Self Driving Vehicle Task Force Write-up: issues, opportunities, and next steps

State and Local Policy Program - Humphrey School of Public Affairs

University of Minnesota - Twin Cities

June 2017

As the momentum of self-driving vehicle development increases, legislators, local governments, and research institutions have a growing responsibility to facilitate policy conversations that will help plan for the uncertainties of new transportation technologies. At the University of Minnesota's Humphrey School of Public Affairs, transportation researchers Frank Douma and Adeel Lari have hosted a variety of conversations on self-driving vehicle technology and policy implications over the past three years. Their presentations and discussion groups have engaged in topics ranging from congestion and land use implications to how self-driving vehicles will operate alongside other intelligent technologies such as e-medicine and telecommuting. In the last year and a half, Douma and Lari's work has turned to the important issues of equity in the development and implementation of self-driving vehicles (SDV). The early fruits of their work has been included in the publication of "The Legal Obligations, Obstacles, and Opportunities for Automated and Connected Vehicles to Improve Mobility and Access for People Unable to Drive" in the *Michigan State Law Review* this Spring.

Also this Spring, Douma, Lari, and Sandy Vargas, a Senior Fellow at the Humphrey School, started the Self-Driving Vehicle Task Force. This strategic group was made up of local government staff, University researchers and professors, policy experts, local port authority members, State DOT representatives, and social advocates from both the Twin Cities and

Greater Minnesota[1]. This experienced group of public servants is helping the Transportation Policy and Economic Competitiveness Program (TPEC) and the Minnesota Legislature identify and evaluate innovative transportation technologies aimed at improving Minnesota's economy and livelihood.

The widespread deployment of the driverless vehicles on American roadways appears to be imminent and will soon find its way to Minnesota. In 2016, the ridesharing service Uber implemented a fleet of driverless vehicles in the city of Pittsburgh. These self-driving rides are still supervised by a human driver. However, the automotive industry and tech firms are actively developing commercial fleets of SDVs; cars which are estimated to be available to the public in the next 3 to 5 years. And Olli, an electric 12-person self-driving bus, offers the potential to reshape low speed public transportation. Olli is cost-efficient and equipped with the IBM technology Watson. This interactive technology gives riders the ability to engage with the driverless vehicle and, for example, tell it where they'd like to go. With these unfolding advancements in transportation systems, Minnesota, and communities around the world, must begin to address new and complex challenges. Important issues such as safety, scale, pricing, equity, ethics, regulation, implementation and much more will have to be analyzed. Through the creation of the SDV Task Force, Minnesota researchers, stakeholders and lawmakers are evaluating these issues in order to properly assure that driverless vehicles can, and in fact will, enhance the lives of their many community members.

With an emphasis on equity issues, the intent of the SDV Task Force was to identify how various self-driving vehicle deployment strategies could improve mobility and access for

[1] See Appendix A for a complete list of SDV Task Force Members.

transportation dependent Minnesotans: seniors, the disabled, and other others who are not able to drive themselves. Undoubtedly, a variety of SDV models will be introduced throughout the state, however the Task Force aimed to understand how different models could be used to best serve the specific needs of each community From January to May, the Task Force met three times to discuss this topic. At these meetings, it was readily transparent that the needs of Minnesota's transportation dependent populations are best addressed based upon geography and in within the context of their current access to transportation services. The Task Force set about constructing a Matrix of Users in order to analyze how different self-driving vehicle deployment strategies compare with the equity issues faced by transportation dependent populations in the Twin Cities and throughout Greater Minnesota.

The Matrix of Users is a chart designed to cross-compare geography, barriers to participation, and the potential forms of self-driving transportation that may be implemented in Minnesota. The various deployment strategies identified by the Task Force include high speed transit, low speed transit, a shared vehicle model, community car/collective ownership, ownership and driverless rural transit. The Matrix also separated Minnesota's population into four geography ranges: Central City, Suburban, Small City and Rural locales[2]. These different communities already employ a variety of transportation models to best achieve their specific needs. The deployment of self-driving transportation will likely resemble these previously determined transportation models in the effort to best meet the needs of each community and maintain economic viability.

[2] See Appendix B for more information on all Matrix of Users categories and definitions.

