

Autonomous Trucking and Freight Haulage

Attitudes and Beliefs about Changing Technology in the U.S.

Transportation Industry

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Summary

While the prospect of autonomous (self-driving) trucking is exciting for some, others are concerned about how this technology will impact the job security of the 3.5 million truck drivers in the United States. Within this group, 1.6 million long-haul truck drivers are most at risk because the new technology is focused largely on long-haul trucking. This study examines the attitudes of three stakeholder groups in the transportation industry: technology vendors, truck drivers, and members of transportation unions and motor associations. It examines the opinions of members of these three groups about autonomous trucking, their predictions of when the new technology will become a reality, what they believe about what will happen to truck drivers when autonomous truck technology is operative, and who they feel should have responsibility for meeting the needs of truckers who will be displaced by autonomous trucking. Predictions vary widely about when autonomous trucking will begin, ranging from five years from now to never. Attitudes among the three groups toward autonomous trucking technology range from a belief that autonomous trucks will positively revolutionize the industry to a belief that they will be a danger to society. The beliefs of the members of these three groups about what automating the trucking industry will do to their jobs fall into three categories: some believe automation will displace them as workers, some believe it will augment the work they do, and some believe it will have deleterious effects on their work. When they were asked in interviews who should be responsible for finding solutions that would alleviate the negative impact of automation on the employment security of those who work in the trucking industry, members of these three groups were divided in their opinions. The study proposes four solutions: rethinking work design, investing in reskilling programs, formulating government policies that would alleviate the negative impact of automation, and increasing collaboration among industry stakeholders. While these solutions are preliminary and partial, they can help generate discussions about directions for moving forward.

The disagreements among the three groups of stakeholders about the future and impact of autonomous trucking can be explained by a number of factors. Some stakeholders might not have access

to as much information about the new technology as others. Some may not believe that autonomous trucking technology is possible or will work. Some may be blindly optimistic about the success of the new technology. Until a consensus exists about whether this technology is feasible and when it might be implemented, it will be difficult for these three stakeholder groups to come together to find solutions and formulate plans for alleviating the negative impacts on jobs as technology changes the industry. This technological change is coming and it will involve significant rethinking across the whole industry. The stakeholders should begin moving the debate away from wild predictions about how many jobs digital technology will eliminate or create and toward asking how they can use new technologies to shape the future of work in productive, equitable, and inclusive ways.

Overview of the Trucking Industry

To date, the conversations about the future of autonomous trucks have mostly taken place among technology vendors, truck drivers, and worker associations. The impact of these discussions ranges from the generation of considerable anxiety to apathy. The promise of technological changes in trucking has large positive implications such as a reduction in the cost of insurance and shipping, greater fuel efficiency, and quicker transportation. However, questions about how autonomous trucking will be implemented and how the role of truck drivers will evolve raise concerns about how autonomous trucking will affect the U.S. economy. In 2015, there were 3.5 million truck drivers in the country, of which 1.6 million were long-haul truck drivers. The latter group is most at risk of job loss when autonomous trucking is implemented.¹ In 2016, the White House published a report that predicted that automation would cost 1.3–1.7 million heavy truck drivers and tractor-trailer truck drivers their jobs.² However, innovation in itself is not the problem. Other case studies have shown that new technology can augment the work people do, creating more and better jobs.³ How a broader circle of participants, including

technology vendors, truck drivers, worker associations, economists, politicians, and social scientists, will acquire a better grasp of what is to come is a key issue.

Right now, technology organizations are testing partial automation (a human driver in an autonomous vehicle) in real-world environments.⁴

