Driverless Cars and the City: Sharing Cars, Not Rides

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A world of driverless cars seems likely to provide massively improved highway safety, better mobility—especially for those with mobility disadvantages (such as the rising elderly population)—faster travel times, better use of existing roadway infrastructure, and a reduction in traffic congestion. All this should lead to better lives and better economies.

Some people imagine a driverless car world in which a mobility service company delivers exactly the car you want (Neil, 2015) on a moment's notice. The ultimate vision may be a city with few residential garages and in which virtually every automobile trip might be in a different vehicle, often shared with strangers. Good reasons raise doubt, however, that this ambitious scenario will ever be achieved.

An Evolutionary Process

The world of driverless cars heralds revolutionary changes, but for cities (metropolitan areas) the process will be evolutionary. No "Big Bang" will occur, in which today's driver-dependent personal mobility system will quickly become driverless.

We are entering what the National Highway Transportation Safety Administration calls "Level 3 automation," in which new cars have automated features, but some circumstances require driver intervention. Transition to driverless cars (Level 4), in which drivers *are not permitted to intervene*, would come later. That eventuality is the focus of this discussion.

The evolutionary development of the driverless future will be determined by consumer preferences. Fortunately, those preferences will be fashioned by the experience of implementation. If significant system difficulties, problems with reliability, or "hacking" concerns arise, the driverless future could be many more years away than is currently predicted.

Recently, concerns have arisen because of a well-publicized fatal accident that involved a driverless car in automatic mode (Knight, 2016). Furthermore, questions have been raised because of complex moral choices that a driverless car would need to make in some potential accident situations (Greenemeier, 2016).

If the public does not become comfortable with having no means to intervene with automobile operation in an emergency, the transition to full automation could be slower, or may not even occur. If driverless deployment is less attractive to consumers in lower-density areas, such as suburbs and exurbs, many households could opt for conventional vehicle ownership, which may or may not include fully automated vehicles.

In short, we are about to witness the development of a new market for mobility that will succeed only by satisfying consumers. The shape of the market will be what consumers want it to be.

Consumer Cost Implications

A common assumption is that conversion of the automobile from private ownership to ownership by corporate mobility providers will result in lower costs. Mobility service companies would use vehicles more efficiently, reducing purchase costs and passing the savings on to consumers, assuming a fully competitive market.

The cost of mobility involves more than buying cars, however. Other vehicle costs, nearly all for vehicle operation, will likely be paid by the mobility service companies, which will need to *add sufficient amounts to its fees* to pay its expenses and to earn a return on investment.

Sharing Cars, Not Rides

Some forecasts of the driverless car era suggest an ultimate future in which virtually all personal mobility will be by a vast ridesharing, or carpool, system. People would travel around the city with whoever happened to get into the car. Ridesharing with strangers would become the norm. This vision presents problems. Because not all passengers would start and stop at the same place, trips would likely often be longer and include more stops, making sharing less attractive.

Lower prices from ridesharing may not be enough to entice significant numbers of travelers. The experience with carpooling in the United States may be instructive. Despite the considerable cost savings available from commuting by carpool and improved computer matching systems, carpooling is in the midst of a decades-long decline.

A much larger barrier looms. As long as personal security concerns remain (and they seem to be becoming more, not less, of a concern), broad adoption of the ridesharing model—at least with strangers—will be unlikely. Prescreening and security cameras can reduce risks; however, the potential for breaches of personal security remain. Many people may not be willing to share rides with people they do not know.

An Array of Ownership and Deployment Options

The evolutionary market development process should provide ample opportunity for a vibrant, competitive mobility services industry to develop, with product offerings that meet the differing needs of consumers.

In the competitive market, companies are likely to provide cars (mobility) to consumers, ranging from short-term rentals to long-term leases, similar to car leases today. The success of such services in places as dense and compact as the core city of Paris, France, with its incomparable transit system (for a western city), may be surprising. However comprehensive transit is in the central core of Paris, some trips within the core of the city can be substantially shortened by automobile travel.

