The Future of Truck Driving in America

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Introduction

As you drive on a major interstate highway in America, you will pass a plethora of trucks on the road. What if, while you were passing said trucks, you could see inside and realize that there was no one behind the wheel? In recent years, there has been escalating development and discussion around fully autonomous vehicles, with the idea that autonomous vehicles will eliminate the factor of human error while driving. However, this concept does not end with passenger cars, as startup companies are attempting to create fully autonomous trucks to eliminate or reduce the need for truck drivers.

To start, it is essential to define the six different levels of autonomous vehicles. Levels zero to three require the driver to be engaged with the vehicle, with level zero containing no automation whatsoever. Level three allows the driver to have the vehicle in control but must be ready to take over at any moment. Then looking at levels four and five, the vehicle can be fully autonomous in most or all conditions.[1] In commercial cars, Tesla's AutoPilot, Nissan's ProPilot, and GM's Super Cruise before March 2021 had the highest level of automation at level 2. Though, in March 2021, Honda began to sell a vehicle with level 3 capabilities in Japan utilizing their Sensing Elite's Traffic Jam Pilot function.[2]

Looking at autonomous trucks themselves, several major players are looking to capitalize on the innovation in the industry. Mercedes Benz planned to put an autonomous truck on the road in 2015, and FedEx and UPS are also looking into the technology. However, most of the significant players are startup companies looking to revolutionize the industry. Some of these top companies

in 2022 include TuSimple, Kodiak Robotics, and Embark, which have received over a billion dollars in funding combined.[3]

Trucking in America

Around 3.5 million people occupy truck driving in America in March 2022. The majority (66.6%) consists of white males, with the next largest demographic being Hispanics at 14.6%, and only 6% of these drivers are women.[4] The current average age for truck drivers in America is around 49 years old, and that age has been slowly increasing in recent years. Alongside the high average age, more than 90% of them do not have a bachelor's degree as of 2017.[5] Even without a college degree, the average salary for truck drivers in America is around $74,000 per year, making this job an excellent opportunity for Americans who did not attend college and are looking for high-paying jobs.

That large salary does not come without grueling work. On average, a semi-truck driver drives upwards of 45,000 miles a year, while long-distance drivers push an average of 100,000 miles per year. Some of the most common routes that help make up these numbers are Miami to New York City, around a 1,200-mile trip, and Seattle to Washington D.C., around a 3,000-mile trip. Due to these long trips and the lifestyle of the job, there is a shortage of drivers. In February 2022, the shortage reached 80,000 drivers with no clear solution. The lifestyle brings health problems, loneliness, and significant stress. It may seem that autonomous vehicles are the solution to this shortage that companies are looking for.

Are we ready to make the switch?

Safety issues when it comes to cars becoming fully autonomous is one among the most important. Autonomous vehicles must be safe for pedestrians around these cars and other cars with human operators on the road. In 2018 when Uber was test-driving an autonomous vehicle, the

vehicle fatally hit a pedestrian. The operator sitting in the driver's seat was supposed to be ready to intervene if the car had stopped functioning correctly but had become distracted.[6] This is not an isolated incident, as there have been other cases where autonomous vehicles have failed to detect objects or people around them. While the technology is still far from being ready for level five capabilities, it might make other drivers on the road anxious for this switch. That public anxiety could prevent companies from pushing toward fully autonomous vehicles on the road.

Besides the original safety issues with autonomous vehicles, the AI for autonomous trucks needs to be designed differently. Trucks drive on highways for the majority of the time and are much larger than passenger vehicles; therefore, the technology used and how the AI is programmed will be different. TuSimple, a significant company in autonomous truck technology, addressed this issue, "Given that a large truck going down an interstate at 65 miles an hour requires about 100 meters to execute an emergency stop, you're talking about a primary sensor that is only reliably seeing about as far as your stopping distance. That means that you're always on the verge of a crisis."[7] To combat this, TuSimple opted to use ten cameras on their trucks instead of using LIDAR technology, which has become popular among autonomous vehicle manufacturers. They claim that the trucks can see farther than LIDAR systems with cameras, and the use of cameras would also be much less expensive. LIDAR is worn out quickly and needs replacing around every 2,000 miles. That becomes very expensive to maintain since trucks can do more than 2,000 miles in one trip. Though it is still unconvincing that cameras alone will be safe enough to operate a vehicle as large as a semi-truck. What happens when one camera fails since the weather impairs its visibility? Other companies seem to be working with LIDAR technology, but the question remains of what is the best practice to ensure safety with such large vehicles.