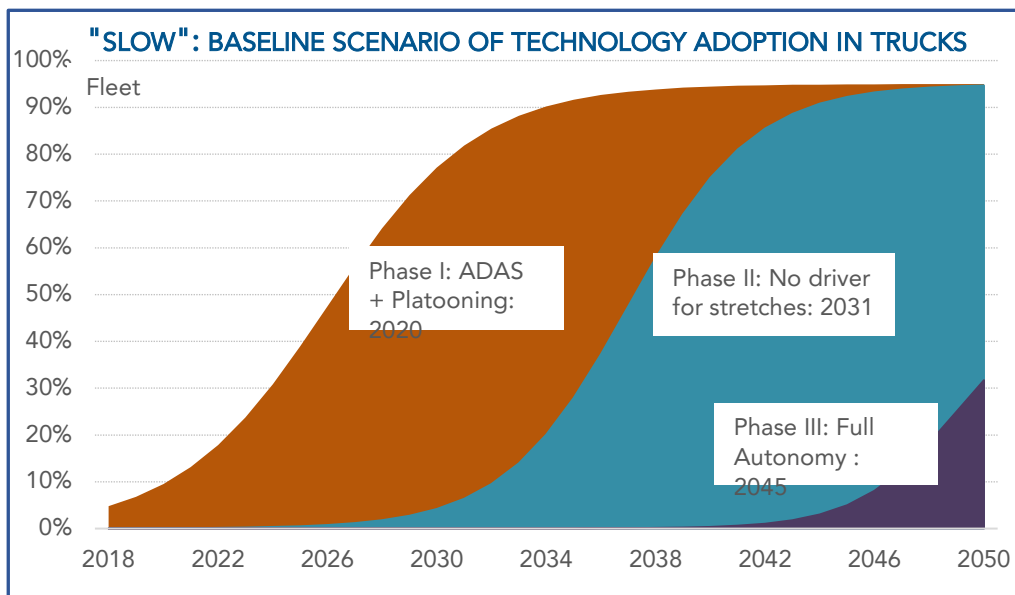
1. Highway Driving: One plan is to test autonomous long-haul trucking technology under good weather conditions. There will still be a human driver in the vehicle who can drive in more unpredictable situations such as last-mile city driving, loading/unloading at exchange points, or on roughly paved roads. However, during ideal highway conditions the artificial intelligence (AI) system would drive the vehicle while the human operator would monitor or conduct other tasks unrelated to driving.⁵

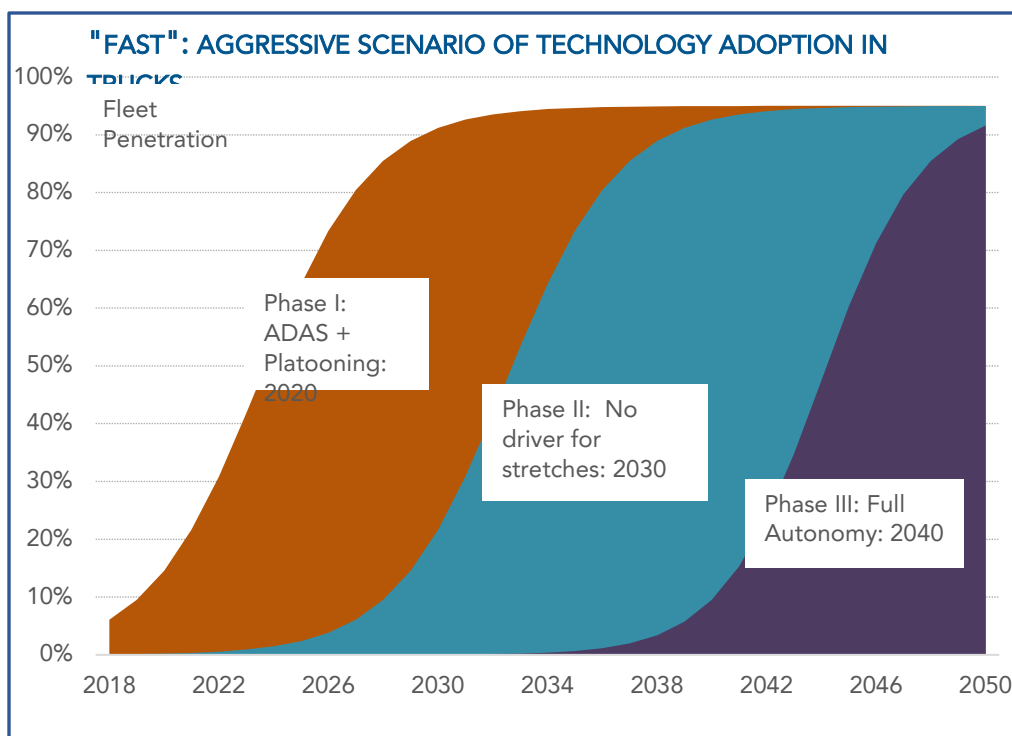
2. Platooning: Truck platooning is the grouping of trucks that follow one another closely in convoy while being digitally connected. This practice reduces fuel usage. Platooning technology involves automated braking and transmitted signals between vehicles. Currently, companies are looking into testing a human driver in the lead truck with many trucks behind it that do not have drivers and are automated.