Long-term arrangements could be exclusive, involving no vehicle sharing for the lessee, replicating car-leasing arrangements common today. Alternatively, the long-term arrangement could include the mobility service company's using the customer's garage for storage between short-term rentals.

At the same time, individual ownership could continue, and many individual owners could take advantage of Internet-based alternatives for renting out their cars on a short-term basis. Some websites (such as turo.com and getabout.com) already facilitate such arrangements. The bottom line is that the advantages of the driverless vehicle are likely to be achieved regardless of the pattern of personal vehicle ownership.

The deployment of vehicles, ultimately, is likely to include various options, from private ownership to mobility companies that send driverless vehicles on demand. The deployment of a fully driverless vehicle fleet likely would not eliminate the residential garage or private ownership.

Size of the Vehicle Fleet

Vehicles sit idle more than they move. One estimate is that cars are parked more than 90 percent of the time (Burgess, 2012). Some projections have suggested that reducing the vehicle fleet by 80 to 90 percent is achievable. That projection may be possible in some very unique environments, such as the core of New York City (Claudel and Ratti, 2015) and the core city of Lisbon, Portugal (Martinez, 2015). Travel environments such as those, however, are the exception, not the rule.

Most people in the United States and Portugal live at far lower densities than do residents of New York City and the city of Lisbon. New York City represents less than two-fifths of the metropolitan area population (combined statistical area) but covers only one-fortieth of the land area. The city of Lisbon contains one-sixth of the metropolitan area population but covers only one-thirtieth of the land area.

Markets within metropolitan areas are different enough that the pace of implementation and the array of services could vary substantially. Exhibit 1 indicates the substantial variation in market factors between sectors within the 52 metropolitan areas with a population of more than 1,000,000, using the City Sector Model (Cox, 2014).[1] The high zero-vehicle household densities in the urban core suggest a strong market for mobility service companies. The much lower vehicle densities in suburban areas suggest that the costs of doing business there could be much higher, principally because of longer vehicle deployment trips ("deadhead" trips), in which the vehicles have no passengers.

[1] The City Sector Model (http://www.newgeography.com/category/story-topics/city-sector-model) classifies small areas (ZIP Codes) of major metropolitan areas by their urban function (lifestyle). The model includes five sectors (exhibit 1). The first two are labeled as "urban core," replicating the urban densities and travel patterns of pre-World War II U.S. cities—although those classifications likely fall short of densities and travel behavior changes sought by contemporary urban planning (such as Plan Bay Area; http://www.newgeography.com/content/003899-plan-bay-area-telling-people-what-do). The third and fourth are suburban sectors, earlier and later. The fifth sector is the exurbs, outside the built-up urban area. The principle purpose of the City Sector Model is to categorize metropolitan neighborhoods based on their intensity of urbanization, regardless of whether they are located within or outside the boundaries of the historical core municipality. City Sector Model criteria are described at http://demographia.com/csm2015.pdf.

Exhibit 1

Selected Market Characteristics by City Sector: 2012

City Sector	Car Density	Zero-Car Household Density	Cars per Household	Population Density	Share of Population (%)
Urban core: central business district	5,646	7,015	0.49	23,280	1.3
Urban core: ring	4,368	1,316	1.05	11,155	13.4
Earlier suburbs	1,606	82	1.71	2,588	41.6
Later suburbs	905	19	1.89	1,346	27.3
Exurbs	109	3	1.96	155	16.4
Metropolitan area	429	28	1.68	700	100.0

Note: Density measured per square mile.

