

THE AUTONOMOUS TRUCKING REPORT

HOW SELF-DRIVING TECHNOLOGY IS DISRUPTING THE WAY GOODS ARE DELIVERED AND CREATING OPPORTUNITIES FOR RETAILERS AND SHIPPING FIRMS

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BI INTELLIGENCE

KEY POINTS

- **The trucking industry is facing a series of challenges that are impacting current operations and casting a shadow over its future.** These include high fuel costs, which make up either the first- or second-largest expense for truck operators; a driver shortage that's expected to only worsen in the future; and strict industry regulations that limit how much a driver can drive in a day.
- **Advanced and autonomous technology will enable operators and shipping firms to eradicate some of the challenges that have long plagued them.** Innovative technologies will allow trucks to take over more and more driving responsibilities, saving time and money for operators and businesses that rely on shipping.
- **The impact of autonomous technologies on the trucking industry will come in three major waves:**
 - In the first wave, companies will be able to put multiple trucks together in platoons, using sensors and vehicle-to-vehicle communication to allow trucks to drive in proximity to one another, leading to reduced fuel use and lowering the amount of effort needed from drivers.
 - In the second wave, fleet operators will start to use semi-autonomous advanced driver assistance systems (ADAS) that will gradually but fundamentally change the role of the driver in trucking, prompting changes to regulation that will cut down delivery times and lower personnel costs.
 - In the third wave, companies will leverage fully autonomous trucks and start removing the driver from the truck altogether, allowing huge savings through drastically reduced personnel spending and radically transforming the logistics industry.

- **Change to the trucking industry will be gradual but inexorable.**

Companies with foresight can start to make long-term plans to account for the ways that autonomous technologies will change how goods and products move from place to place.

[Download the charts and associated data in Excel »](#)

INTRODUCTION

Trucking is set to transform radically in the coming years. Innovative technologies will enable trucks to take over more and more driving responsibilities, saving time and money for operators and businesses that rely on shipping.

Like cars, autonomous trucks are being tested on roads around the world, and systems from startups like Peloton and Embark — which have raised tens of millions of dollars in the last year — could make their way into commercial trucks as soon as next year. Fleets will be able to leverage autonomous technologies to cut costs and gain a critical edge over competitors. And operators will be able to start buying or leasing trucks with systems that will allow the start of a more fundamental transformation, eventually culminating in fully autonomous trucks.

Autonomous technology will come to trucking in three separate waves, each of which will bring new opportunities for companies that ship goods:

- **In the first autonomous wave (2018-2025)**, companies will be able to put multiple trucks together in platoons, using sensors and vehicle-to-vehicle communication to allow trucks to drive in proximity to one another, leading to reduced fuel use and lowering the amount of effort needed from drivers.
- **In the second wave (2025-2040)**, fleet operators will start to use semi-autonomous advanced driver assistance systems (ADAS), which will gradually but radically change the role of the driver in trucking, prompting changes to regulation that will cut down delivery times and lower personnel costs.
- **In the third wave (2040 and beyond)**, companies will be able to leverage fully autonomous trucks, where the driver is removed from the truck altogether, leading to huge savings through drastically reduced personnel spending.

But to start planning for, and eventually implement, those technologies, companies need to know what technologies will be ready and when. In addition, regulatory hurdles will persist, potentially inhibiting the deployment of autonomous technologies.

In this report, BI Intelligence offers an early glimpse into the emerging autonomous trucking market. First, we look at the trucking market as it stands today, offering a basic profile of the industry and highlighting a number of the challenges and issues it faces. Then, we go through the three waves of autonomous technology that are set to upend the industry — platooning, semi-autonomous systems, and fully autonomous trucks — looking at who is making strides in each of these areas, when the technology can be expected to start making an impact, and what companies can do to get ahead of the curve.