For example, with declining car ownership nationwide and the quick rise of ridesharing services such as Uber and Lyft, the vision of shared vehicle models and ride sharing apps seem to be settling in most metro areas. These models, however, are problematic in a rural context. The advantage of a carsharing system is that the costs are spread across a broad base of users. This fleet model is financially viable, in part because users live within reasonable distances of one another, cutting down the time and distance between active trips. In rural areas, users are miles away, rather than blocks apart. Furthermore, rural areas lack the critical mass of people required for the cost of the fleet to be spread across. This means that rural areas will require the development of a different driverless transit model which can blend the functions of high speed and low speed public transit in order to best accommodate the needs of Minnesota's smaller communities. Looking to current transit methods in Greater Minnesota will guide the development of rural driverless transit. As self-driving vehicles become more prevalent on Minnesota roadways, the successful implementation of these new technologies depends on how SDVs service the specific needs of each particular community equitably and economically.

The Matrix of Users also cross compares self-driving car deployment strategies with the Center for Disease Control's common barriers to participation as they're experienced by transportation dependent stakeholders[3]. The Task Force identified that in order to achieve successful SDV implementation, and properly address equity issues, all driverless vehicles must account for common barriers to participation. The Matrix of Users analyzes these barriers based upon geography in order to assure that SDV equity issues are properly addressed throughout the state of Minnesota. According to the World Health Organization (WHO) these

[3] See Appendix B for more information of the CDC's barriers to participation.

CDC barriers are “factors in a person’s environment that, through their absence or presence, limit functioning and create disability.” The common barriers analyzed in the Matrix include financial, communication, physical, policy, programmatic, social, attitudinal and transportation barriers. The Task Force recognizes that public policy will play an important role in assuring that all self-driving vehicles deployed in Minnesota properly address these equity issues.

Looking beyond geography, the Task Force discussed what features SDVs would need to include in order to be accessible to all community members. Using the CDC’s barriers as a guide, the group identified the necessity for all SDV designs to be compliant with the Americans with Disabilities Act. Other important accessibility issues identified by the Task Force include the ability to travel anonymously, ramp features for wheelchair access, drop-off/pick-up functions that are aware of the surrounding infrastructure accessibility, and features that accommodate the visually and auditorily impaired. These features, in order to properly address equity issues, ought to come standard in all of Minnesota’s self-driving vehicles, regardless of geography.

It is possible that self-driving vehicles could be commonplace on American roadways within the next 15 to 20 years. With the advent of these efficient and economically advantageous transportation technologies, it will be imperative for communities to begin forecasting for the future. The SDV Task Force has broadened the analysis of automated vehicles by identifying various models of deployment and evaluating the potential of SDVs in rural communities. The Task Force also recognizes the important role policy makers will have in determining the extent to which SDVs will accommodate the equity issues faced by Minnesota’s transportation dependent populations. This important work will carry on as Douma and Lari

plan to enhance the Matrix of Users through community outreach and stakeholder meetings across the state of Minnesota in the months to come. These upcoming meetings with stakeholders, non-profit organizations, transportation providers and local governing bodies will provide TPEC with critical insights on the current needs of transportation dependent populations and how innovative transportation technologies would best suit the needs of Minnesota's communities.

Below is a brief summary of the issues, opportunities and next steps that were identified by the SDV Task Force followed by appendix A and B.

Issues

- There is a lack of research and no clear vision for self-driving vehicles in rural areas
- The transportation needs of Minnesota's Tribal Nations need to be accounted for
- Provisions and regulations must be established to ensure that self-driving vehicles are affordable and accessible to all peoples regardless of income and ability
- People are suffering from a lack of mobility now-- we cannot wait for self-driving vehicles

Opportunities

- MNDOT Autonomous Bus Project
- Potential partnerships with the community of Grand Rapids, Minnesota for a pilot
- Fall Conference to share work and connect with local leaders on self-driving vehicle implications
- Dakota County's Mobility Framework establishes a baseline idea on how to address accessibility issues

Next Steps

- The Task Force identified the need to increase outreach efforts in rural Minnesota as well as with elected officials throughout the state
- Support MNDOT's self-driving bus project
- Run a cost analysis on rural transportation dollars and current spending
- Identify intermediate steps to address mobility disparities today - we are not waiting for self-driving vehicles (Ex. Dakota County Mobility Framework)
- Engage with Advisory Council on Tribal Transportation to identify the needs of Tribal Nations
- Identify clear SDV models in rural areas
- Complete the Matrix of Users