Sources: Derived from 2010–2014 American Community Survey 5-year data; City Sector Model

The first driverless cars that operate without driver intervention will likely be "city cars" operating in urban cores, where sufficient mapping will have been completed. Those cars will not be attractive to individual users who need to travel outside a service area that is smaller than the metropolitan area. Driverless cars will probably be available and practical within the densest parts of metropolitan areas first, with a gradual expansion of individual service areas to the suburbs and exurbs. Eventually, driverless cars would likely be able to make long-distance trips between cities.[2]

At this point, the size of the required fleet is not known, and the abysmal record of transport planning projections (Flyvbjerg, 2007) suggests substantial potential for error. Fortunately for consumers, mixed operations will continue for a long time, and consumers will switch to driverless vehicles only when they are satisfied with the reliability of the system.

Dispatching cars every day from parking facilities to the many workers and school-trip drivers, who have virtually the same daily need for a car, may not be feasible for mobility service companies. Using customers' garage space may make more sense in such cases, and that would likely reduce costs and would certainly reduce unnecessary deadhead mileage.

It would also reduce traffic because, in the lower-density suburbs and exurbs where 85 percent of metropolitan residents live,[3] deadheading cars the much longer distances from mobility service company facilities would increase both car mileage and traffic congestion.

A similar though lesser problem exists with respect to the mid-workday storage of work-trip vehicles. Sufficient demand for vehicles may not exist between the morning and evening work trips. Mobility service companies might find that parking those vehicles in the already existing parking facilities near work locations makes sense, rather than making an additional trip to the company facility to await dispatch.

[2] See "Top Misconceptions of Autonomous Cars and Self-Driving Vehicles," Driverless Car Market Watch, http://www.driverless-future.com/?page_id=774.

[3] According to the City Sector Model, in 2012, 85.2 percent of residents of the metropolitan areas with more than 1,000,000 in population lived in the suburbs and exurbs (41.6 percent in the earlier suburbs, 27.3 percent in the later suburbs, and 16.4 percent in the exurbs). See Cox (2015).

The best markets for the permanently roving car seem likely to be "one-off" trips, such as to and from airports, enabling travelers to avoid expensive parking. Shopping trips are another promising market, especially in geographic areas that have either low automobile ownership rates or less penetration of longer-term lease arrangements by mobility service companies. Unlike airport parking lots, however, shopping center parking lot sizes may not be reduced much by driverless cars because those cars will have to be immediately available for the return trip, so they would be taking up space in the parking lot.

Effects on Transit: Positive and Negative

Mass transit access is exceedingly limited in the modern metropolitan area. According to research by the University of Minnesota Access Laboratory, the average worker in large metropolitan areas can reach less than 2 percent of jobs by transit in 30 minutes and less than 10 percent of jobs by transit in 1 hour (Owen and Levinson, 2014). By comparison, more than 65 percent of jobs are within a 30-minute commute by car (Levinson, 2013), and the average travel time for driving alone is approximately 25 minutes.[4] Transit is thus less attractive than driving in terms of travel time. Transit's huge travel time disadvantage relative to cars is the result of transit authorities' necessary focus on central business districts, the location of the most concentrated demand, and sparse coverage in the suburbs, which contain 80 percent of jobs. In 2014, central business districts had 65,700 jobs per square mile, more than 30 times the density of urban core rings (2,100), more than 60 times that of the earlier suburbs, more than 120 times that of the later suburbs, and approximately 1,500 times that of the exurbs (Cox, 2016; Demographia, 2016). The result is the "last mile" problem—the fact that most potential transit destinations, jobs and otherwise, are often beyond walking distance from transit stops. This practical consequence is indicated by the Owen and Levinson (2014) findings, which show the overwhelming majority of destinations in major metropolitan areas—from the largest, New York, to the smallest, such as Raleigh, North Carolina, and Salt Lake City, Utah—cannot be reached by the average resident in a time remotely competitive with the automobile.

Driverless vehicles could be both a bane and a boon to transit. Improved car travel times, combined with door-to-door access, could severely disadvantage transit's ability to retain riders who can afford to travel by car.

On the other hand, a large share of transit riders have low incomes and generally will not have a sufficient budget to take advantage of driverless car alternatives. Transit thus will likely retain its low-income ridership market, not least because rates could be unaffordable without some form of subsidy; however, American Community Survey data indicate that most commuting by low-income workers is already by car.[5]

[4] In 2010, the average drive-alone travel time was 24.0 minutes (American Community Survey).