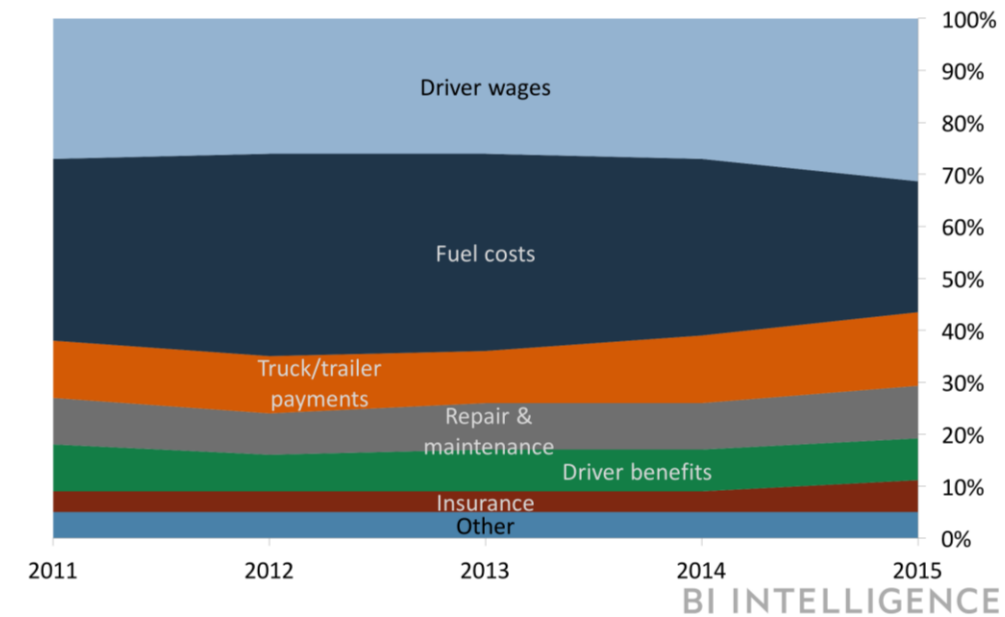
THE TRUCKING MARKET TODAY

Trucking is a massive industry in the US and around the world. More than [80% of cargo](#) is transported by trucks, and the US trucking industry generates \$726 billion in annual revenue. This revenue is spread out among a massive number of companies; the top five trucking companies account for less than 9% of that total revenue. It's also a major employer: 7.1 million people in the US work in the trucking industry, with about [1.8 million](#) heavy truck and tractor-trailer drivers in the country, approximately [350,000 of whom](#) are independent operators who own their own vehicles.

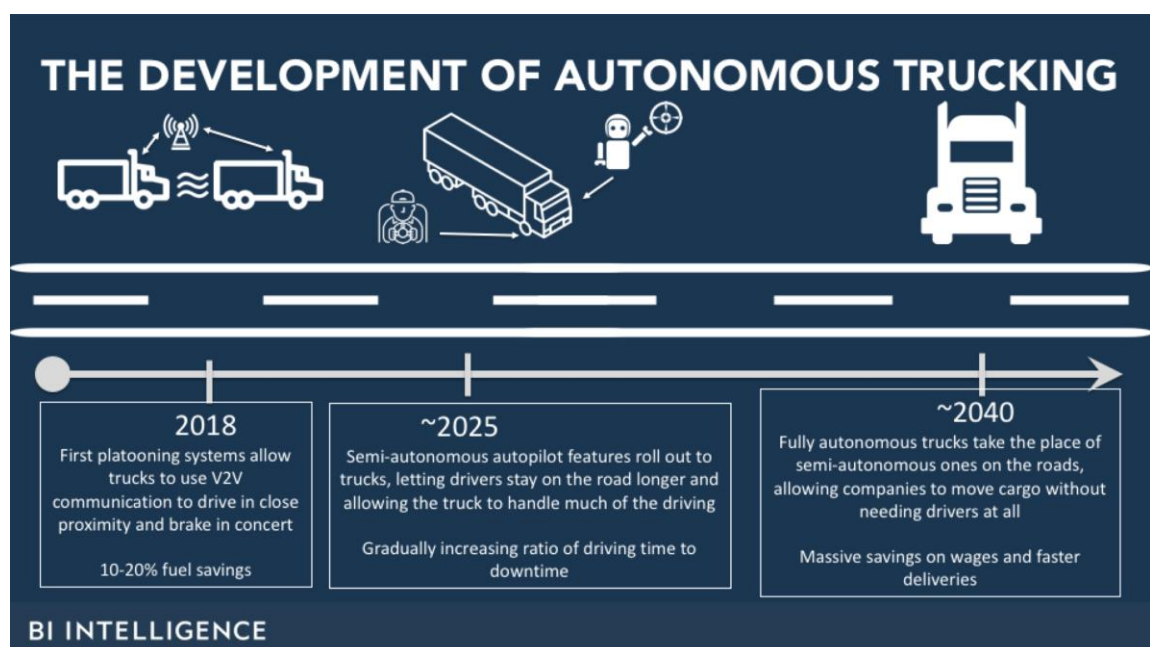
Here are some of the major issues that affect the industry:

