

The Effect of Automated Vehicles on Toll Roads

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Anne Tricerri, Fitch Ratings

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Full Autonomy Will Be Transformative

Progress continues towards full automation with automated vehicles (AVs) already being tested worldwide. Fitch Ratings' view is that widespread use of AVs without a safety driver will likely occur in more than a decade. The flexibility of travel dramatically increases without drivers, which will affect traffic patterns.

VMT Expected to Increase

Fitch expects full autonomy will most likely increase vehicle miles traveled (VMT). Longer journeys would be more tenable for commuters, who could complete other tasks en route if they don't have to drive. More trips are also expected due to induced demand from improved throughput, empty AVs repositioning themselves and improved mobility for individuals who cannot drive a conventional vehicle.

Other Factors Are Unfavorable

On the other hand, data collection and connectivity will allow AVs to optimize routes, which could decrease VMT. AVs could also encourage more carpooling, resulting in fewer individual trips. Ridesharing fares could decline since there are no salary costs for drivers and carpooling further lowers the fare. Lower fares could make ridesharing more economical than owning a car.

Effects on Ratings

Fitch has not taken rating actions or changed Outlooks on toll road issuers due to risks from AVs. The effect on traffic patterns is unknown and complex, with competing positive and negative implications. Issuers with shorter debt maturities and structural features, such as lock-up tests and mandatory prepayment mechanisms, will be less vulnerable to revenue volatility.

Monopolistic Systems Best Positioned

Toll roads with no viable competing routes, such as monopolistic bridge systems and large expressways, are least susceptible to revenue loss from AVs. Small networks that compete with free routes and serve as congestion relievers are more at risk.

Managed Lanes Most Vulnerable

Congestion relievers, particularly managed lanes, are most susceptible to reduced toll revenue from AVs. Even if AVs increase the number of trips, they are expected to reduce congestion. AVs increase throughput by reducing the distance between cars and optimize trips by communicating with other AVs and connected infrastructure. AVs also decrease the value of time (VOT) since passengers can complete other tasks on their journey instead of driving. Lower VOT reduces the willingness to pay tolls for a faster trip.

Timing of Widespread AV Use Uncertain

Traditional car manufacturers and technology companies continue to make progress with the development of AVs. Advanced driver assistance systems, including technologies such as adaptive cruise control and collision warning systems, are already incorporated in numerous vehicles on the road today. Pilot programs are also underway globally as a first step towards mainstream AV use, but most programs employ backup drivers. Fitch believes that widespread full autonomy is not expected for at least a decade due to safety concerns, as well as technological limitations. Fitch does not anticipate a sea of change in the amount of VMT until the achievement of full autonomy that is not restricted to geofenced areas.

Changing Demand for Toll Roads

The advent of full autonomy will most likely increase VMT; however, there are numerous factors that will affect traffic patterns, which makes it challenging to forecast the effect of AVs. Fitch reviews traffic and revenue (T&R) forecasts provided by consultants when developing Fitch's rating cases. Fitch has not yet received a T&R forecast that incorporates the effect of AVs given that there are so many unknowns. However, T&R consultants have begun modeling the potential outcomes of full autonomy. Fitch maintains a dialogue with consultants and continues to monitor technological developments.

Factors Expected to Increase VMT

Induced Demand

Reduced congestion from AVs could induce demand. AVs travel more precisely and safely than a conventional car, allowing for less space between vehicles on all sides and increasing throughput. Existing roadways could also expand by fitting a greater number of narrower lanes within the existing corridor. Time savings from reduced congestion could draw users from other forms of transportation or alternative routes.

It is also possible that AVs could increase congestion. Provided that ridesharing fares become cost competitive and AVs are readily available to meet trip demand, individuals could take AVs instead of transit, such as buses, subways and rail. Full autonomy eliminates the largest cost for ridesharing companies — paid drivers — which makes it feasible for ridesharing companies to generate profits from lower fares. The effect of AVs on congestion remains uncertain, but the potential outcomes suggest that the number of vehicle trips will likely increase.

Decreased VOT

VOT is a major variable in toll revenue forecasts since it is a predictor of willingness to pay a toll. A driver will choose to use a toll road if the driver's VOT saved is greater than the cost to pay the toll. VOT estimates, which vary based on drivers' characteristics, are especially important to forecast traffic on congestion relievers such as managed lanes. Given that managed lanes compete with the free adjacent general purpose lanes, they rely on the premium drivers place on time savings.