Another challenge associated with autonomous vehicles is the battery life of these vehicles. In 2022, the passenger car with the longest battery life is the 2022 Lucid Air Dream Edition R, with a battery life of 520 miles. The recharge time of this vehicle from zero to a hundred takes around an hour and twenty minutes.[8] With a popular route being Seattle to Washington D.C. that stretches 3,000 miles, even with the best battery on a commercial vehicle, it will need to be recharged around six times to reach the destination. When we compare this to what semi-trucks are capable of now with gasoline, we see that these trucks get around 6.5 miles per gallon on average. Though not very fuel-efficient, with two gas tanks that can hold up to 150 gallons of fuel each, a semi-truck can go almost 2,000 miles before refueling. On the trip from Seattle to Washington D.C., the gasoline-based truck will only need to refuel once, which would take minutes compared to over an hour.

An additional question is how are the conditions of the roads going to affect a transition to autonomous trucks. To be ready for a transition to autonomous trucks on the highway, the government will need to repair and maintain highways. The technology used in autonomous vehicles is dependent on clear lane lines and smooth roads. However, the United States is far from this reality since the Department of Transportation estimates that in 2017 65% of roads are in poor condition.[9] The technology used for autonomous vehicles is not advanced enough to operate on highways with faint lines or poor conditions. The time it will take for AI to overcome this issue is at least a decade meaning the government needs to prepare highways if the transition is wanted to come earlier. The repair of United States highways is a needed task separate from autonomous driving that will cost upwards of $558 million.[10] If the government plans to be on the timeline of trucking companies, this costly task will need to be funded and accomplished within the decade.

Monetary Aspects of Autonomous Trucks

Is the savings on time with gasoline-based trucks and the high wage of truck drivers worth keeping the industry how it currently is? In March 2022, there is no standard or average for how large the batteries for electric trucks should be. Though, to compare, it costs an average of $0.20 per kilowatt to charge an electric car battery, with the average kilowatt per mile being around a hundred miles. Matching the 2,000 miles needed before refueling the average truck would cost $400. This is exponentially cheaper than paying for diesel gas which in March 2022 had an average price of $3.532 per gallon or over $1,000 to reach 2,000 miles of driving. These savings would be tied to the lack of or reduction of truck driver salaries. Therefore if we are looking at this problem through the lens of trucking companies, the switch would see significant benefits in profits.

In reality, there will most likely be a need for a driver to still be in the driver's seat for the foreseeable future. Truck drivers will still be needed since they will not be at level five capabilities when first becoming commercialized. They will be designed for specific applications and will not be able to handle tasks such as navigating city spaces.[11] Though this comes back to the question of how much can these drivers be paid. The workload will not be as it is in March 2022, being only needed for instances throughout 2,000 miles on a highway and for a short time in a city area. The work being done will most likely be similar to what we see airplane pilots currently do. Commercial airplane pilots do most of their work during takeoff and landing, the equivalent of truck drivers taking autonomous trucks out of cities and onto highways. The way technology is progressing for autonomous trucks, truck drivers will shift into a similar role. The difference is that airplane pilots require much more training than truck drivers do. Pilots have to go through four or five years of training and multiple test flights before becoming certified, compared to a 12-week program for truck driving. In the eyes of trucking companies looking to save money, only being needed for short portions of a trip will not constitute a similarly high salary.