- **High fuel costs:** Trucks are large vehicles and carry heavy cargo, which means that they use a lot of fuel. Depending on the cost of diesel, fuel is either the highest or second-highest [expense](#) for truck operators, making up between 25% and 39% of total costs.
- **A driver shortage:** There aren't enough truck drivers to meet all the demand for moving such a large portion of cargo in the US — a shortage of about 48,000, according to the [American Trucking Association](#), which warns that that could rise to 175,000 by 2024. A number of [factors](#) are driving the shortage, from a grueling daily routine to low pay and high debt. One result of the shortage has been higher driver wages, which have risen to 31% of total truck-operating expenses.
- **Strict industry regulations:** Commercial drivers are often limited by Hours of Service (HOS) regulations. These primarily apply to operators of long-haul, over-the-road trucks. In the US, drivers may be on duty for up to 14 hours, and driving for 11 hours, before they are [required](#) to take a 10-hour rest period. The EU has [similar](#) regulations, setting a maximum daily driving period of 9 hours and requiring 11 hours of rest. This puts a hard cap on how long a driver can work a day and, consequently, how far they can move cargo.

Share Of Total Costs Of Truck Operations



Overall, it's a traditional industry that's operated much the same way for decades, with slight changes to equipment but only highly limited changes to practice. But a number of companies, especially tech startups, are developing products that could help address many of these pain points and provide key savings for truck operators, which they'll need to stay competitive as the market evolves and technology finally starts to disrupt trucking.



THE FIRST WAVE, 2018-2025

The first technologies that will disrupt trucking practice are nearly here already. The biggest change in early days will come from the introduction of semi-autonomous platooning techniques and technology to long-haul over-the-road trucks and fleets.

Platooning

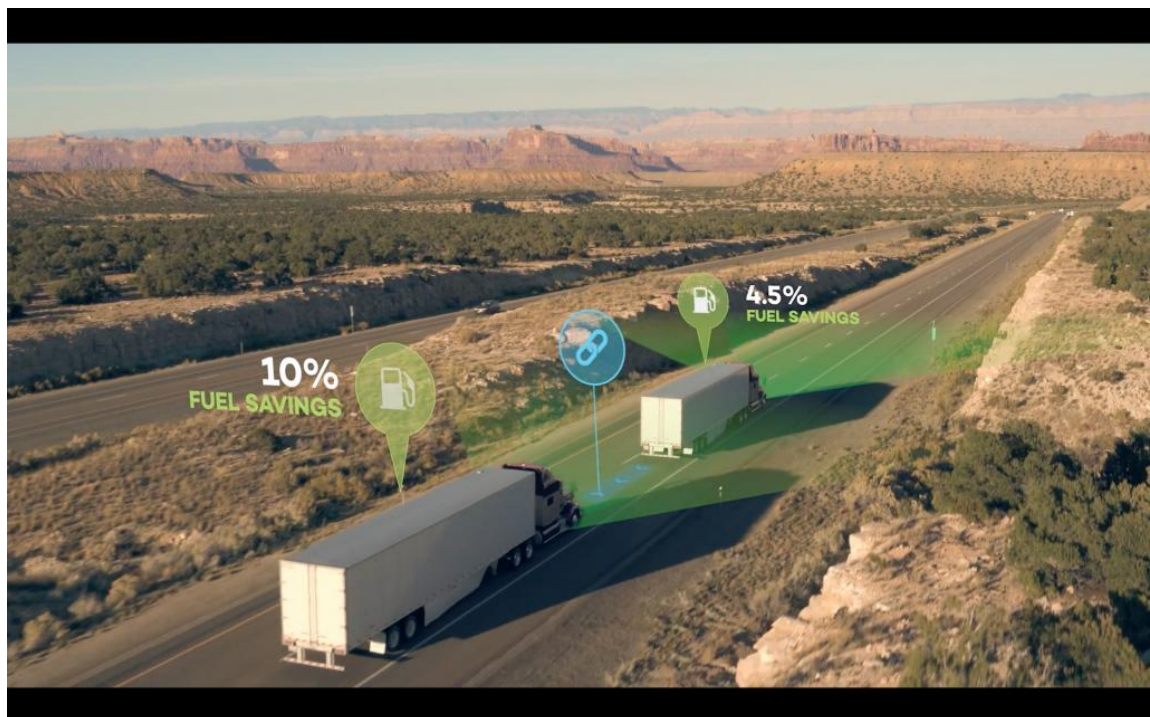
Platooning is a form of advanced adaptive cruise control that allows vehicles to use sensors and vehicle-to-vehicle communication to travel at high speeds in proximity to one another. It can feature as few as two trucks, but can also support many more. The trucks still have drivers who are in full control of steering their vehicles, but when they get onto a highway and engage the platooning system, the trucks follow a lead vehicle and use sensors and radios to communicate with that truck to regulate speed and following distance.



