



// FREIGHT AUTOMATION'S IMPACTS ON TRAFFIC AND HEALTH // //

Current dangers:

- Truck-related collisions cause serious injuries and deaths across the United States.
- Train-related collisions, while far rarer, can be catastrophic and cause death and injuries.

Future threats:

- Automation that replaces most or all truck and train driver labor may worsen traffic-related safety in some situations.
- The safety-related consequences of fully automated trucks self-driving portions of a route are unclear and require more research.

Opportunities:

- Automation that complements some truck and train driver labor holds significant promise for improving traffic-related safety in many situations.
- Automation may play a role in inspecting train tracks for safety problems.

Summary Trends: What Freight Automation Means for Traffic and Health

“We all know GPS [global positioning system] will get you lost in a minute. So you are going to have to be able to read a map, have to be able to navigate some systems in order to get you where you’re going, because there’s always construction, there’s always roads down, there’s always accidents. So you’re going to have to be able to cut that machine off and just drive this thing manually.”

– Wendell Mitchell, over-the-road truck driver

Sensors and software can detect and respond to traffic-related risks far faster than a human could, and offer an opportunity to reduce the considerable burden of freight-related traffic collisions. As with many different aspects of freight automation, however, the context is important.

Near-term, driver-assistance automation that complements truck and train driver labor is likely to reduce traffic collisions and related injuries and fatalities.

For truck drivers, collision reductions are likely to benefit Black drivers particularly, who are overrepresented among truck drivers nationally.⁵⁸ Reducing traffic collisions brings other benefits, too, such as reducing congestion that occurs after an incident.

Longer term, automation that replaces most or all of truck and train driver labor may worsen traffic-related safety in some situations. Additional research is needed.

For example, some automated systems require human monitoring and potential intervention at a moment’s notice; maintaining such vigilance may be difficult. Other types of automation, such as a truck or train that self-drives a portion of a route, are simply too new to provide definitive data regarding their safety.

A Closer Look: Sector-Specific Examples

Various driver-assistance technologies hold significant promise for improving truck- and train-related safety.

As use of automatic braking, lane-departure warnings, blind-spot detection, and adaptive cruise control grows, traffic-related safety will likely improve. A study by the Insurance Institute

HOW DOES FREIGHT TRAFFIC CURRENTLY AFFECT SAFETY?

Big rigs carrying thousands of pounds of materials. Trains more than 1 mile long. The laws of physics dictate that collisions between trucks and trains and other vehicles have significant health consequences: big rigs are involved in thousands of crashes annually, which resulted in 4,119 deaths in 2019, a 31% increase since 2009. Eleven percent of annual roadway fatalities occur in crashes involving large trucks.¹¹⁴ Class 1 trains, the primary movers of freight throughout the country, were involved in 5,376 incidents in 2019, a number that has stayed relatively flat over the past 10 years. Fatalities totaled 546 in that same year, an increase from the previous 10 years, when fatalities hovered between approximately 400 and 450 per year.¹¹⁵

The freight transportation system often stretches through crowded residential areas, so these crashes aren't limited to long stretches of congested highways or rail lines stretching through deserted landscapes. Veronica Roman, a resident of San Bernardino in southern California, notes that her community sees truck and train traffic associated with



Roberto Clack

nearby warehouses, a rail yard, and freeways. As warehouses continue to multiply closer and closer to homes and schools, truck traffic and related crashes have increased. Now, families need to leave earlier to get kids to school, and for those who walk to school, it is less safe to cross the streets. Roberto Clack, the associate director at Warehouse Workers for Justice in the Chicago area, sees similar challenges. "There's so many fatalities and there's so much traffic involving the trucks locally. Fatalities have definitely risen, and most of the fatalities involve semi-trucks." ■

for Highway Safety suggests that the combination of side-view assist, forward collision warning and mitigation, lane-departure warning and prevention, and adaptive headlights-on passenger vehicles might prevent or mitigate as many as 1,866,000 crashes each year, including more than 10,000 fatalities.¹¹⁶ Such promise with passenger vehicles bodes well for using similar technologies with trucks. Indeed, a more narrowly focused study concluded "equipping large trucks with forward collision warning and automatic emergency braking (AEB) systems could eliminate more than 2 out of 5 crashes in which a large truck rear-ends another vehicle."¹¹⁷ An assessment by a business consulting firm concluded automated trucks could reduce truck-related collisions from 222 truck crashes per one million vehicle-miles (in 2000) to only eight truck crashes per one million vehicle-miles by the year 2040.¹¹⁸

“Equipping large trucks with forward collision warning and automatic emergency braking (AEB) systems could eliminate more than 2 out of 5 crashes in which a large truck rear-ends another vehicle.”

