A conversation with Daniel Fagnant on March 18, 2014

Participants

- Daniel Fagnant — Ph.D. candidate in Transportation Engineering, UT Austin; Assistant Professor at University of Utah (Anticipated August 2014), author of the Eno Center report "Preparing a Nation for Autonomous Vehicles" and "The Travel and Environmental Implications of Shared Autonomous Vehicles, Using Agent-Based Model Scenarios"
- Alexander Berger — Senior Research Analyst, GiveWell

Note: These notes were compiled by GiveWell and give an overview of the major points made by Daniel Fagnant.

Summary

GiveWell spoke to Daniel Fagnant to learn more about opportunities for philanthropy around autonomous vehicles. Conversation topics included the commercial introduction of autonomous vehicles, legislation and regulation, technological progress, and implications for urban planning.

Commercial introduction

Auto manufacturers are attempting to rapidly develop autonomous vehicles. Manufacturers including General Motors, Nissan, Volvo, Audi, and Mercedes-Benz aim to release vehicles with self-driving capabilities by 2020. These vehicles will probably be autonomous in most situations, such as on freeways and in low-speed areas, but not in intermediate-speed urban situations, where there is more uncertainty. Google aims to have autonomous vehicles on the market by 2017 or 2018, though they would still need licensed drivers at all times. There is some uncertainty among the tech community as to whether Google will be able to accomplish this.

The average lifespan of a car, from manufacture to scrap, is about 17-18 years. Because of this turnover rate, there may be a long adoption curve for autonomous vehicles. As autonomous vehicles become more common, the last remaining non-autonomous vehicles may need to be retrofitted.

Prospects for regulation

States that have been at the forefront of legislation related to autonomous vehicles include California and Nevada and, more recently, Florida, Michigan, and Washington, D.C. These states have passed legislation enabling the testing of autonomous vehicles on public roads. California mandated its Department of Motor Vehicles to establish a framework by 2015 for certifying autonomous vehicles.

In 2013, the National Highway Traffic Safety Administration (NHTSA) issued a policy statement saying that autonomous vehicles are not yet safe enough for commercial introduction and that more research and technological development is needed. The statement established guidelines for testing and identified areas for more research.

The best and most likely scenario for regulation in the long run is one in which autonomous vehicles are regulated at the state level based on a national framework. Alternatively, requirements could be federally mandated or determined state by state.

Groups currently involved in regulatory efforts include NHTSA, which is studying regulatory systems in states that are considering commercial licensing or have allowed testing on public roads, and the Transportation Research Board (TRB), which is working to develop national guidelines for regulation, in addition to various state governments.

Other groups working in this area include:

- Google, which advocates extensively on the topic
- RAND Corporation, which recently published a report on autonomous vehicles
- KPMG and the Center for Automotive Research (CAR) in Michigan, which collaborated on a report on vehicle connectivity technologies.
- A number of universities

Technological progress

It is not clear how long it will take for autonomous vehicle technology to improve to a point where they can be certified as safe in a fully autonomous capacity (i.e. without a driver). Crashes involving non-autonomous vehicles occur about every 100K miles and generally result from unpredictable events. Autonomous vehicles would need sophisticated technology to be able to quickly evaluate hazards and make judgment calls in such events. Because autonomous vehicles could be developed to have learning capabilities, Mr. Fagnant believes that autonomous vehicles will gradually improve and eventually surpass the safe driving abilities of the best human drivers. The cost of such technology is also likely to decrease over time.

Autonomous vehicles might be shared at much higher rates than most currently used vehicles, which would cause them to travel more and decay faster than conventional vehicles. The high turnover rates might lead to faster improvements in vehicle technologies.

Concerns

Some people, including NHTSA, are concerned that introducing autonomous vehicles before the technology is sufficiently advanced could result in fatal accidents that could set back the successful roll-out of the technology. It is not clear at what point autonomous vehicles will be safe enough to alleviate this concern; some people have suggested that autonomous vehicles should be twice as safe as the average human driver before being sold

commercially.

There are some privacy concerns with regard to vehicle-to-vehicle and vehicle-to-infrastructure connectivity. It would be important to make this data anonymous so that individual cars could not be tracked.

There is no significant ideological or structural opposition to autonomous vehicles. Google is not planning to compete with manufacturers—instead, it will likely build and sell technology to manufacturers—so manufacturers are unlikely to try to obstruct their efforts.

Implications for urban planning

The impact of autonomous vehicles on urban planning is a major emerging research area. Florida is one of the leading states in the effort to anticipate and respond to these implications. Because there is a lot of uncertainty around autonomous vehicles, the exact considerations that urban planners should take into account in their planning remain very much in question. For instance, it is not clear whether urban planners should expect autonomous vehicles to lead to more or less urban density.

Induced vehicle travel

Induced vehicle travel (e.g. longer or more vehicle trips) and suburbanization are one conceivable consequence of the adoption of autonomous vehicles. Autonomous vehicles could free people to do other things in transit, decreasing the opportunity cost of travel time and increasing people's willingness to spend more time in transit, which could contribute to suburbanization. Autonomous vehicles also have the potential to drive unoccupied, which could induce more travel.

Shared autonomous vehicles

The shared autonomous vehicle (SAV) paradigm is essentially a system of driverless taxis. The potential implications of SAVs include:

- More overall travel due to unoccupied trips, relative to non-shared autonomous vehicles.
- Reduced air pollutant emissions, due to fewer vehicles (each SAV might be able to replace around 10 conventional vehicles), and fewer cold starts.
- Congestion in downtown areas caused by SAVs anticipating rush hour demand.
- Greater urban density, because SAVs would be more cost-effective if vehicles did not have to spend as much time driving unoccupied or cover as much area. SAVs also seem likely to reduce demand for parking in urban areas, which would also permit more density.

Autonomous vehicle research community

Mr. Fagnant is investigating shared autonomous vehicles for his dissertation. Autonomous vehicles are a popular emerging research topic in transportation and engineering, and Mr. Fagnant is confident that he could have continued his research at a non-profit or a research institute, had he not chosen to go into academia.

Who else to talk to

- Andy Palanisamy, a transportation engineer who blogs at www.transportgooru.com.
- Steven Shladover leads the Transportation Research Board's Vehicle-Highway Automation Committee and is a research engineer at UC Berkeley.
- Alain Kornhauser is a professor of operations research and financial engineering at Princeton University who does research and maintains a newsletter on autonomous vehicles.

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