Preparing our cities for shared autonomous-vehicles

What infrastructure improvements will promote the growth of autonomous vehicles while simultaneously encouraging shared ridership?

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Imagine a future in which fleets of autonomous buses and shuttles effortlessly navigate through city streets to their designated stops. Ridesharing services dispatch shared autonomous vehicles (AVs) to pick up multiple passengers traveling along similar routes. Car ownership and traffic congestion drop because shared-mobility AVs fulfill most transportation needs.

Now imagine an alternative future in which everyone who once owned a traditional car instead has an AV. Many people without licenses also purchase AVs for their personal use, even though they haven't had a car for years or never owned one. Passenger-miles traveled increase by 25 percent and city streets become even more gridlocked.[1]

Which scenario will emerge around the world? The answer will depend, in part, on whether public and private stakeholders invest in the infrastructure required to enable shared autonomous mobility (SAM). Here's a look at the benefits that stakeholders can obtain by pursuing an infrastructure strategy that encourages SAM, as well as some steps that can help them move in the right direction.

Autonomous-vehicle infrastructure at a crossroads

If stakeholders build infrastructure to support SAM, multipassenger robo-taxis could account for 500 billion miles traveled on US roads—about 9 percent of the total—by 2030. By 2040, they could account for 50 percent of all miles traveled. In addition to less traffic congestion, vehicle emissions could plunge. With more AVs in use that make fewer errors than human drivers, transportation fatalities could decline. Real estate previously dedicated to parking could be repurposed into commercial or residential properties. These improvements, in combination, could produce economic benefits totaling $850 billion annually.

Basic upgrades: Keeping infrastructure assets in good repair

Some of the upgrades essential for SAM are simply intended to make the roads friendly to AVs. Currently, only 41 percent of US roads meet the requirements for a "good ride," as scored according to the International Roughness Index. Potholes, poor striping, and other maintenance issues not only create safety problems but also present challenges to AVs. For instance, the physical structure of intersections will change if roads or markers deteriorate, making it difficult for mapping software to guide AVs accurately. If governments consider adopting faster, more efficient approaches to improving basic infrastructure, they could reduce such problems and enable greater AV use. Governments could also eliminate some issues by contemplating partnerships with various stakeholders, such as utility companies, transportation departments, and cable companies, to ensure coordinated and cost-effective street repairs. With fewer detours and road closures, AV navigation will be easier.

Shared mobility: Shaping the future of transit

Other infrastructure upgrades are specifically designed to encourage SAM. These alternations may not be an immediate concern for public officials who are busy juggling priorities and dealing with tight budgets. But acting now on a forecasted need is less costly than acting later on an existing or emerging need. SAM investments could also produce some immediate improvements in congestion and transportation, even though traditional vehicles far outnumber AVs.

Some of the most important structures and accommodations needed for SAM include the following:

- **Support facilities.** Autonomous fleets will need large support facilities to service and charge AVs. If cities allow private companies

to operate vehicle fleets, officials might only need to regulate support facilities; their private partners would bear all infrastructure expenses. But if officials want to create public fleets, they should consider planning for the development of support facilities, much as they do when creating or enhancing today's bus systems. In some cases, they could repurpose existing facilities that are no longer essential, such as parking garages.

- **Staging areas.** To avoid congestion, AV fleets and shared-ride services need locations where they can idle when picking up or discharging passengers. One solution might involve converting existing parking spots into staging areas accessible to multiple fleet operators.

- **Curb modifications**. In most cities, the curb predominantly serves as a space for parking. Transportation leaders could consider pricing this resource more dynamically, taking market demand into account, to free up spaces. They could also designate it for specific purposes at different times (designated with signs or beacons that send signals to AVs). During rush hour, the curb might be a pickup site for AV shuttles that are part of the public transportation system. Later, it could provide parking for food trucks during lunch and a site for freight delivery at night. Transforming the curb may encourage SAM because travelers could share costs related to drop-off, especially during times when the price increases. Dynamically pricing curb space could also reduce congestion and cut down on vehicles circling—current problems that will extend into the AV world of the future.

- **Mobility hubs.** For SAM to flourish, travelers must be able to transfer seamlessly between different modes. A commuter might take a robo-taxi from home to the nearest train station then grab an electric scooter to get the final mile from the train stop to the office. If this process is too difficult, passengers might opt to take a private AV from point to point—a trend that would increase delays and unreliability. To avoid this situation, officials could consider investing in more mobility hubs where travelers going in the same direction can access shared transportation, including AVs. These facilities could include micromobility-pickup locations (places where people could get scooters or bikes) next to subway stops or large transit facilities that also contain dining and shopping options at critical nodes.

Funding autonomous-vehicle-infrastructure upgrades: Possible approaches

Federal, state, and local governments are already struggling with budget deficits, and transportation is underresourced. According to the American Society of Civil Engineers, the United States has a $836 billion backlog of highway- and bridge-capital needs.[2] Adding to the problem, the growth of AVs and EVs could exacerbate the current funding gap by 22 percent—about $80 billion—by 2040. (Given that most AVs will be electric, fuel-tax revenues may fall by more than half). And without the need to license and register drivers or personal cars, various fees could also fall substantially. These shifts will likely present a daunting financial challenge for the public sector.

Public officials could mitigate the funding gap by finding new revenue streams. When considering their options, it would be helpful if they investigate whether new revenue streams would incentivize or discourage more cost-efficient SAM. In many cases, these streams may come from public–private partnerships (PPPs), which are becoming more common with large transportation projects.

PPPs provide means for encouraging the diverse mix of capital investments that may be needed to support the growth of AVs and SAM. (No single public or private organization has the resources needed to make all required infrastructure upgrades.) With all PPPs, careful consideration

must be given to ownership issues, contract terms, and the potential value of the future revenue streams. Prime mobility-related PPPs that encourage SAM might focus on the following activities:

- developing the infrastructure necessary to price the curb dynamically and collect revenues (for instance, by installing smart meters that display current prices, accept payments, and notify servers if they are occupied)
- bundling a variety of small capital improvements across a broad geography to capture economies of scale and attract the most efficient and sophisticated private-sector companies (for instance, by repairing multiple bridges simultaneously)
- setting up and operating mobility services, such as AV fleets, on behalf of a city, following the model that some have implemented for bikeshare programs
- constructing infrastructure to collect user fees on shared-AV-only lanes

The greater use of shared AVs won't just change transportation systems—it could also breathe new life into cities. If transportation officials begin looking into SAM issues now, before AVs become widespread, they can create a future in which traffic flows smoothly and predictably, public transportation operates efficiently, and overall emissions drop. Residents could have more parks, restaurants, and businesses to enjoy in their own neighborhoods, giving them a greater connection to the local community. Risks to bicyclists and pedestrians, which have been growing in recent years, could also fall. The benefits that such changes could bring to society and the environment could be beyond price.

[1] Eric Hannon, Colin McKerracher, Itamar Orlandi, and Surya Ramkumar, "An integrated perspective on the future of mobility," October 2016, McKinsey.com.

[2] "Roads," *2017 infrastructure report card*, American Society of Civil Engineers, 2017, infrastructurereportcard.org.

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