– Insurance Institute for Highway Safety

There has been significant uptick of safety-related technologies in trains, with train sensor data and alarms providing many crews with situational awareness while in operation.

After a 2008 freight and commuter train collision Los Angeles, CA, that killed 25 people when an engineer missed a stop signal, Congress mandated the adoption of PTC technology “to prevent train accidents by automatically controlling train speeds and movements if a train operator fails to take appropriate action in certain operational scenarios.”¹¹⁹ That system has now almost fully been implemented nationally. In reviewing incidents that could have been prevented by PTC, the Federal Railroad Administration (FRA) estimates reduced fatalities and injuries, damage to track and equipment, and hazardous material cleanup, among other benefits, will save \$90 million annually.¹²⁰

PERSPECTIVES FROM THE DRIVER’S SEAT: AUTOMATIC BRAKING

Wendell Mitchell has been driving trucks for over 25 years. “Truck drivers, you know, we’re the heart of America.” He currently drives from Orlando to Fort Lauderdale, FL. Is driving stressful? “Aww man, stress isn’t the word for it... You got a lot of cars on the road now, and a lot of people aren’t really thinking about safety. When you don’t think about safety, you have accidents.” One thing that makes Wendell feel safer: his new Volvo 2020 truck, which has automatic braking that kicks in when the truck senses a car slowing down quickly in front of it.

Jorge Mayorga is a truck driver with over 35 years of experience. He appreciates the help of an automated brake. But he’s also quick to point out the many scenarios on the road where automation alone wouldn’t cut it. “Yo he tenido que sacar el camión del carril y meterme donde no está designado para poder evitar un accidente y eso no lo puede hacer un camión solo.” [I have had to merge out of the lane and get onto the shoulder in order to avoid an accident and the truck alone cannot do that.] ■

Lower levels of truck automation that complement driver labor may result in new safety risks.

Take platooning, for example, where one or more trucks follow a lead truck at distances that are much closer than would be safe without automation. As technological advances permit trucks to platoon at ever-closer distances to one another, how will other nearby vehicles handle navigating in proximity to these lengthy caravans? One researcher noted, “interactions between truck platoons and cars may be problematic, because drivers may need to speed in order to change lanes around the platoons of trucks following each other closely.”¹⁴

The safety-related impacts of fully automated trucks self-driving portions of a route are unclear.

Fully automated trucks regularly self-driving portions of a route aren't likely viable for at least another 5 to 15 years. The technological issues alone are daunting. Jeff S. Johnson, former director of Global Thought Leadership at Dell Technologies, described a self-driving car in these terms: “Research shows that in order to make an autonomous car 80% as efficient as a human driver you would need 15 billion miles of data. It's going to take several years before that kind of data is collected.” Car-maker Tesla's experience—and fatal problems with ever-more automated passenger vehicles²¹—offers a cautionary tale, albeit not with a freight vehicle, about the likely safety challenges inherent to increasingly automated freight. Research shows risks particularly increase when drivers are required to actively monitor an automated system:

When automation is used to relieve a human operator of task duties, the operator is not relieved of work. Instead, the nature of the work changes. Human-automation interaction typically requires that an operator remain alert and attentive so that they can monitor one or more automated systems and be prepared to intervene should automation fail. This monitoring role is highly monotonous and requires that an operator be ready to respond to rare, seemingly random automation failures. ... Unfortunately...human operators are limited in their ability to maintain vigilance. The longer operators are required to monitor automated systems, the more likely they are to demonstrate the vigilance decrement, that is, to miss or respond too slowly to a critical automation failure.¹²²

Even as self-driving trucks requiring no human supervision on board become technologically feasible, there are also questions about how they will behave in real-world situations like traffic jams, road construction, closures, and hazardous road conditions (e.g., ice, which may require longer braking distances) and what this will mean for traffic safety. Higher levels of automation also come with more potential vulnerability to cyber attacks.¹⁴

If safety concerns can be addressed, higher levels of automation may ultimately reduce the risks of incidents: with a less-active driver or no driver at all, trucks will be able to drive more during off-peak hours and have less interaction with other cars and people.⁵³ Of course, any

