Self-Driving Road Vehicles and Transportation Planning

The prospect of self-driving cars provides an opportunity for this country to plan for its transportation future. What will our personal and commercial transportation needs and desires be twenty and fifty years from now? What input will Americans have concerning the transportation options available to them? What public and private funding will be available to meet our transportation needs and will the current anti-tax fervor prevent serious public financing of transportation infrastructure and systems?

The chaotic development of our current, somewhat dysfunctional transportation suggests that rational, democratic planning is likely to take a back seat to corporate and political interests in the development of our future transportation systems.

Self-driving vehicles will be used for personal transport (as a substitute for human-driven personal vehicles and taxi-type services), and for commercial trucks and buses. Major economic pressures are likely to favor self-driving vehicles for both applications: the former by ride-sharing companies (Uber, Lyft) and the latter by trucking companies and bus operators. Both will look toward reducing labor costs.[1]

Public Needs and Desires

In their transportation systems people want flexibility, speed, safety, comfort, low cost, control, and privacy. No transportation system could deliver all of these things even if cost were not an issue. A rich man's limousine or Ferrari cannot get through heavy traffic congestion any faster than the poor man's jalopy.

Self-driving vehicles promise greater flexibility and the opportunity to do other tasks while in transit. They may offer greater safety and lower cost. However, one must cede control to a self-driving vehicle so that people will have to have a good deal of trust in these vehicles. As with our cell phones and the internet, privacy will be sacrificed with such vehicles. Unless there is major spending on the U.S. road system, self-driving vehicles will suffer many of the same limitations as conventional vehicles.

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[1] Public concerns may stymie this result. The Bay Area Rapid Transit (BART) system was designed to be operated without on-board personnel. However, a minor crash aroused public concern resulting in a decision to put human operators on all trains. A similar decision was reinforced for the D.C. Metro system after a major crash showed deficiencies in its operating system. The same concerns could result in regulations requiring human operators on intercity buses and on large trucks that have the potential to inflict major losses if they crash.

Parameters of a Transportation Future

The cost of developing and producing a major fleet of self-driving vehicles is likely to be substantial as will its impact will be on safety and road congestion.[2,3] The greatest safety challenge will come when there are both self-driving and conventional vehicles together on the road. Drivers may be confused when driving vehicles with different levels of automation. The interaction of vehicles with human and non-human drivers could be dangerous. The problem will be exacerbated by the poor condition of the road infrastructure and by construction projects that will increase the difficulties for the self-driving vehicles.

We face a period of decades when most of the following conditions will hold:

- Political and business decisions may facilitate work-from-home or workplace siting which will affect commuter transportation needs;

- Political uncertainty will affect the amount and direction Federal and state investment in roads and public transportation (mostly urban and suburban transit) systems;

- Private investment in transportation is likely, but the direction of such funding is uncertain (fleets of self-driving vehicles, toll roads, transportation systems);

- Large numbers of automated vehicles of various types will come into use and they will feature innovative materials and manufacturing technologies;

- Public tastes and needs for road transportation will affect whether people opt to purchase and use personal vehicles or elect to substantially increase the use of ride-sharing services or other options;

- Roads and bridges will continue to deteriorate necessitating large numbers of maintenance and construction projects that will affect traffic;

- Road congestion, particularly in urban and suburban areas, will increase;

- Governments will set and enforce new regulations such as for fuel economy, safety, and the operation of self-driving vehicles (which may differ from state to state) some of which will be affected by public attitudes and opinions;

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[2] This is a case where the now-dormant Congressional Office of Technology Assessment could have provided important guidance by exploring what future costs and other impacts of self-driving vehicles might be. It is sad that we no longer have this capability in the legislative branch although either the Government Accountability Office or the Congressional Research Service could provide some guidance if it is requested and funded.

[3] A recent study by John Hoffecker of AlixPartners LLP, argues "You've got 50 major players trying to develop autonomous software and you'll probably get three or four of them who will win. There will be billions and billions of dollars lost in bets that were put in the wrong place."

- On-line shopping and the demise of traditional shopping centers will continue, reducing the need for shopping trips but increase truck and air-based postal and package delivery, not to mention car-based food delivery, which will affect traffic (with trucks blocking urban and suburban roadways);

- Competition among the types and costs of energy used in transportation (electricity, gasoline, diesel, hydrogen . . . .) and energy storage technologies will increase, affected by regulation, tax policies, supply, and demand; and

- Weather conditions that are likely to become more severe because of climate change, affecting the safe operation of all vehicles.

Government Policy on Transportation

Two major, but not exclusive options for government funding and other policies or commercial investment are for mass transportation systems and for improved roads that will facilitate self-driving vehicle operation. Such investments may not be adequate to facilitate improvements in either personal or commercial transportation. Private investment is likely for fleets of self-driving vehicles (such as for car sharing programs like Zipcar and Car2Go). Individuals are likely to purchase automated vehicles for personal use and ride-sharing under an Uber, Lyft or other car-sharing umbrella.