The need for truck drivers in the driver's seat comes back to the question regarding savings. There seems to be an issue with safety being overlooked by attempting to save money. Looking at Starsky Robotics, we see safety being overlooked as an issue. Starsky Robotics was a startup that looked at making autonomous trucks differently. They had planned to create autonomous vehicles that could be controlled remotely. That idea excited investors, but after one of their trucks failed on the road, the company was forced to shut down. What is interesting about the shutdown is that the CEO put out a detailed essay about it. He claims, "Everybody talks about how Safety is #1, but it isn't and doesn't attract attention or investment."[12] It begs the question of how much companies will invest in safety if investors care more about how innovative the product is and how fast it could be put on the market. In the Starsky Robotics case, if there was less pressure to push a finished product before competitors, the truck that caused them to shut down might not have failed and have been safer for other cars on the road.

Is this Ethical for our Truck Drivers?

The profession of truck driving in America becoming automated brings up ethical issues about implementing AI. The first question is whether it is ethical to replace the job or drastically cut the salaries of these drivers. While facing a shortage in 2022, the profession employs 3.5 million Americans, and most are not college-educated. With low entry barriers, many non-college-educated Americans have come to work in this industry. If it is determined that it is unethical to take away the job from truck drivers, would it be ethical to attempt to retrain them with more technology-based skills? With a high average age, most are not overly enthusiastic about learning new skills in technology and AI. Along with the fact that the average salary of truck drivers sits around $74,000 a year, the jobs to be easily retrained to do will not pay nearly as much.

During Andrew Yang's campaign for the presidential election in 2020, he talked to truck drivers about how they felt about autonomous vehicles coming a rise. Most drivers were surprisingly not scared of this reality. Bill Gillen, a truck driver for 42 years, said in September of 2019, "When a computer truck can haul 40 tons over The Rockies, on four inches of snowpack and a 60 mph crosswind in a blizzard, I'll be impressed".[13] Truck drivers are accustomed to the reality of being on the road while making a good livable wage. Most drivers are unaware of how this might change even if they do not directly lose their jobs. With automation taking away the bulk of their jobs, wages will decrease dramatically.

Is it ethical to take away the majority of these workers' wages? As stated before, the primary demographic of truck drivers consists of older workers who are not college-educated. This can help explain why they do not see automation taking away the majority of their work in the future. These workers will most likely not be fond of being retrained to sit behind a desk and make money somewhat near what they made in the past. They may take up similar driving jobs such as Uber but make nearly $50,000 less. Yang has also claimed that "retraining doesn't work"[14] and that you can not turn these workers into coders. There needs to be a middle ground between retraining truck drivers for needed jobs and having them be able to earn similar wages.

What is also worth noting is that the move to autonomous trucks would have little to do with safety. In most crashes that have trucks involved, the passenger car is at fault most of the time. Even if it is the truck driver's fault, there is a clear culprit for wrongdoing.[15] Truck drivers are rarely ever drinking and driving and are generally able to stay awake and aware on long trips. With truck drivers being reliable for safety and companies being safe from lawsuits if an accident were to occur, it tells us that the move to autonomous vehicles is strictly monetary.

Since current truck drivers are already very safe on the road, how will the safety of autonomous vehicles compare? There are millions of trucks on the road every day, and it is unethical to place that many autonomous trucks on the road if the safety standards are not up to par. If it is decided to have drivers behind the wheel in case the AI cannot handle the situation, this issue would be solved. Though seeming simple, this is an unreliable decision as drivers tend to become more distracted while driving. According to the Journal of Safety Research, "Drivers using the automated systems responded worse than those manually driving in terms of reaction time, lane departure duration, and maximum steering wheel angle to an induced lane departure event. These results also found that non-driving tasks further impaired driver responses."[16] While truck drivers tend to be more aware and alert than passenger drivers, it does grant them immunity to this. As truck drivers are human and most trips contain long stretches of highways, there will be an increased number of distracted truck drivers. This raises serious concerns as accidents with trucks involved can cause much more collateral damage than accidents only involving passenger cars.

Should or Will the Government Intervene?

The government has an important role in a new world that is AI-driven. As many face losing their jobs to automation, is the government allowed to impose restrictions on technological advancements that benefit private companies? Estimates from the United States Government Accountability Office (GAO) concluded that the number of lost jobs might be up to 900,000, a substantial amount of the workforce. Along with that, after consulting with the Department of Transportation, the GAO concluded that the driver's role would shift to a technician.[17] This technician's role would be to maintain and fix the technology that is equipped on the truck. The technician will also take over the wheel when needed if technology on the truck fails or the truck has entered a city area where it can no longer navigate safely.

