Congressional Research Service
Informing the legislative debate since 1914

IN FOCUS

September 20, 2017

Autonomous and Semi-autonomous Trucks

Introduction

Autonomous trucks potentially offer significant freight transportation savings for the U.S. economy. Trucks carry about three-quarters of U.S. freight when measured by cargo weight or value. Driver compensation represents either the largest or second-largest cost component for truck carriers, depending on the price of fuel. Fuel and driver compensation typically each account for about one-third of total operating costs. A truck driver may not drive for more than 11 hours per day under federal regulations, so it is difficult for carriers to improve labor productivity except by using larger trucks. Also, because driver error is the overwhelming cause of vehicle accidents, automation that reduces accident rates could improve public safety.

Despite the economic motivation, many in the trucking industry doubt whether driverless trucks are feasible in the foreseeable future given the current horizon of autonomous technology. An alternative scenario, at least for the next decade or two, is that truck driver jobs may come to resemble those of airline pilots in that drivers would spend part of their time monitoring an autonomous driving system rather than directly controlling the vehicle at all times. The skills of truck drivers when backing up an 18-wheeler to a warehouse or driving on local roads may be irreplaceable. In addition, some carriers may not be eager to forgo personal contact between drivers and customers, which may create sales opportunities.

Automobile drivers may view driving ease and comfort as the primary benefits of autonomous technology. This is also relevant to trucking because exceptionally high driver turnover has plagued the industry. However, for motor carriers, the technology will primarily be judged on whether it can bring about cost savings.

Challenges to Autonomous Trucking

Deployment of autonomous trucks involves many technologies similar or identical to those being used to increase automation of passenger cars. (See CRS Report R44940, *Issues in Autonomous Vehicle Deployment*, by Bill Canis.) Important technologies for trucking include

- automatic braking that uses cameras and radar to detect objects in front of a truck;
- lane departure warning sensors;
- air disc brakes (as opposed to drum brakes) that allow for shorter braking distance; and
- automatic transmissions, relatively new on heavy trucks, that facilitate use of driver assistance technology.

While development of automated trucks faces many of the same challenges as development of automated cars, such as cybersecurity for computerized control systems and spectrum availability for communications, there are also unique issues. The weight of a fully loaded truck, at times more than 80,000 pounds, makes the vehicle difficult to control, especially at highway speeds. Shredded truck tires are a common sight on highways; autonomous control technology will need to be able to cope with tire blowouts.

Economic factors will also affect the pace at which truck manufacturers install autonomous vehicle technology. Manufacturers often customize trucks for specific customers, for example, and trucking firms are not likely to invest in costly technology that may not function flawlessly in snow, ice, fog, and other difficult conditions. Insurance is another significant cost element for trucking firms and their customers; fully autonomous trucks are unlikely to be adopted until insurers offer them insurance rates no higher than those for conventional trucks.

When considering the potential adoption rate of autonomous technology, it is important to recognize the different sectors of the industry. Autonomous technology is primarily geared toward long-distance tractor-trailer trucks, as opposed to cement and dump trucks moving locally for construction projects or intra-city delivery trucks. The long-distance tractor-trailer segment is composed of companies both with large fleets and with just one or a handful of trucks. Tens of thousands of such smaller carriers carry a substantial portion of highway freight, but may lack the resources to install the latest equipment. Large fleet operators generally have the financial means to adopt new technologies and may view doing so as an opportunity to gain advantage over smaller competitors.

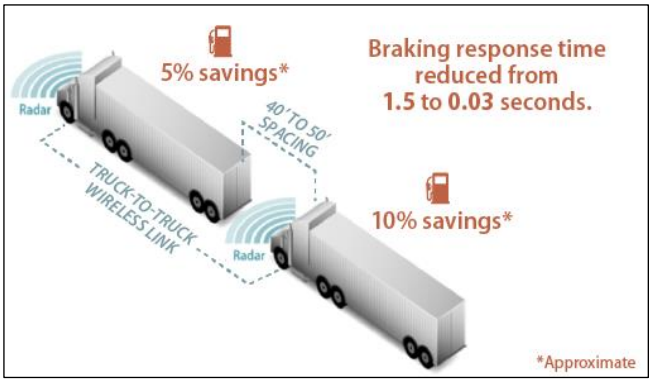
Truck Platooning

Although an autonomous truck delivering a load of beer in Colorado received widespread publicity in October 2016, it appears that truck "platooning" is receiving more widespread testing than fully autonomous trucking. Platooning is a form of semi-autonomous operation that could be a precursor to fully autonomous trucking. Platooning involves one or more trucks following closely behind a lead truck (see **Figure 1**), linked by wireless communication. This configuration reduces wind resistance, thereby saving fuel (around 10% for a following truck, 5% for the lead truck).