3. Private Property and Slow Routes: Companies are starting to experiment with smaller trucks that follow defined routes at a slow speed within private facilities. Another potential use involves garbage trucks that follow public roads but drive at a very slow pace.⁶

Predicted deployments of partial and fully autonomous trucking technologies have varied. Estimates of when a commercial rollout could take place range from five to fifteen years from now.⁷ However, these estimates depend on many factors that are unpredictable, such as when driverless trucks will become reliably safer than human drivers, whether the government will implement supportive regulations, whether companies will adopt the technology quickly enough, and whether manufacturers can provide enough autonomous trucks to support demand. It is important to consider who could be directly and indirectly displaced if the transition to driverless road freight is not managed smoothly. A report from Securing America's Future Energy (SAFE) explored what the technological transition could look like by simulating future outcomes. While the exact year projections are still up for debate, the way SAFE modeled fast and slow fleet transitions is helpful. In SAFE's model, the change would move in phases. Phase I would include advanced driver-assistance systems (ADAS) and platooning; Phase II would add driverless trucking for some phases of a journey; and Phase III would be fully driverless. This simulation enabled SAFE to predict the number of truck drivers who would be displaced each year during a phased rollout of autonomous trucking.⁸

Figure 1. Two Models of Rollout Timeline for Autonomous Trucking





Source: Adapted from Erica L. Groshen, Susan Helper, John Paul MacDuffie, and Charles Carson, "Preparing U.S. Workers and Employers for an Autonomous Vehicle Future," June 2018, prepared for Securing America's Future Energy (SAFE), <https://avworkforce.secureenergy.org/wp-content/uploads/2018/06/Groshen-et-al-Report-6.13.18.pdf>.

In 2015, there were 1.3 million trucking companies in the United States, 46 percent of which were private carriage (managed by companies like Walmart or Amazon) and 54 percent of which were for-hire trucking.⁹ The latter group has increased significantly since the industry deregulated in the 1970 and 1980s and decreased the barriers to entry. This has resulted in the decline of unions and the rise of independent contracting. Intense competition in a fragmented market, lower profit margins, and the increasing cost of freight services has driven truck driver wages downward.¹⁰ Because of low wages, high risk, and the pressure to transport freight more quickly, the industry has been plagued with a very high turnover rate. The turnover rate for the long-haul trucking sector in the second quarter of 2014 was 96 percent; the rate in the small truckload sector was 94 percent.

All of these changes have been coterminous with a dramatic increase in demand for freight goods, and the industry is starting to experience a truck driver shortage. According to one prediction, by 2026,

freight revenue will grow by 75 percent due to an increased demand for shipped goods.¹¹ Yet in the spring of 2018, the American Trucking Association (ATA) reported a shortage of 51,000 truck drivers nationwide (up from 20,000 in 2013 and 36,500 in 2016). The ATA projects that this driver shortage will increase to 100,000 by 2021.¹²

Despite the reported poor working conditions, lower wages, and high turnover, truck driving is still considered a good job. Driving is an important source of work for those who have a low level of education: 93.2 percent of drivers have less than a bachelor's degree. In addition, drivers have a lower poverty rate than non-driving workers in the United States (7.32 percent compared to 8.08 percent).¹³ There are still many truckers who enjoy their jobs, are treated well by their employers, and strongly rely on truck driving for income, especially those without a bachelor's degree. While for some, autonomous trucks may seem like a solution to driver shortage, industry stakeholders need to be aware that automation isn't a way to free workers from a bad job. Instead, they should ensure that the problems of low wages, high risk, and pressure to perform aren't perpetuated in a driver's new role or new job.

Scope and Methodology of the Study

This study examines the attitudes and opinions of various stakeholders regarding autonomous trucking. I interviewed members of three groups: technology vendors, truck drivers, and motor unions/associations. I conducted eight interviews lasting one hour each with members of these groups. I also analyzed truckers' attitudes as expressed on a closed Facebook membership group.