As of January 2021, the government is preparing for the new reality where autonomous transportation is becoming more advanced and widespread. The Department of Transportation has created a comprehensive plan regarding autonomous vehicles that include three main goals. The goals, such as "Modernizing the Regulatory Environment,"[18] have the government start to create plans that benefit companies producing autonomous vehicles. The same report mentions that having many truck drivers is incredibly expensive for companies, so most will look to eventually replace them. The caveat is turning many truck drivers into technicians will not leave as many drivers unemployed. However, having nearly one million truck drivers without a job is still concerning. The government in March 2022 does not seem to have the plan to deal with the inevitable mass job loss from not only truck driving but other professions where automation will take over.

Even with no plans for how to move forward with workers losing their jobs, the government continues to push legislation that would make them obsolete. On March 10, 2022, U.S. regulators eliminated the need for autonomous vehicles to be equipped with manual driver controls. This eliminates the need for companies to equip trucks with steering wheels or driver-side seats.[19] Though it seems there will be a need for truck drivers for autonomous trucks to navigate through city roads, this legislation shows how the government is ready for a switch to automation. This new legislation can eventually make jobs such as Uber drivers obsolete as now autonomous vehicles can do their jobs better and safer. When that eventuality becomes a reality, we may start to see the role of truck drivers become a lower-paying and less intensive job. At that point, the government may finally have to step in.

However, if the government switches and decides to side with current truck drivers and allows the current models of trucks that run on gasoline, is that ethical considering the climate

crisis in the world? As of September 2020, trucks are responsible for nearly half of nitrogen oxide emissions and 7% of the total pollution in the United States.[20] If nothing is changed, these numbers are expected to continue to rise. The climate crisis is nearing a point of no return, and countries are working together to reduce the impact of fossil fuels on the environment. It would seem irresponsible for the United States government to try and delay the switch to autonomous vehicles to protect current truck drivers. In the context of everyone affected by climate change, the loss of jobs is insignificant. The government pushing for autonomy in the trucking industry through this lens is an ethical decision. Workers will have to accept that their jobs will change, and the salary they are accustomed to will decrease as the use of automation increases due to the climate crisis.

Brief Future Outlook

Looking at the current state of autonomous technology, it is clear that truck drivers being replaced by autonomous vehicles is decades away. For level 5 autonomous trucks to be possible, companies need to overcome the hurdles of roads not being in excellent condition and how to navigate city spaces with such a large vehicle. That evolution will come after other companies have commercialized level 5 passenger vehicles, which is a decade away or more. Until that point, truck drivers will still be needed in the driver's seat. If truck drivers are to be replaced, it will be a slow transition along with the slow process of the technology and companies needing time to replace the current gasoline-based fleet.

There is also a high chance of solving the truck driver shortage before level-five autonomy. With trucks equipped with level three capabilities, the pressure and stress of truck drivers will decrease. To be a truck driver takes a particular type of person that can be happy and aware on the road for long periods. Autonomous driving takes many tasks away from drivers, and more people may be more inclined to take up this profession. This might be true if wages stay similar to what

they currently are at an average of $74,000. The work might not be as intensive as it is in March 2022, so it is improbable that wages will be similar. Though if wages are to fall drastically, the shortage of drivers may continue to rise. Trucking companies can not afford to have this happen as the technology for level 5 autonomy is still too far away to begin to plan for.