All the trucks in a platoon have drivers, but only the driver of the lead truck is in full control of the vehicle. The drivers in the following trucks steer their vehicles, but their feet are off the accelerator and brake because truck speed is controlled by wireless communication from the lead truck.

This communication reduces the braking response times of the following trucks and therefore allows trucks to follow closely enough to more significantly reduce wind resistance. With this technology, braking among the trucks in a platoon is essentially synchronized. A forward-facing camera in the lead truck allows drivers in the following trucks to see the road ahead of the lead truck, so that a driver can disengage from the platoon if highway conditions make that desirable.

Figure 1. Truck Platooning



Source: CRS modification of figure from http://www.overdriveonline.com.

Synchronized braking requires that all trucks in a platoon have good tires and well-maintained brakes. Poor road conditions, such as snow and ice, are still a safety concern. Platooning is most worthwhile on limited-access roads in flat, rural areas where trucks can travel at high speeds; the fuel savings are much less at low speeds. In principle, the drivers of any properly equipped trucks traveling in the same direction could agree to platoon, but coordination problems complicate platooning by trucks under separate ownership: assignment of liability should accidents involve platooning trucks from more than one trucking firm is uncertain, and each company would prefer its trucks to follow rather than lead the platoon in order to enjoy greater fuel savings. For this reason, platooning is likely to be most attractive to large fleets that have sufficient and consistent business over a given corridor.

It is possible that platooning could evolve into a system in which the first truck, with a driver at the wheel, leads a number of driverless trucks. At the moment, however, most tests appear to involve only one lead and one follower truck; tests with multiple trucks and then driverless trucks lie in the future.

Road tests of platooning first require that state laws prohibiting tailgating be waived. About 20 states are in the process of developing rules allowing for tests of truck platooning, and several states have already done so.

The Federal Role

Federal regulation of trucking is focused on interstate trucking activity; states have more leeway in regulating intrastate motor carriers. Four agencies within the U.S. Department of Transportation are the principal regulators of the trucking industry:

1. The Federal Motor Carrier Safety Administration (FMCSA) regulates truck drivers and trucking firms. This includes driver training requirements, limits on hours of driving, and safety inspections of trucks on the road. Autonomous technology may significantly change the qualifications required of truck safety inspectors. In April 2017, FMCSA held a public listening session to solicit information on issues related to the design, development, testing, and deployment of automated commercial vehicles (see Docket No. FMCSA-2017-0114, http://www.regulations.gov). The agency is working on guidelines for allowing testing and demonstrations of autonomous truck technology.
2. The National Highway Traffic Safety Administration (NHTSA) regulates safety equipment required on trucks, such as electronic stability control and speed limiters. NHTSA recently updated its policy document concerning the testing and development of automated vehicles, which is also relevant to trucks (82 *Federal Register* 43321, September 15, 2017).
3. The Federal Highway Administration regulates the maximum weight of trucks on the Interstate Highway System and the allowable dimensions of trucks over a national network of truck routes. It also overseas vehicle-to-infrastructure communication as well as any other highway-related infrastructure that supports autonomous vehicles, such as road markings and signs.
4. The Pipeline and Hazardous Materials Safety Administration imposes additional safety regulations on trucks carrying hazardous materials.

Legislation

Congress is evaluating to what extent federal policy should assist autonomous vehicle technology by granting exemptions to certain federal requirements that otherwise would impede testing and demonstrations of these vehicles. Congress is also considering preempting states from issuing certain regulations that are contrary to federal regulations or contrary to other states' regulations in order to avoid differing state requirements.

Whether to include trucks in autonomous vehicle legislation was debated during a hearing held by the Senate Commerce Committee on September 13, 2017. The House-passed SELF DRIVE Act (H.R. 3388), which would establish a regulatory framework for autonomous vehicle development, specifically excluded trucks (§13(a)(1)(C)).

John Frittelli, Specialist in Transportation Policy

IF10737

Disclaimer