AVs reduce VOT because a passenger's time is freed up to complete other tasks, such as checking emails, instead of driving. Individuals would potentially be willing to take a longer route that avoids toll roads if the total cost of the trip is lower. AVs could also encourage urban sprawl since individuals can be productive during their commutes. Both of these outcomes would increase the VMT, but could reduce toll traffic if free alternate routes are feasible.

Greater Accessibility

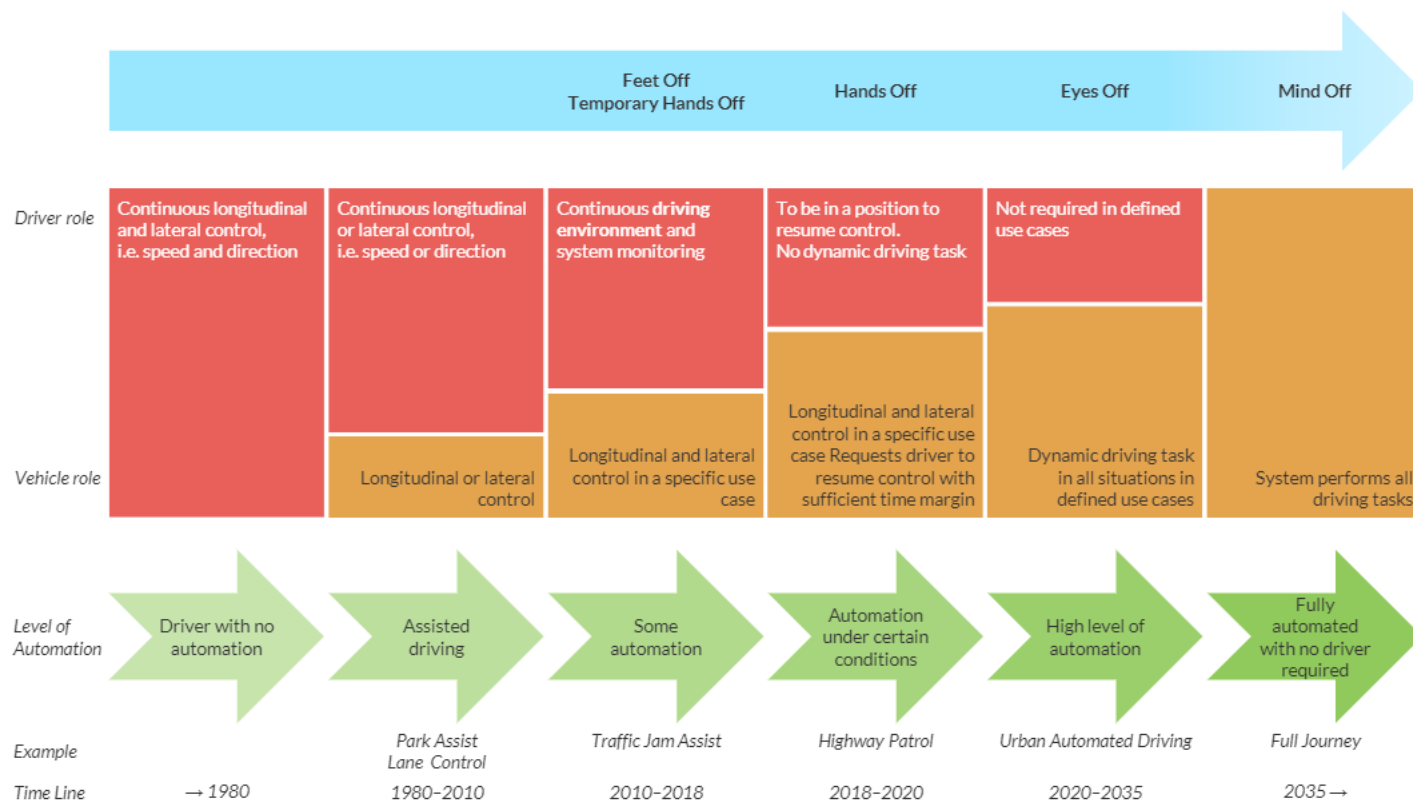
AVs could provide mobility to individuals who cannot drive a conventional vehicle. Ridesharing apps have increased mobility but there is room for improvement. Ridesharing companies are working on increasing wheelchair access since most of their drivers do not have wheelchair accessible vehicles.

Uber and Lyft have policies that children under 18 cannot ride alone, therefore ridesharing companies, such as HopSkipDrive, Kango and Zum, emerged specifically to transport kids. Fully automated vehicles would alleviate safety concerns about the driver, but introduce numerous concerns about a child traveling alone in the event something goes wrong. AVs need to be designed to meet the specific needs of the disabled and children in order to be safe and accessible.