PERSPECTIVES FROM THE DRIVER'S SEAT: PEOPLE ARE ESSENTIAL TO FREIGHT AND TRAFFIC SAFETY



Jorge Mayorga

“Al llegar al puerto tiene que ir a buscar ese chasis, ósea la plataforma, conectarlo, y después bajarse para la seguridad del público, para la seguridad de las personas, para la seguridad hasta de la misma compañía porque el chofer tiene que asegurarse que el chasis este en buenas condiciones. Que las llantas están buenas. Que no haiga un liqueo de aire porque esos tractores ya conectados tienen que ponerlos a trabajar con el chasis conectado con el tractor con aire y si hay un liqueo de aire es casi algo fatal que puede ocurrir y que no lo puede checar el camión. Tiene que revisar las luces

porque si no pueden pasar unos accidentes si el camión no da las señales correctas. Si no están en buenas condiciones, puede ser un peligro para el público. Estoy casi seguro que pueden pasar muchos accidentes y eso no lo puede hacer solo el camión, se necesita a una persona. Después de checar todo el equipo tienen que ir a otra máquina a que le pongan el container. Y cuando le ponen ese container el chofer tiene que bajarse del camión y asegurarse que los cuatro esquinas de los container se aseguren por medio de un pin de seguridad porque si no en una vuelta ese container se cae. Entonces el camión solo no lo puede hacer. Incluso conectar las mangueras de la luz, del aire no lo puede hacer el camión. No lo van a poder hacer sin una persona.” *[When you arrive at the port you have to go find the chassis, that is, the platform, connect it, and then get off for the safety of the public, for the safety of people, for the safety of even the company itself because the driver has to make sure that the chassis is in good condition. That the tires are good. That there is no air leaking because when the tractor is connected they have to work with the chassis connected (via air hoses) to the tractor and if there is air leaking it is almost something fatal that can happen and that the truck cannot check (on its own). You have to check the lights because accidents will happen if the truck does not give the correct signals. If they are not in good condition, it can be a danger to the public. I am almost certain that many accidents can happen and the truck alone cannot do that [i.e., check the truck], it takes a person. After checking all the equipment, they have to go to another machine to place the container. And when they place that container, the driver has to get off the truck and make sure that the four corners of the container are secured by means of a safety pin because if not, in one turn that container will fall. So the truck alone cannot do it. Even connecting the hoses for the lights and for the air, the truck can't do that. They won't be able to do it without a person.]*

— Jorge Mayorga, veteran port truck driver ■

marked shift to off-peak hours may also have implications for drivers who do remain in the cab; see the section *Freight Automation's Impacts on the Economic Security, Health, and Safety for Frontline Workers* for more on worker conditions.

There is no consensus on the safety impacts of reduced train-crew size due to automation.

Industry stakeholders are currently engaged in a contentious struggle about the number of crew members that should be required on most trains. One core question: will reducing the number of crew members from the typical two crew members per train to one affect safety? The question is complex because it's often difficult to uncouple concerns about safety with other motivations. For example, railroad companies interested in reducing costs often look to labor reductions, whereas railroad workers want to protect well-paying jobs.

In 2016, the FRA issued a Notice of Proposed Rulemaking to establish minimum train-crew size requirements for various operations. In 2019, the FRA rescinded that Notice, stating that "no regulation of train crew staffing is necessary or appropriate for railroad operations to be conducted

A RAILROAD CONDUCTOR LAUDS THE STRENGTH OF CREW MEMBERS WORKING TOGETHER

James has worked in rail for 16 years, including as a railroad conductor with Union Pacific. In California in about 2006, Union Pacific started switching over to a remote-control engineer, taking the engineer out of the driver's seat and reducing the crew from three to two people. James took the 13-month remote-control conductor training, but he didn't use it. He doesn't support crew reductions for a variety of reasons. "I'm against remote control because I think it takes away from the jobs for other guys at the railyards and it tends to move slower. I just didn't like the way it operates."

James believes trains run more efficiently with more crew members. "When you have two guys working together everything is a lot smoother. ... [For the long-distance trains, rail companies] have been trying to figure out a way to have a one-man road freight train. Which is ridiculous. Can you imagine being by yourself in a train for twelve hours, nine o'clock in the night to nine o'clock the next morning? Going to the desert by yourself from L.A. to Yuma, Arizona. That's just ridiculous, especially if the train breaks too. What happens then? [That's] too much to put it on one guy. And then with one guy on the cab imagine walking 10,000 feet for a train that is two miles long to repair it." He raises security concerns, too, because with less crew members it would be easier for someone to board the train.