Six of the eight interviewees were technology vendors and two were members of unions and motor associations. The category of technology vendors includes large companies that are developing and selling new technology, small and medium startups, and university innovation centers that are actively working on or researching autonomous vehicles and trucks. The interviewees who work for technology vendors included a founder/CEO, a vice president of design, a corporate strategy manager, a lab director, and a business operations manager. The union member is part of an organization that represents the

interests of freight employees, including truck drivers. The member of the motor transportation association is part of a group that represents small, medium, and large companies that use commercial vehicles. I have protected the identity of all of the interviewees.

The key goal of this study was to look at what members of these various groups thought about the timeline of the rollout of autonomous trucking, attitudes toward autonomous trucking, opinions and predictions of the new role of truck driving, and feelings about who should take ownership and responsibility for the new technology. The questions I asked during interviews included:

- What are your predictions about the timeline and rollout of autonomous trucking?
- What do you believe is driving these changes?
- What is your opinion about autonomous vehicles and the potential positive or negative impact on the job security of truck drivers?
- What do you think the role of a truck driver would look like with autonomous trucks?
- What new jobs and opportunities could be created from autonomous trucks and which would be a good fit for truck drivers?
- If there are negative impacts on the job economy, is your organization making plans to help reduce these negative impacts?
- What other organizations, institutions, groups, or entities should play a role in helping to reduce any negative impact? What would that involvement look like?

To gauge the opinions of truck drivers, I analyzed responses to articles about autonomous trucking posted on social media. I used this data to evaluate truck drivers' predictions about the timeline of the rollout of autonomous trucking and their attitudes toward the technology. The primary social media channel I used was a closed Facebook group, Rate Per Mile Masters, which has 21,600 members and is the largest moderated professional forum for a group focused on information about rates and logistics in the trucking industry. The majority of members are truck drivers, including owner-operators and drivers

who are employed by carriers. My sample consisted of 367 responses to seven articles posted within the last few years related to autonomous trucks. While these were comments from self-selected participants, union and motor association representatives validated the attitudes expressed in them. The collected responses were coded into two categories: (1) Prediction: a belief that autonomous trucking will happen, a belief that it will not happen, or the absence of an opinion about whether it will happen; and (2) Attitude: an optimistic attitude toward the technology, a negative attitude toward the technology, or the absence of an expressed attitude toward the technology. After coding the responses, I analyzed them at the aggregate level.

This study was guided by MIT Sloan School of Management faculty advisors Thomas Kochan and Barbara Dyer, both of whom are part of MIT's Institute for Work and Employment Research. The recent research of Tom Kochan and Lee Dyer focuses on an integrated strategy for the future of work. The elements of this strategy include finding ways to make technology work for everyone in society, a simultaneous design process that considers the impact of new technology on workers during the design process, training for workers who will be displaced before the technology is deployed, and compensation for those who will most adversely affected.¹⁴ Companies that implement new digital technology should adopt an interrelated process in which the business strategy for developing digital technology, workforce strategy design, and continuous workforce training and development should all be happening in tandem instead of sequentially. In addition, workforce development for the digital age should train workers in both the technical skills and the social-behavioral skills needed for a new job before the technologies arrive. Kochan and Dyer suggest that industry stakeholders all should shift the debate from wild predictions about how many jobs digital technology will eliminate or create to questions about how they can use advancing technologies to shape the future of work in productive, equitable, and inclusive ways.

Research Findings

Predictions about the Timing of the Rollout of Autonomous Trucks

Predictions about the timeline of a mass rollout of autonomous trucking vary widely among the three stakeholder groups. Most of the technology vendors I interviewed believe that the rollout for long-haul trucking could happen within the next five years. The product manager of a large transportation company said that it “may be even way sooner than that,” particularly for selected regions. Several factors must be in place before autonomous trucks can be deployed. First, the technology must fully develop to complete automation without human involvement. Second, government regulations must be in place to ensure the safety of other drivers on the road. Finally, manufacturers must be able to produce enough autonomous trucks to replace from 1.5 to 2 million long-haul trucks. This will require major restructuring; in 2015, U.S. manufacturers sold only 250,000 Class 8 (long-haul) trucks.¹⁵ However, technology vendors predict that autonomous trucking will not happen in the United States for another 20–25 years for local delivery, which includes first-mile and last-mile pick-ups and drop-offs. This is because of the complexities of driving in cities. City driving involves dense populations, many unpredictable situations, and poorer road conditions.