Even at the point of level 5 autonomy, there is a place for jobs inside the truck. A worker ready to fix the technology on the inside or to take over if needed. New jobs will be created from the advancement of technology where current truck drivers will not be left behind by AI.
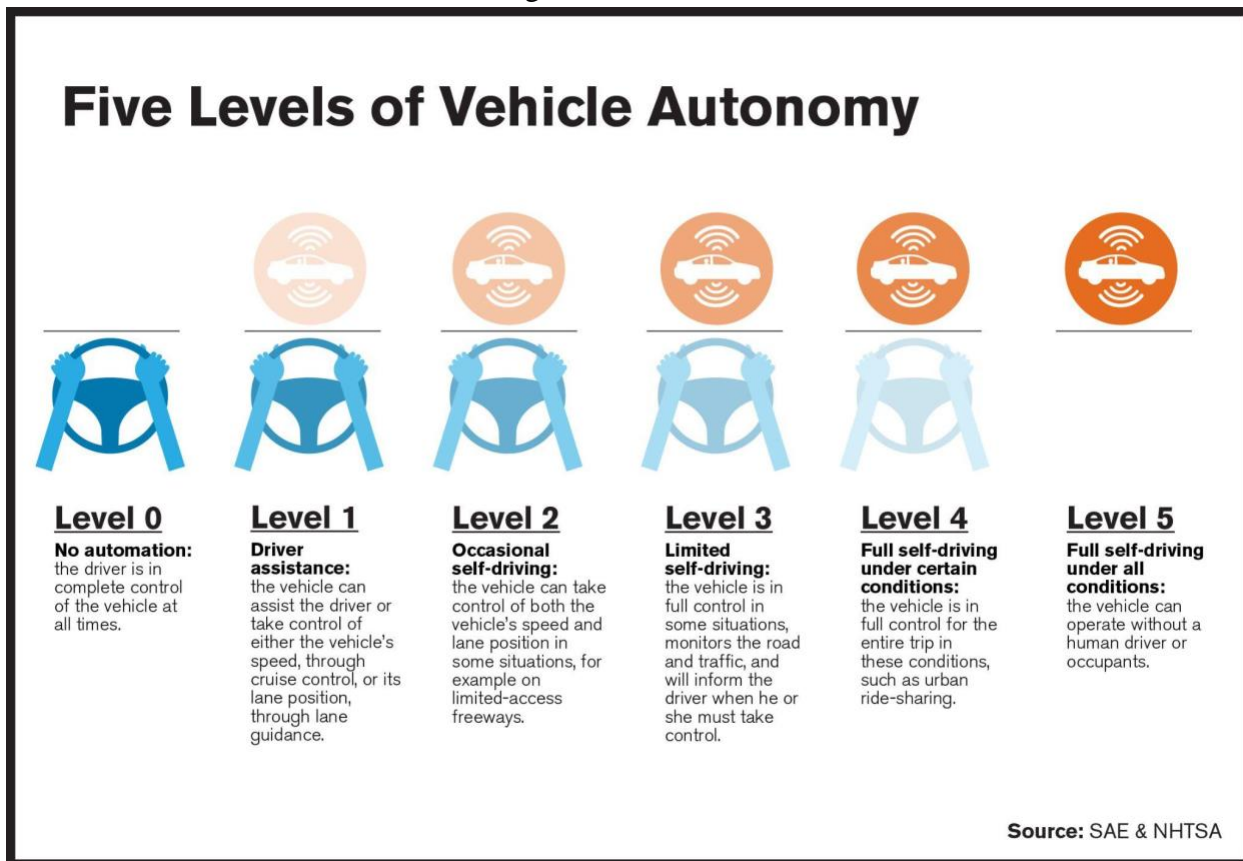
Exhibit 1: Levels of Autonomous Driving