Trucks are able to drive much closer to one another than they would be able to otherwise, as the linked systems maintain a safe distance and also take control of acceleration and braking so the trucks move in concert. So if an aggressive driver cuts off the lead vehicle, for instance, the system can detect the car and simultaneously slow down the lead truck and the trailing vehicles to prevent one truck from colliding with another.

Platooning doesn't require advanced technologies or development in things like LiDAR or computer vision and routing. And it's able to increase operational efficiency for shippers.

The vehicles in a platoon benefit from reduced aerodynamic drag, which leads to lower fuel usage. Estimated savings on fuel costs range from [10-20%](#), depending on the technology used and the number of trucks involved. The lead vehicle also benefits from the system maintaining optimal cruising speeds, saving about 5% on fuel costs. As diesel prices are primed to continue their gradual [increase](#) in the next year, fuel costs will make up a larger part of overall operating expenses, and reducing fuel use will be a key part of bringing down overall trucking costs.



The Companies And Groups Testing Platooning

The startup making the most news in developing and commercializing platooning for trucks is [Peloton Technology](#). The company is working on real-world road tests in Ohio, Nevada, and New Mexico, where it will be able to take advantage of large stretches of mostly open roadway to gather critical data, but still be faced with drivers who can provide unpredictability, which it can use to improve its systems. The company is working with partners including truck manufacturer Volvo and fleet-management company Omnicracs.

Other companies and groups are also testing out platoons. Here are a few notable examples:

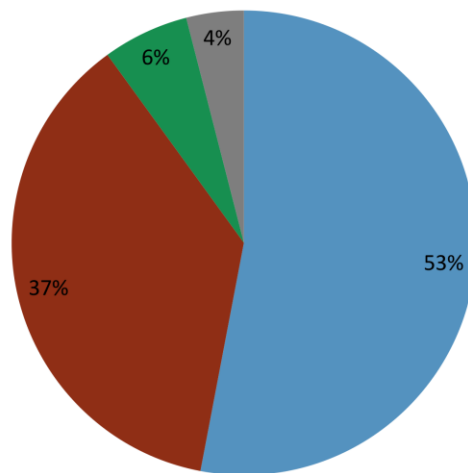
- **Daimler AG's** trucks division recently [began testing](#) truck platoons in Oregon, following early tests in Nevada in 2015.
- **Scania**, a subsidiary of Volkswagen and Toyota, began testing platooned trucks on a route between ports in [Singapore](#).
- **The US Army** ran a [series of tests](#) in Michigan using four trucks in a platoon convoy to take advantage of drafting. The Army is looking into potentially using platoons to reduce costs in moving troops and supplies.
- **The US Department of Transportation (DOT)** began tests of its own using a three-truck platoon on a [Virginia highway](#), as it looks into the developing technology and how it can be regulated to ensure safe operation in the near term.