Empty Car Trips

Empty automated vehicles will make trips to pick up passengers and return to facilities for charging and maintenance. Individually owned automated vehicles could also drop off the passenger in a central business district and drive to free or cheaper parking outside the city center. The ability for empty AVs to reposition themselves also removes concerns about range anxiety. A replacement vehicle could pick up passengers before the charge runs out and the empty vehicle could travel to the nearest station to recharge. Toll roads would benefit from tolls paid on these additional trips by empty vehicles. However, vehicles could take cheaper, longer routes to avoid tolls, especially if there is no urgency to pick up a passenger or fix an operational issue.

Stages of Automated Driving



Source: Fitch Ratings.

Credit Implications of Automated Vehicles on Toll Roads

Positive	Negative
<ul style="list-style-type: none"> Induced demand from less congestion New trips from users switching from transit Urban sprawl due to lower value of time New trips by individuals who cannot drive Empty car trips Policy incentives More truck trips 	<ul style="list-style-type: none"> Lower toll revenue on congestion relievers Shorter optimized routes More carpooling New costs for automated vehicle-related infrastructure Higher maintenance expenses from more trucks

Source: Fitch Ratings.

Policy Incentives

Municipalities could craft policies that encourage AV usage to reduce congestion and carbon emissions. Policies aimed at reducing congestion are mostly directed at urban traffic but could have secondary effects on toll roads outside of city centers. Some cities adopted congestion pricing programs to manage traffic levels, but this approach can face significant political opposition.

Since most AVs are designed as electric vehicles, AVs will reduce carbon emissions and improve air quality. The federal government and some states already provide financial incentives, such as tax credits for electric vehicles. AVs could also enable cities to repurpose parking spaces in congested downtown locations for various forms of economic development.

Freight

Automated trucks with backup drivers are already being tested in pilot programs across the country. Trucks that mostly travel on highways are more conducive to automated technology due to the simple road configuration without stop lights, intersections and pedestrians. Highways are also ideal for platooning, which uses vehicle to vehicle technology to automate braking and spacing between vehicles, which reduces drag and saves fuel.

Automated technology could spur a significant increase in the number of truck trips. AVs not only reduce salary costs by eliminating drivers but also address structural limitations in the trucking industry. The U.S. is experiencing a shortage in commercial truckers that is only expected to worsen. Also, AVs could operate for longer periods of time than drivers, who are required to take breaks after 11 hours of continuous driving.

Despite these benefits, Fitch expects there will be considerable political opposition to widespread fully automated trucking because of its implications for job losses.

Another consideration is that more trucks would increase toll revenue but wear and tear from heavy vehicles would increase maintenance expenses.

Factors Expected to Decrease VMT

Optimized Routes

The data collection and connectivity of AVs will allow vehicles to choose the quickest route. AVs will map out the shortest distance and communicate with connected infrastructure and other vehicles to gather information on road conditions, such as inclement weather, construction and accidents. However, the quickest route could be a longer distance to avoid adverse road conditions.

Greater Ridesharing and Carpooling

AVs for passenger travel are likely to be introduced under a ridesharing model in which passengers use an app to summon a vehicle. Ridesharing companies are already testing the technology. Over 60,000 self-driving rides have been completed in Las Vegas through Lyft's partnership with Aptiv. The vehicles are labeled in the Lyft app as automated and there is a safety driver. Waymo started testing fully automated vehicles on public roads in Arizona in 2017. However, safety drivers have been present for rides available to the public. In October 2019, Waymo announced that

fully automated rides will soon be available for members of Waymo's early rider program in the Phoenix area.

Shared vehicles are used more efficiently than individually owned cars that are parked for most of the day. However, there will not be a significant reduction in the number of trips unless more people carpool. Given less individual car ownership, passengers could view AVs as an extension of public transit and pay a lower fare by carpooling. Ridesharing companies have offered carpooling services for years, but AVs could improve the experience. Communication issues between drivers and passengers, especially locating passengers for pickup, would be eliminated. Also, AVs could be designed specifically for carpooling, for example, by having more private compartments.