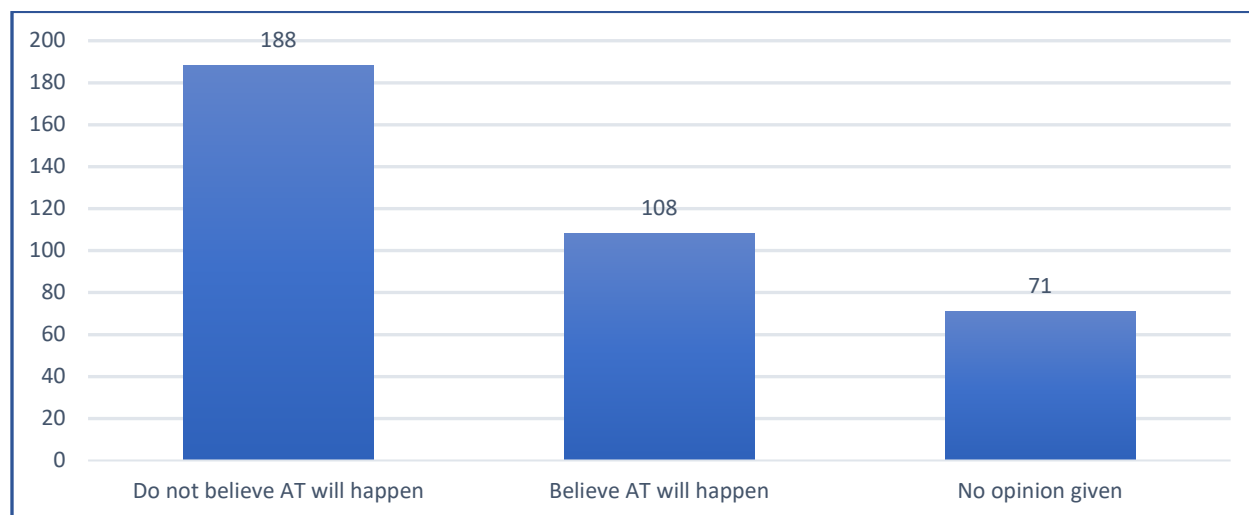
The rollout for long-haul autonomous trucks will happen in gradual phases. Technology vendors prefer partial autonomy first, which involves a combination of a human and an autonomous vehicle (AV). Technology vendors view the role of a truck driver in a human-AV combination as changing. In one model, the truck driver would be in the truck, but the AV would control the majority of the route while the driver would monitor the system.

In the second model, a truck driver would perform the same task in shorter relays. An autonomous vehicle would drive the middle portion of the route without a human driver and the human driver would be in the truck at the beginning and end of the route. Drivers would have shorter and more local hauls so they could spend more time at home with their families. The drivers would conduct the same task as they would today, but they would continuously run the same short loops, picking up the

trailer from a facility and transporting the goods to an exchange facility. Then the AV would continue for the middle portion of the route and meet another human driver at an exchange facility. One interviewee said, “The role of a driver would be the same, but the relays and the route would differ.”

Truck drivers have a different point of view from vendors regarding timing of the rollout. Over 50 percent of the online reactions to articles about autonomous trucking claim that autonomous trucking will never get the necessary safety approvals from the government or reach the technological requirements to be functional. However, around 30 percent of those who reacted to these articles believe that it will happen. Another 20 percent did not express an opinion on this issue.

Figure 2. Truckers’ Predictions about Whether Automated Trucking Will Happen in the U.S.



Source: Responses to online articles about automated trucking on the Rate Per Mile Masters Facebook group.

Many of those who believe that autonomous trucking will not happen aren’t presenting knee-jerk reactions. They raise important issues that technology companies should address. Below is a sample of comments from the social media sample of responders in this group.

Figure 3. Reasons Why Truckers Believe Automated Trucking Won't Work

Reasons Why	Comments
Safety	"It won't happen. A self-driven truck will wreck and kill someone and that will be the end of that."
Cannot do all the tasks a human driver does	"Still going to need a driver . . . unless this type of truck also fuels itself, hooks up air lines, straps loads, signs BOLs, does a pretrip on the trailer, sets and starts Intellisnet reefer controls, and rolls landing gear."
	"The 5 senses (or 6 for some) CANNOT be replaced by make a quick return on investment [for] technology . . . too cost prohibitive trying to mimic all human sensory and motor reactive functions."
Government won't approve	"The liability won't allow it."
Technical feasibility	"Not going to happen any time soon. The technology is still in need of massive development, there's zero infrastructure for it, and you can't take out the human driver to take control when needed. It's not feasible folks"
Can't function well in bad weather	"In any heavy snow, rain, ice, fog, these self-driving trucks are useless, just like current sensors!"
Industry won't have necessary infrastructure	"In order to FULLY automate, the shippers, receivers, cross docks, ports, and the rest will have to have automation on their end. I've been to docks that look like they need to be condemned. How quickly do you think ALL these places are going to pony up the cash to upgrade? It will happen eventually; maybe your great-great-grandchildren will be the ones working on them."