Preparing For Platooning

Platooning is coming soon, and fleet operators need to account for it. Adaptive cruise control systems need to be built into trucks, rather than added on aftermarket. This means that these trucks, by incorporating this added technology, could have a slightly higher upfront price than today's vehicles. But they'll cost less to operate, mainly due to lower fuel usage, and those savings will outweigh the increased initial costs over the life of the vehicle and provide clear operational savings. And as platooning develops, there will be a space for companies to launch services — along the lines of [Uber Freight](#) or [Convoy](#) — to pair up independent operators carrying cargo to nearby locations, allowing these drivers to form platoons and lower their operating costs.

Share Of Delivery Costs, By Part Of Journey

■ Last-mile delivery ■ Line haul ■ Sorting ■ Collection



Source: Honeywell, 2016

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BI Intelligence expects commercial platooning systems to be available on trucks for companies to purchase within the next year. By 2020, platooning will be a mainstream technology in trucking, and as older vehicles in fleets and on the roads are replaced as part of normal cycles, most long-haul trucks should be able to function in platoons by around 2023. Companies should start planning to incorporate platooning systems into their next fleet purchases.

THE SECOND WAVE, 2025-2040

While platooning will leave today's trucking model mostly intact, the continued development of semi-autonomous driving technology and its incorporation into trucks will upend that model and start to radically transform trucking, altering everyday practice and requiring new regulatory approaches to accommodate these developments.

Semi-Autonomous Driving Technology

Self-driving cars are rapidly approaching, and many of the same technologies that will allow cars to drive themselves will also filter into trucks very soon.

With trucking, though, a number of difficulties will stop computer systems from taking total control of trucks even when comparable technology can drive cars.

The first part of this wave of technology will be the development of semi-autonomous highway systems that will be able to handle much of the driving load on limited-access roads. These types of systems will be a lot like [Tesla's Autopilot](#) or [GM's SuperCruise](#) semi-autonomous driving programs in early iterations. They'll offer drivers modes that will lessen the burden of driving, but still require that they stay behind the wheel.



Companies Working In The Semi-Autonomous Trucking Space

Here are some of the companies already making waves in the semi-autonomous trucking space:

- **Embark** is an autonomous-trucking [startup](#) that's developing systems that use sensors and advanced vehicle-routing software to allow trucks to drive on their own. The company, which came out of stealth in [February 2017](#) and raised over \$17 million in a Series A funding round, is [working with](#) truck-manufacturer Peterbilt. Embark is testing its autonomous trucking systems, which are currently at Level 2 on the [SEA automated driving index](#), meaning that the system controls acceleration and steering but requires the driver to monitor conditions around the truck. The company recently [announced](#) a joint test with truck-leasing company Ryder and appliance company Electrolux, towing trailers on a highway route for 650 miles from Texas to California.

- **Uber** is looking to develop self-driving trucks alongside its autonomous-car program. Its effort began when it acquired Otto, an autonomous-trucking startup founded by a former Google self-driving engineer, for [\\$680 million](#). The ride-hailing company is [testing](#) hardware components and software systems, and gathering data in real-world trials on highways in and around San Francisco.
- **Volvo** is also developing autonomous systems for its trucks. The company [already released](#) driver-assist systems to help drivers in its trucks today take advantage of existing technology, and it's looking to continue developing systems that will allow drivers to do less driving while moving cargo.
- **Tesla** [announced](#) its upcoming Tesla Semi, a fully electric truck with a 500-mile range that will feature a version of its Autopilot system that will allow drivers to offload some driving responsibilities to the truck's computer, much like how consumers use the system in the company's passenger cars. Additionally, the Semi will be able to participate in platooning, though it's not yet clear what vehicles will be compatible. The trucks will be available in 2019, according to CEO Elon Musk, though the full availability of features remains unclear.