Maintenance and Capital Expenditures

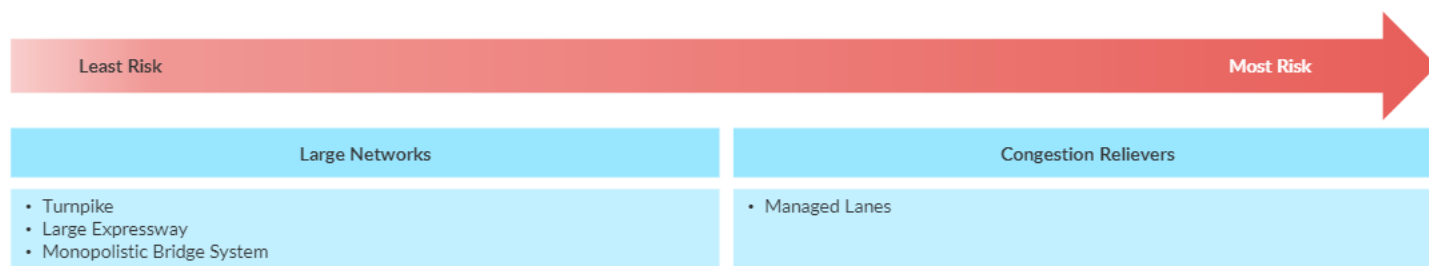
AVs will affect O&M requirements and require new infrastructure. Lane markings will need to be repainted to be detectable by cameras. Also, due to precise movement of AVs, there will be concentrated wear in the center of the lanes, which could require more frequent paving. Connected infrastructure, such as road side units that monitor traffic conditions and communicate with connected vehicles, is already being installed in pilot programs. Also, most AVs are being designed as electric vehicles, therefore more charging stations will be required.

Toll road entities will need to incorporate additional costs into their capital plans. Many pilot programs are funded by a combination of state, local and federal grant money. There are also opportunities to partner with AV technology developers to receive private investment. In the long term, entities will need to allocate funding for ongoing O&M costs associated with AVs.

How Fitch Addresses AV Risk

Fitch is not directly incorporating the effect of AVs on toll road traffic due to the uncertainty of timing and traffic patterns. AVs are less of a threat to toll roads than other assets, such as parking facilities or consolidated rental car facilities, and will likely increase traffic.

Toll Road Assets' Exposure to Risk from Automated Vehicles



Source: Fitch Ratings.

Managed Lanes Most Exposed to Demand Risk from AVs

Factors that could potentially decrease tolling revenue are less of a threat to large networks and monopolistic bridge systems. These assets are major thoroughfares that cannot be avoided easily. It is more feasible for AVs to take alternative routes that avoid tolls on small networks.

Unlike conventional toll roads, managed lane projects are more vulnerable to revenue loss since AVs are expected to reduce congestion. The premise for managed lanes is to pay a toll to avoid congestion for a quicker and more reliable trip. Less congestion and lower VOT reduce the incentive to pay a toll to use the managed lanes. Tolling policies will also need to be examined. Free access for high-occupancy vehicles (HOV) with two or more passengers, commonly granted on managed lanes, could become unsustainable if AVs significantly increase carpooling.

Alternatively, managed lanes could promote the use of AVs by becoming dedicated AV lanes. In the early stages of mainstream AV use, it would be much easier for AVs to travel in an isolated environment in which traffic flow could be optimized through vehicle to vehicle communication than to navigate among unpredictable conventional vehicles.

Fitch Cases Accommodate for Downside Risk

Although Fitch does not explicitly include AVs in its forecasts, Fitch tests the sensitivity of cash flows to various parameters, such as traffic patterns, toll rate increases and operating expenses. Fitch cases typically incorporate declines in traffic growth in outer years, which accommodate for long-term risks, including technological developments. Fitch's rating cases apply reasonable downside stresses to reflect the expected bottom of the economic cycle and a degree of operational underperformance. Current rating cases would likely accommodate moderate volatility, but Fitch would update its cases to account for structural changes in demand due to AVs.

Fitch will most likely incorporate assumptions for AVs when T&R consultants begin including AVs in their projections. When there is greater uncertainty in revenue projections, for example on greenfield managed lanes projects, Fitch errs on the side of conservatism in its forecasts.

Fitch also tests the strength of toll road assets by performing break-even analysis. Assets that could sustain annual declines in toll revenue and maintain coverage of debt service demonstrate

resiliency to potential declines in demand. As for parking assets, debt structures with long maturities of 30 years or greater are most exposed to shifting demand from AVs. Structural elements, such as cash sweep triggers and management strategies to de-lever and maintain high coverage ratios in outer years, especially for bullet debt, mitigate risk. However, unlike parking assets, toll roads will likely generate more revenue from AVs.

Implications for Tolling Methods

AVs could facilitate new tolling methods such as charging per VMT since AVs could easily collect the required data. Also, since most AVs are electric, federal and state gas taxes are expected to decline, requiring a new way to generate funds. VMT-based tolling requires significant coordination among public entities and technology companies. Voluntary VMT-based programs for hybrid and electric vehicles were launched in 2015 and 2020 in Oregon and Utah, respectively. Fitch continues to monitor industry discussions around innovations in tolling methods.

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