Source: Responses to online articles about automated trucking on the Rate Per Mile Masters Facebook group.

However, if drivers who do not believe that autonomous trucking will become a reality do not communicate or collaborate with other stakeholders in the industry, their concerns about the technology will not be addressed. In addition, these drivers may not be prepared for the new role of truckers once autonomous trucking begins or for a job switch. It is critical to engage the workforce to help them understand that technological change is not always something that is done to them, that it instead could be an opportunity for workers to shape it.

Members of unions and motor associations do not agree about timeline predictions. In my interviews with unionized truckers, I learned that half of the union's staff members believe it will happen

very soon and the other half believe it won't happen in the near term. Union representatives who are aware of activities such as the development and testing of autonomous vehicle technology can see rollouts beginning within five to ten years, a longer range than the technology vendors predict. Since unions are in a unique position to negotiate labor contracts that could last up to 20 years, the representatives believe they need to construct clauses that would protect their members based on likely technological changes in the trucking industry. The timeline of the head of a state's motor trucking association is much longer. He believes that the United States is 30 to 40 years away from widespread use of self-driving trucks. He doesn't believe that the U.S. government would allow autonomous trucks weighing 80,000 to 100,000 pounds on the road. Even if there was a dedicated highway lane, he believes that the hype is overblown and that the technology is farther away than the industry realizes. He also believes that the hours-of-service regulation of the Federal Motor Carrier Administration, a division of the U.S. Department of Transportation, will operate as a restraint on the development of autonomous trucking in the United States. He believes that this regulation could remain in place for human drivers in self-driving trucks even if they are not driving 100 percent of the time.

Members of these three groups illustrate that a wide range of predictions exists about the timeline of a rollout of autonomous trucking. The majority of truck drivers do not believe the technology will succeed. These disagreements could stem from information asymmetry, lack of transparency about the technology or government regulations, complete disbelief, or even blind optimism. Without a consensus about the reality of this technology and when it could roll out, it will be difficult for these groups to come together to find solutions that will mitigate the impact of autonomous trucking on the employment of long-haul truckers.