A number of other companies have also started developing autonomous trucking technology, including [Alphabet's Waymo](#) and delivery company [DHL](#).



Regulatory Hurdles

One of the primary challenges that truckers face is a limit on the number of hours they're able to drive in a given stretch of time. These regulations are necessary to ensure that drivers are able to safely operate their vehicles, but they also create wasted periods where trucks and their cargo must sit on the side of a road or parked at a truck stop while the driver rests and waits for their HOS clock to reset. What counts toward HOS and how many hours truckers are able to drive are defined by regulators, so for the introduction of semi-autonomous driving systems to have an impact on the amount of time trucks spend on the roads, authorities will need to be on board and update regulations to account for changes to the way truckers drive.

Initial semi-autonomous systems likely won't meet regulators' muster to provide relief from HOS limitations, as the driver will still need to be fully engaged with the truck for the entire time that it's in operation. **As autonomous driving systems move beyond SAE Level 2, the self-driving computer will start to monitor the environment around the truck.**

This means that the driver won't be fully engaged with the operation of the vehicle, opening the door for regulators to change the way that advanced driving systems impact HOS. These officials will need to determine how much the use of a semi-autonomous system will allow the driver to divert his or her attention from the road, and the impact of these systems on fatigue — **and now is the time for companies to start pushing for dialogues with these regulators, to ensure as much as possible that regulations match technology rather than lag.**

How Autopilot Systems Can Benefit Fleet Operators

Early semi-autonomous systems will provide operators with a degree of fuel savings, since the computer will be able to optimize acceleration and deceleration to reduce fuel use. These programs will also ease the driver's job; though they'll still have to keep their full attention on the road in front of them, they won't be required to manually regulate many of the features of the vehicle, instead leaving that to the system while they oversee its operation. This will result in drivers being more aware and less fatigued — though they could still be tired out by a day of overseeing systems.

Within the next five to seven years, trucks will likely be available for purchase that include Level 3 automation, meaning the driver will not need to actively monitor the driving environment during large portions of a route. Instead, the driver will operate mainly as a backup for the autopilot system, able to take over in the event of a failure and drive the truck when it's not on a highway.

And further down the line, likely in the late 2020s, trucking automation will likely continue to advance alongside passenger-vehicle technology, meaning that the driver won't even need to be fully responsible for monitoring the vehicle on highways, with trucks featuring redundancies so that they can fall back on secondary automation systems. **At this point, the driver will only be required to step in and control the vehicle when off the highway, meaning they can bide time in a truck's cab for the vast majority of long-haul trips.**

These autopilot systems will be key in driving major savings for fleet operators. They will allow trucks to spend more time on the road and less time waiting for hours to reset, so cargo will move to destinations faster, freeing trucks to perform more deliveries without needing additional vehicles or more drivers.

Increasing the amount of time each truck and driver can spend on the roads addresses two major problems that logistics company and providers have to deal with:

- It limits the number of drivers needed to meet demand for moving goods around. Each driver can do more, overseeing a truck as it drives across long stretches of highway. This will alleviate the growing driver shortage, giving fleet operators the chance to use their current drivers to fulfill orders or transport their own goods from warehouse to destination.
- And these drivers won't butt up against HOS restrictions, so they'll be able to stay on the road to complete more of those long-haul trips without needing to stop to rest and recharge, as the truck will ensure that it operates safely and computer systems won't tire.

At some point during this period, electric trucks will also likely come to market that offer semi-autonomous features, which will also provide a degree of cost-savings since fuel will no longer be an issue, addressing the third major industry concern.

Truck operators can get out ahead of the curve by working closely with manufacturers to ensure that they're fully up-to-date on current and upcoming technology from their vehicle suppliers, and that they're able to implement the newest cost-saving options when they become available. And perhaps more importantly, for larger companies and associations, they need to start dialogues with regulators and public officials to get policies put in place that will allow all truck operators to take full advantage of the development of semi-autonomous systems.