James does think drones could play a helpful role in rail operations, specifically inspecting the tracks to prevent train derailments because, he notes, there has been a cut in track-labor workers for track inspections. ■

safely at this time.”³³ In its explanation of the withdrawal, however, the FRA noted that a workgroup assigned to examine the issue “was unable to reach consensus on any recommendation or identify conclusive, statistical data to suggest whether there is a *safety benefit or detriment* from crew redundancy [emphasis added].”³³ In addition, the FRA’s own review of collision-related data “could not determine that any of the accidents/incidents involving a one-person crew would have been prevented by having multiple crewmembers” while noting that data limitations made it “impossible” to compare the relative safety of one-person crews to two-person crews.³³

The FRA also responded to stakeholders who cited the value that two-person crews have in mitigating environmental hazards after an incident, for example, or being able to decouple a train blocking a rail crossing in order to allow emergency personnel through. Specifically, the FRA found these “indirect connections” didn’t warrant train-staffing minimums, and such challenges could be addressed through other safety procedures.³³ The absence of data indicating a benefit or a detriment isn’t particularly conclusive at this point and warrants additional careful study to determine likely outcomes.

Automation may help with inspecting train tracks for safety problems.

In 2018, the FRA suspended various requirements related to track inspection so that BNSF Railway could test an automated track-inspection system. Echoing the debate about train crew sizes, unions and the train company have divergent perspectives on the safety-related implications of such automation.

The Brotherhood of Maintenance of Way Employees Division of the International Brotherhood of Teamsters, a national union, supports new technology to increase safety, but its leaders are “alarmed that the testing of this new automated system of track inspection could potentially fail because BNSF Railway has reduced the number of visual track inspections that are crucial in catching any errors that the new system makes.”¹²³ BNSF counters with the technological advantage provided by the new system. “We know that inspecting through the technologies we’re using provides us with better data than visual inspections. So, while the number of visual inspections may change, the inspections we’re adding actually provide better inspection data than in many cases the human eye is capable. ... To date, key performance metrics judging the success of the pilot have surpassed expectations.”¹²⁴

How Freight Automation’s Impacts on Traffic Affect Health and Equity

When collisions are reduced, health improves.

It’s a fairly simple equation: where automation that complements driver labor reduces traffic collisions, there will be a corresponding decline in injuries and fatalities.

The aforementioned analysis by the Insurance Institute for Highway Safety concluded “equipping large trucks with forward collision warning and automatic emergency braking (AEB) systems could eliminate more than 2 out of 5 crashes in which a large truck rear-ends another vehicle.”¹¹⁷ Another aforementioned study found that various warning and automatic braking systems implemented on passenger vehicles might prevent or mitigate as many as 1,866,000 crashes each year, including more than 10,000 fatal crashes.¹¹⁶

Although all truck drivers stand to benefit from these improvements, that’s particularly true of Black drivers, who are overrepresented among truck drivers nationally; that is, a greater proportion of truck drivers are Black compared to their proportion of the US population.⁵⁸

There are other benefits when the number of collisions is reduced as a result of automated technologies, including reductions of injuries, injury severity, and property damage.¹²⁵ Other benefits include a reduction in spills caused by collisions and resulting environmental hazards, and reducing congestion that occurs after a big crash and causes stress to other drivers.¹²⁶

Conversely, if automation that replaces some or all driver labor to an ever-greater degree worsens traffic-related safety, we would expect to see a corresponding increase in injuries and fatalities. Given the uncertainties, this is an area that requires additional research to better assess the outcomes. This research not only needs to happen in the short term, because technological advances allow vehicles to operate with less and less human supervision on freeways and highways; it’s also needed if and when automation moves off freeways and into freight-congested, fence-line neighborhoods.

AREAS FOR EXPLORATION

-  How will platooning trucks and passenger vehicles interact? Do the chances of collisions increase?
-  What are the health and safety issues where humans are still required to monitor and engage with higher levels of truck automation?
-  What are the safety implications of trucks self-driving in ever-more complicated roadway conditions?
-  How would the reduction in train-crew size affect traffic safety in a variety of real-world conditions? ■