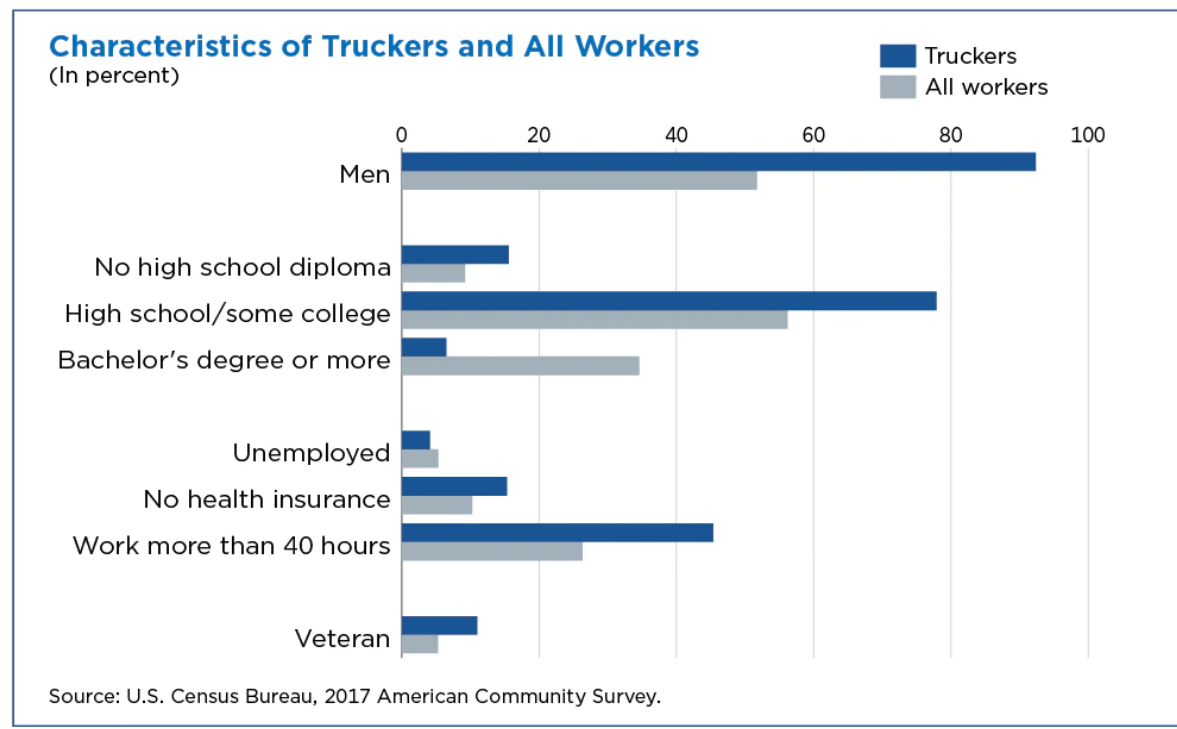Exhibit 2: Demographics of Truck Drivers

Exhibit 3: Excerpt From GAO Report to the Subcommittee on Transportation, Housing and Urban Development, and Related Agencies, Committee on Appropriations, U.S. Senate

Regardless of their vision for how automated trucking might materialize, many stakeholders said there could be new trucking-related occupations, such as specialized technicians, mechanics, and engineers, which will accompany the deployment of automated trucks. For example, one study noted that these jobs could include producing the technology used by automated trucks, in addition to jobs created as a result of potential greater spending on other consumer goods and services, if automated trucking decreases overall industry transportation costs. Another study noted that autonomous trucks, e-commerce, and economic growth are together poised to create many new trucking jobs. However, new jobs may be located in different geographical areas than any jobs lost, and as noted above, may require different skills than the prior jobs. One study noted this development could potentially leave lower-skilled workers competing for jobs that pay little and have few opportunities for advancement.

Exhibit 4: U.S. Department of Transportation Automated Vehicles Comprehensive Plan

Automated Vehicles Comprehensive Plan, January 11, 2021, Washington, DC.

Building upon the principles stated in AV 4.0, the Automated Vehicles Comprehensive Plan defines three goals to achieve USDOT's vision for Automated Driving Systems (ADS).

1. **Promote Collaboration and Transparency** – USDOT will promote access to clear and reliable information to its partners and stakeholders, including the public, regarding the capabilities and limitations of ADS.
2. **Modernize the Regulatory Environment** – USDOT will modernize regulations to remove unintended and unnecessary barriers to innovative vehicle designs, features, and operational models, and will develop safety focused frameworks and tools to assess the safe performance of ADS technologies.
3. **Prepare the Transportation System** – USDOT will conduct, in partnership with stakeholders, the foundational research and demonstration activities needed to safely evaluate and integrate ADS, while working to improve the safety, efficiency, and accessibility of the transportation system.

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