THE THIRD WAVE, 2040 AND BEYOND

The boundary between the second wave of autonomous disruption in trucking — autopilot systems — and the third wave, fully self-driving trucks, won't necessarily be a bright line. Fully autonomous systems will evolve out of the autopilot programs, allowing drivers to hand off driving responsibilities to the truck while they're still in the cab, and take over in those rare circumstances when trucks aren't fully able to handle a road situation.

Fully Autonomous Trucks

It will take awhile to get to the point where fully autonomous trucks are on the roads, as maneuvering trucks, especially in chaotic and unpredictable city environments, is a difficult feat. According to conversations with experts in the industry and [published](#) works, it will be decades before fully autonomous trucks arrive on the roads. Nobody's entirely sure when, but even the most optimistic estimates place the first trucks on the road in the late 2030s, with some looking further into the future.

The same companies that offer software that enables semi-autonomous trucks — looking 20+ years into the future makes it impossible to forecast whether any of the companies looked at above will still be relevant, or if a whole set of new players will have entered and gained dominance in the space — will likely build on that technology to allow operators to buy and use fully autonomous trucks.

Regulatory Hurdles

The limiting factor in the deployment of these fully autonomous trucks will, once again, be regulation rather than technology. There are a couple of ways that fully self-driving trucks will most likely start making their way onto roads.

- The first fully autonomous trucks will almost surely still feature drivers. These vehicles will be able to drive themselves in all circumstances, but will still have a person in the cab to take over for the autonomous system, even if that system features built-in redundancies — just like how fully autonomous ride-hailing vehicles will likely continue to feature drivers to oversee a vehicle that's technically able to drive on its own. And over time, as these systems prove to regulators and operators that they're fully reliable, restrictions will be lifted and the driver will start to leave the cab.
- There may be certain designated areas where trucks are able to drive themselves without any driver or passenger in the vehicle. On highways where trucks, by this point, are driven by automated systems rather than by people, for instance, regulations could allow for autonomous convoys to transport goods to terminals, where they would be met by drivers who would operate or oversee the trucks after the long-haul portion of the journey is over, making trucks work much like railways that are able to move on their own once they get to the station. These systems would eventually expand beyond just highways to encompass the whole of a trip.

The Inevitable Transformation Of Shipping

However they end up being introduced, fully autonomous trucks are going to radically transform shipping. There are 3.5 million truck drivers in the US today, and those jobs would be gradually and then fully eliminated, as would many of the 3.6 million supporting roles that will either not have enough business or will themselves be automated. This will allow companies to devote less of their resources to moving their goods around, creating clear savings.

Trucks will also be able to move goods much faster than they can today, as there will be nearly no time wasted while trucks transport those items from a manufacturing facility or warehouse to their end destination. The autonomous system won't be limited by HOS restrictions or the need to sleep, and in all likelihood won't even need to stop for fuel, traveling on roadways that [charge](#) electric vehicles themselves.

The shape and design of trucks will change based on the growth of autonomous trucks. A self-driving vehicle doesn't need to make space for a driver or include a cab at all, so it can take on [radically different forms](#) from what we're used to seeing today. Trucks will be purely minimalistic vehicles, streamlined to efficiently move cargo to its destination.

One of the only developments that could impact this course would be the growth and increased capability of [additive manufacturing](#), also known as [3D printing](#). One of the main uses of trucks is to move goods from the location of production or manufacture to an end destination. If those goods can be created near that destination, rather than needing a central site that helps create more efficient production, then there won't be many added benefits from autonomous trucks.

But regardless of the way manufacturing evolves, there will always be things to transport from one place to another by truck, be it food, mail, or handcrafted products. Trucks will be an essential part of the global transportation infrastructure for the foreseeable future, but the development of autonomous trucking technology will alter the landscape forever, transforming the way that goods move and radically reducing the costs for companies that use them.

THE BOTTOM LINE

- The trucking industry is facing a series of challenges that are impacting current operations and casting a shadow over its future.
- Advanced and autonomous technology will enable operators and shipping firms to eradicate some of the challenges that have long plagued them.
- The impact of autonomous technologies on the trucking industry will come in three major waves.
- Change to the trucking industry will be gradual but inexorable. Companies with foresight can start to make long-term plans to account for the ways that autonomous technologies will change how goods and products move from place to place.

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