditory impairments | For profit, subsidized by state/local | Low speed transit, with features that accommodate visual and auditory impairments | County, regional with subsidy, non-profit | Driverless Rural Transit , Community car/collective ownership , Ownership, with features that accommodate visual and auditory impairments | Subsidized by state/local, non-profit |
| Physical Barriers (Ex. Steps and curbs that block a person with mobility impairment from entering a building or using a sidewalk). | High/low speed transit, shared vehicle model , with ramp and drop-off/pick-up features that are aware of surrounding infrastructure accessibility | Federal, State, region, municipality, for profit | Low speed transit, shared vehicle model , with ramp and drop-off/pick-up features that are aware of surrounding infrastructure accessibility | For profit, subsidized by state/local | Low speed transit, with ramp and drop-off/pick-up features that are aware of surrounding infrastructure accessibility | County, regional with subsidy, non-profit | Driverless Rural Transit , Ownership , Community car/collective ownership , with ramp and drop-off/pick-up features that are aware of surrounding infrastructure accessibility | Subsidized by state/local, non-profit |
| Policy Barriers (Ex. Denying reasonable accommodations to qualified individuals with disabilities, so they can perform the essential functions of the job for which they have applied or have been hired to perform). | High/low speed transit, shared vehicle model , ADA compliance, the ability to travel anonymously | Federal, State, region, municipality, for profit | Low speed transit, shared vehicle model , ADA compliance, the ability to travel anonymously | For profit, subsidized by state/local | Low speed transit, ADA compliance, the ability to travel anonymously | County, regional with subsidy non-profit | Driverless Rural Transit , Ownership , Community car/collective ownership , ADA compliance, the ability to travel anonymously | Subsidized by state/local, non-profit |
| Programmatic Barriers (Ex. Inconvenient scheduling, Provider's attitudes, knowledge, and understanding of people with disabilities). | High/low speed transit, shared vehicle model , vehicle requirements that mandate ADA accessibility ensuring on demand services are equitable | Federal, State, region, municipality, for profit | Low speed transit, shared vehicle model , vehicle requirements that mandate ADA accessibility ensuring on demand services are equitable | For profit, subsidized by state/local | Low speed transit, vehicle requirements that mandate ADA accessibility ensuring on demand services are equitable | County, regional with subsidy non-profit | Driverless Rural Transit , Ownership , Community car/collective ownership vehicle requirements that mandate ADA accessibility ensuring on demand services are equitable and expand services i.e after hours rides and more extensive services | Subsidized by state/local, non-profit |
| Social Barriers (Ex. People with disabilities are far less likely to be employed) | High/low speed transit, shared vehicle model | Federal, State, region, municipality, for profit | Low speed transit, shared vehicle model | For profit, subsidized by state/local | Low speed transit | County, regional with subsidy, non-profit | Driverless Rural Transit , Ownership , Community car/collective ownership | Subsidized by state/local, non-profit |
| Transportation Barriers (Ex. Lack of access to accessible or convenient transportation for people who are not able to drive because of vision or cognitive impairment) | High/low speed transit, shared vehicle model , vehicle requirements that mandate ADA accessibility ensuring on demand services are equitable | Federal, State, region, municipality, for profit | Low speed transit, shared vehicle model vehicle requirements that mandate ADA accessibility ensuring on demand services are equitable | For profit, subsidized by state/local | Low speed transit, vehicle requirements that mandate ADA accessibility ensuring on demand services are equitable | County, regional with subsidy, non-profit | Driverless Rural Transit , Ownership , Community car/collective ownership , vehicle requirements that mandate ADA accessibility ensuring on demand services are equitable | Subsidized by state/local, non-profit |
| Attitudinal Barriers (Ex. People sometimes stereotype those with disabilities, assuming their quality of life is poor or that they are unhealthy because of their impairments) | High/low speed transit, shared vehicle model , vehicle requirements that mandate ADA accessibility ensuring on demand services are equitable | Federal, State, region, municipality, for profit | Low speed transit, shared vehicle model | For profit, subsidized by state/local | Low speed transit | County, regional with subsidy, non-profit | Driverless Rural Transit , Ownership , Community car/collective ownership | Subsidized by state/local, non-profit |



TPEC Outreach in Greater Minnesota

- SDV Task Force identified need for SDV outreach in Greater Minnesota
- In the coming months, TPEC will conduct listening and learning sessions in communities around the state.
- Objectives:
 - Share TPEC & SDV Task Force work and findings.
 - Hear stakeholder's thoughts and opinions on SDV technology, SDV equity issues, and SDV implementation in rural settings
 - Better understand current and forecasted transportation needs of the community





Thank you Questions?

- Frank Douma
fdouma@umn.edu, 612-626-9946
- Adeel Lari
alari@umn.edu, 612-624-7746



| SAE level | Name | Narrative Definition | Execution of Steering and Acceleration/Deceleration | Monitoring of Driving Environment | Fallback Performance of Dynamic Driving Task | System Capability (Driving Modes) |
|---|-------------------------------|--|---|-----------------------------------|--|-----------------------------------|
| Human driver monitors the driving environment | | | | | | |
| 0 | No Automation | the full-time performance by the <i>human driver</i> of all aspects of the <i>dynamic driving task</i> , even when enhanced by warning or intervention systems | Human driver | Human driver | Human driver | n/a |
| 1 | Driver Assistance | the <i>driving mode</i> -specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the <i>human driver</i> perform all remaining aspects of the <i>dynamic driving task</i> | Human driver and system | Human driver | Human driver | Some driving modes |
| 2 | Partial Automation | the <i>driving mode</i> -specific execution by one or more driver assistance systems of both steering and acceleration/deceleration using information about the driving environment and with the expectation that the <i>human driver</i> perform all remaining aspects of the <i>dynamic driving task</i> | System | Human driver | Human driver | Some driving modes |
| Automated driving system ("system") monitors the driving environment | | | | | | |
| 3 | Conditional Automation | the <i>driving mode</i> -specific performance by an <i>automated driving system</i> of all aspects of the <i>dynamic driving task</i> with the expectation that the <i>human driver</i> will respond appropriately to a <i>request to intervene</i> | System | System | Human driver | Some driving modes |
| 4 | High Automation | the <i>driving mode</i> -specific performance by an <i>automated driving system</i> of all aspects of the <i>dynamic driving task</i> , even if a <i>human driver</i> does not respond appropriately to a <i>request to intervene</i> | System | System | System | Some driving modes |
| 5 | Full Automation | the full-time performance by an <i>automated driving system</i> of all aspects of the <i>dynamic driving task</i> under all roadway and environmental conditions that can be managed by a <i>human driver</i> | System | System | System | All driving modes |