From the standpoint of land use, economic efficiency, and the democratic availability of personal transportation major government investment in public transportation would be a strong choice. Public systems reduce road congestion, energy use, and air pollution and, if properly designed, give reasonable, affordable transportation options to all social classes. Nevertheless, in the current political climate it is unlikely that there will be substantial new government spending, and it is likely that government spending will put a priority on roads rather than transit.

Safety

Some governments and companies have embraced the concept of *Vision Zero*: the goal of no traffic fatalities or serious injuries (currently road deaths exceed 35,000 annually along with tens of thousands of severe injuries). The *Vision Zero* goal could be enhanced or sabotaged by self-driving vehicles depending on how safety questions are addressed by governments and industry.

It is generally assumed that self-driving vehicles will enhance road safety. This is likely but with some glaring reservations. There will certainly be technological failures (programming errors and omissions; vehicle degradation and deterioration; and the inability of a machine to match the challenge of roads, traffic and unpredictable drivers, pedestrians, animals, and unexpected road hazards). It is critical that such failures be fully investigated and addressed. The public may not tolerate these failures even if their overall level of safety is

improved. A public demand for safety regulation could hamper the adoption of self-driving vehicles.[4]

The particular challenge will be to introduce automated vehicles into the current road and traffic situation which is neither adapted to nor forgiving of them. The interaction with conventional vehicles and the serendipity of human behavior (drivers, riders and pedestrians) and other factors will be a particular challenge.

In order to diagnose problems with automated vehicles, we need a substantially improved systems for timely investigation and reporting on crashes, and perhaps on near crashes as well. Police crash investigation and reporting must undergo major modernization.[5] This will raise questions about the degree to which the operation of self-driving vehicles will be monitored and about the use of that data (including, of course, privacy concerns).

Even after a majority of vehicles are self-driving, there will still be those who want and expect to drive conventional vehicles on public roads (motorcycles, classic cars, farm vehicles which themselves may be self-driving, and such). There are also questions about whether self-driving vehicles can operate successfully on isolated and unimproved rural roads.

Insurance can play a role in enhancing safety. If there are requirements for first party insurance that covers not only medical costs but also lost wages and any need for replacement and support services and that has very high limits (i.e. more than $10 million for each injured individual) the insurance companies will become very interested in the safety of specific vehicles as well as how they are used. This could be a very positive force for safety.

Another question will be the role and application of traffic law enforcement. An officer may have difficulty pulling an automated vehicle over to issue a citation unless a means for doing so is programmed into the vehicle (for example, will a vehicle be programmed to pull to the side of the roadway if a siren is detected?). If an automated vehicle goes out of control or suddenly fails in some key way, will there be a mechanism for getting it out of the traffic stream safely? Will there be requirements that the programming of self-driving vehicles fully respect traffic

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[4] Public tolerance for fatalities is not predictable. For example, there seems to be a high tolerance – i.e. an unwillingness to take obvious steps to reduce such deaths -- for gunshot fatalities including from mass shootings; but not for the recent rise in drug overdose fatalities (which have recently exceeded auto crash fatalities). Acceptance of war casualties seems to follow the public support for the war.

[5] Police crash investigation and reporting is critical because officers are usually at the scene of a crash when the evidence is fresh and because they have the authority to collect and record all relevant information on the crash. Modern technologies, digital cameras, satellite photographs of crash scenes, powerful hand-held computers, and such can substantially enhance crash reports.

laws? Will individual owners be able to override this programming (such as for a commercial vehicle to move in excess of speed limits to improve productivity)?

The Federal agencies responsible for road safety, the National Highway Traffic Safety Administration and the Federal Motor Carrier Safety Administration, are not currently equipped to ensure the safety of self-driving vehicles. They are likely to require additional legislative authority and resources. Currently some states are developing programs to regulate self-driving vehicles (mostly for test fleets at this time) led by California. There is a good deal of hoped-for voluntary action in both Federal and state programs, however.

Costs

Self-driving vehicles will cost significantly more than conventional vehicles although the cost will decrease with increased production of them. It is assumed that the fact that they do not require a driver will more than offset this cost, particularly for commercial applications.

Self-driving vehicles will probably accumulate mileage at a much greater rate than conventional vehicles because of their potential to operate on more efficient cycles rather than being parked for most of their lives. As a consequence, they may require more stringent inspection and maintenance programs to ensure their safe, reliable operation. It may even be necessary to require that they be taken out of service or undergo major rehabilitation after a certain number of miles and years of operation because of deterioration and antiquated self-driving technology.

Will a society that is increasingly dependent on self-driving vehicles further disadvantage the transportation needs and desires of the poor? Will society care enough about this prospect to ensure that effective public transportation is available at reasonable cost?

Conclusions

We lack an adequate understanding of how the new world of transportation will develop and what needs to be done to ensure that the transition will go well. The current period of hostility to increased government spending and regulation makes preparing for the transition more difficult. It is likely that economic interests and corporate decisions will drive the changes rather than societal needs or democratic principles. The impacts of self-driving vehicles will be much broader than the introduction of a new technology.

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