[5] More than 75 percent of commuting by low-income workers was by car, according to the 2006–2010 American Community Survey (Cox, 2012).

On the other hand, driverless cars dispatched to transit stops could lessen transit's last-mile problem by placing more destinations within practical access. Because commuter rail services, subways, and some other rail services operate faster than local bus routes, the most important driverless car potential for *increasing* transit ridership could be in rail connections.

If driverless car charges are low, however, the attractiveness of transit could be further reduced, as people opt to use driverless vehicles for the entire trip.

Assessment: Effect on the Urban Form

Reason Foundation's transportation policy director, Robert Poole, rejects the view of some people that "mobility as a service" will lead to a "world of high-density, compact urban living, where people's jobs, shopping, dining, and recreation opportunities will be much closer to their homes than they are today in suburban America." He points out that "there is zero evidence—in census data or anything else—suggesting that any significant demographic group, including millennials or the retired—wants to live in that imagined world" (Poole, 2016).

I agree. Cities evolve. They are not transformed in the short term. Truly transformational cities are rare and are designed and built from scratch. Switching to driverless cars will not be like building and opening a Brasilia, but rather more like slowly retrofitting Rio de Janeiro, from which Brazil's capital moved nearly 60 years ago.

Of course, some future neighborhoods and districts will be built to take full advantage of the driverless car, but, other than gaining intermittent coverage in real estate sections of national newspapers or architectural journals, they will do little to change the city as a whole.

New suburban employment developments beyond the current urban fringes could require less parking, depending on how many people opt for longer-term service arrangements (or ownership) as opposed to on-call arrangements. Suburban residential areas may yield little or no additional developable land. If, as seems likely, many suburban residents continue to have cars that they either own or lease on a long-term basis from mobility service companies, the need for garages will continue. Resale values for houses built without garages may be lower, which could encourage buyers to require garages, whether or not they believe when they move in that they need a garage.

Urban transport seems likely to be characterized by dispersed "many-to-many" travel patterns even more than today. The term *many-to-many travel patterns* refers to the near-random distribution of origins and destinations. The urban transport system must be able to serve trips that begin at any address and end at any other address in the metropolitan area. In the United States, automobiles serve at least 98 percent of urban travel. Indeed, replicating this service coverage and travel time with transit could require expenditures equaling the gross domestic product of any city that attempts it (Ziv and Cox, 2007).

The driverless car city of tomorrow will continue to be automobile oriented, likely more so than today. Some large central business district parking lots can be converted to other uses, and airport parking lots could well become shadows of their former selves.

Driverless cars do not seem likely to have much of an overall effect on urban form, however. Even once the "full deployment" scenario is achieved, much of the land that could be converted to other uses, such as from potentially narrower streets (which might be opposed by bicyclists), provides little potential for development.

The driverless car seems likely to achieve a mobility and safety revolution, implemented in an evolutionary fashion over decades. To directly address the issue at hand, little of "the land and capital currently required for parking, roads, gas stations, and car repair" is likely to "be released to housing, nonautomobile commerce, foot traffic, and other uses." Nor is it likely that "driverless cars will work a huge change in the built environment of the American city."

What the driverless car has the most potential to do is expand opportunity. That means better lives for disabled and other people who are unable to drive. Quicker transport facilitates labor market efficiency, which means more economic growth. This is important in view of concerns about the likelihood of slower economic growth in the future (Gordon, 2016). The real gains could be in the standard of living, not so much in the urban form (and that is as it should be).

A future of greater mobility, quicker door-to-door trips, and increased demand for travel seems unlikely to lead to higher densities or greater centralization. On the contrary, those are the forces that have suburbanized not only the urban periphery but also large areas of core cities. More and better personal mobility is unlikely to reverse that trend.

Author

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