Appendix A - Self-Driving Vehicle Task Force Members

Gina Baas - University of Minnesota - Center for Transportation Studies
Fernando Burga - University of Minnesota - Humphrey School
Heidi Corcoran - Dakota County Community Services Administration
John Doan - Hennepin County, SW LRT Community Works
Leili Fatehi - Apparatus
Tom Fisher - University of Minnesota - College of Design
Thomas D. Henderson - MN Dept. of Public Safety
Brad Henry - University of Minnesota - Technological Leadership Institute
Jay Heitpas - MnDOT
Bob Johns - University of Minnesota - Humphrey School
Andrew Krueger - Metro Mobility
Randy Maluchnik - Carver County Commissioner (Dist. 3)
Arlene Mathison - University of Minnesota - Center for Transportation Studies
Keith Mensah - St. Paul Port Authority
Guillermo Narvaez - University of Minnesota - Humphrey School
Myrna Peterson - Mobility Mania
Steve Peterson - Metropolitan Council
Schane Rudlang - Bloomington Port Authority

Mike Schadauer - MnDOT
Philip Schaffner - MnDOT
Eric Schnell - Aeon
Brendon Slotterback - McKnight Foundation
Carissa Slotterback - University of Minnesota - Humphrey School
Sandy Vargas - University of Minnesota - Humphrey School
Marnie Werner - Center for Rural Policy & Development
Joan Willshire - Mn State Council on Disability

Appendix B - Matrix of Users Categories and Definitions

SDV Deployment Strategies -

- *High speed transit* - An urban area transportation model such as light rail, commuter rail, subway and high speed rail.
- *Low speed transit* - Various modes of 4-wheeled public transportation that typically do not exceed speeds of 25 mph.
- *Shared vehicle model* - A fleet of vehicles that users can rent for short periods of time. Carsharing is common in metro areas and helpful for individuals who have only occasional need for a vehicle.
- *Community car/collective ownership* - Similar to car sharing, but instead of renting cars users have an ownership stake in a collective vehicle(s).
- *Ownership* - Private ownership
- *Driverless rural transit* - A new development that would be able to function similar to low speed public transit, but which could reach higher speeds on highways that connect various communities.

Geographies -

- *Central City*- High density metropolitan areas with a central city core and a wide variety of transportation systems.
- *Suburban*- High to medium density communities without a central city core.
- *Small City* - These communities are geographically isolated, but which have a large community mainstreet and/or central city core and an established low speed public transit system .

- *Rural* - The population in rural settings is highly scattered and public transportation often has to connect several small communities that are widely separated. The distance between communities often requires a blend between high speed and low speed public transit systems. The transportation dependent populations of rural communities is generally older and underserved in comparison with other geographic regions.

Barriers to Participation-As they are defined by the CDC

- *Financial-* Financial barriers include affordability and feasibility of transportation services and available forms of funding and organization.
- *Communication*-Communication barriers are experienced by people who have disabilities that affect hearing, speaking, reading, writing, and or understanding, and who use different ways to communicate than people who do not have these disabilities
- *Physical*-Physical barriers are structural obstacles in natural or manmade environments that prevent or block mobility (moving around in the environment) or access.
- *Policy-* Policy barriers are frequently related to a lack of awareness or enforcement of existing laws and regulations that require programs and activities be accessible to people with disabilities
- *Programmatic*-Programmatic barriers limit the effective delivery of a public health or health care program for people with different types of impairments.
- *Social*- Social barriers are related to the conditions in which people are born, grow, live, learn, work and age – or social determinants of health – that can contribute to decreased functioning among people with disabilities.
- *Transportation*- Transportation barriers are due to a lack of adequate transportation that interferes with a person's ability to be independent and to function in society.
- *Attitudinal*--Attitudinal barriers are the most basic and contribute to other barriers. For example, some people may not be aware that difficulties in getting to or into a place can limit a person with a disability from participating in everyday life and common daily activities.

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	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	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

User Groups	Geography							
	Central City		Suburban (No Centralized Core)		Isolated Small City (Core/Main street)		Rural (Scattered)	
Summarized Solution	High/low speed transit, shared vehicle model, vehicle requirements that mandate ADA accessibility ensuring on demand services are equitable, with features that accommodate visual and auditory impairments	Federal, State, region, municipality, private (vehicle developer)	Low speed transit, shared vehicle model, vehicle requirements that mandate ADA accessibility ensuring on demand services are equitable, the ability to travel anonymously, with ramp and drop-off/pick-up features that are aware of surrounding infrastructure accessibility, with features that accommodate visual and auditory impairments	For profit, subsidized by state/local	Low speed transit, vehicle requirements that mandate ADA accessibility ensuring on demand services are equitable, the ability to travel anonymously, with ramp and drop-off/pick-up features that are aware of surrounding infrastructure accessibility, with features that accommodate visual and auditory impairments	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, the ability to travel anonymously, with ramp and drop-off/pick-up features that are aware of surrounding infrastructure accessibility, with features that accommodate visual and auditory impairments.	Subsidized by state/local, non-profit