Attitudes about Autonomous Trucking

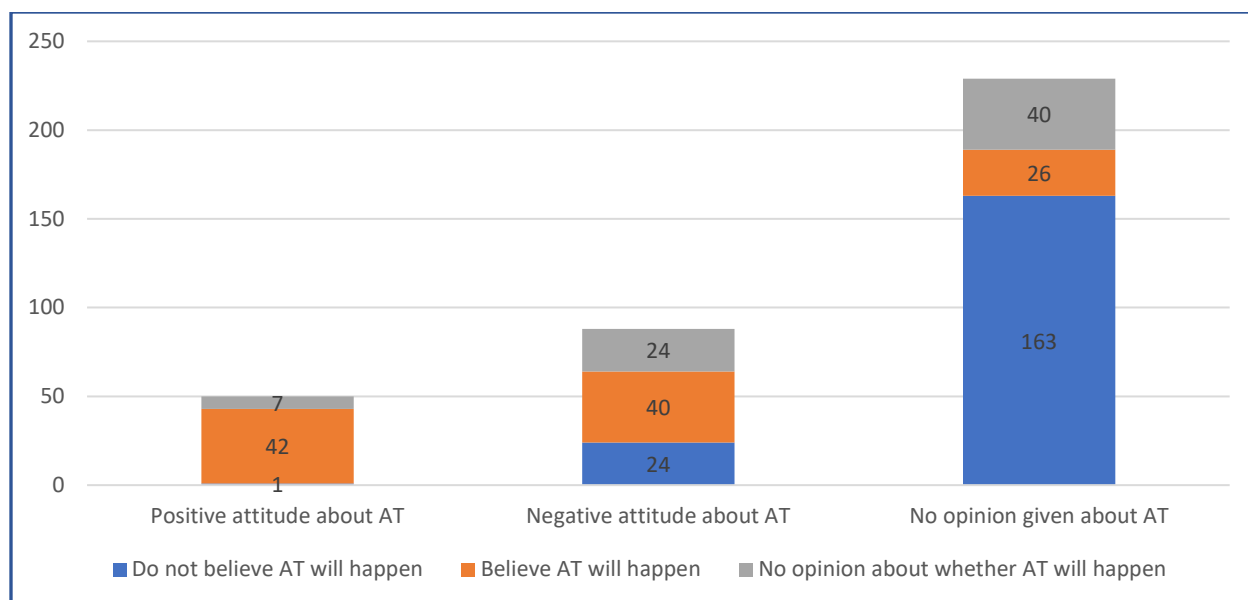
Opinions about autonomous trucking technology range from the position that autonomous trucks will revolutionize the industry to the idea that they are a danger to society. The technology vendors I interviewed believe that autonomous trucking will bring positive change to the trucking industry. First, autonomous trucks will decrease both the cost of labor and fuel and the time it will take to move goods from Point A to Point B. One interviewee stated that “40 percent of operational cost is wage-related (including benefits). If you remove that, you can save 40 percent of the costs easily. On top of that, drivers have an hourly restriction whereas self-driving trucks don’t need to rest. Utilization potential will be twice as efficient as regular drivers.” Other interviewees also mentioned the cost savings that would accrue from increasing the hours of service by having an autonomous truck travel farther in a day than a human driver could. Another benefit many vendors emphasized was that autonomous trucks would fill the gap created by the labor shortage and high rate of turnover in the U.S. trucking industry. Vendors talk about how young people are not going into trucking and how if nothing changes the industry cannot fulfill a demand that is increasing exponentially through a rise in e-commerce purchases. One interviewee presented the situation this way: “This is the first tight market since 2007 and there is a big challenge finding drivers. It’s a lousy job and hard to fill.”

Some technology vendors argue that autonomous trucks will enable truck drivers to have fewer hours driving and be able to spend more time at home with their families. One vendor said, “We’re shifting the dynamic of a truck transaction, which will be a better lifestyle. Their hours will be much more controllable like a regular job to be home Monday through Friday. Now they’ll have a less-paying load at a higher frequency. They’ll keep the same income or have it be slightly higher while having a more comfortable lifestyle.” This vendor believes that automated trucking technology will solve the problem of the labor shortage in the industry. Another vendor stressed that they are not in the business of replacing or automating drivers; in fact, they need drivers during the design process to make sure the needs of drivers will be the center of the new technology. They focus on a work design process that includes input from

drivers so they can truly understand their needs. Some vendors even hire drivers as part of their design and engineering staff.

In contrast, the majority of truck drivers are vehemently against the technology of autonomous trucks. Of the 367 reactions to online articles about autonomous trucks, 62 percent displayed pessimistic attitudes about the technology. Only 14 percent were optimistic about autonomous trucking; 24 percent did not express an opinion. A cross-tabulation of attitudes toward autonomous trucking with timeline predictions among truckers revealed that the most common combination was a belief that the technology will not roll out successfully and a negative view of the technology (Figure 4).

Figure 4. Beliefs about Whether Automated Trucking Will Happen among Truckers with Positive Attitudes toward AT, Truckers with Negative Attitudes toward AT, and Truckers Who Expressed No Feelings about AT



Source: Responses to online articles about automated trucking on the Rate Per Mile Masters Facebook group.

Most of these attitudes stem from a belief that the technology will not be functional or safe. Others feel anger toward technology companies that they believe are chasing after profits by displacing jobs. Below is a sample of comments from truckers who reject the idea of autonomous trucking.

Figure 5. Reasons Why Some Truckers Reject the Idea of Autonomous Trucking

Reasons Why	Comments
Fear of job loss	“Trucking is just one small part of the automation that’s coming. It won’t be long before 30 or 35% of all jobs in America and around the world are automated. When that happens how will those people earn a living?”
	“Why are humans applauding and accepting robots to take over their jobs? Too many people showed up for the unveil.”
	“My concerns are what are they going to with all the people that are laid off. This can bring the market to a crash.”
Safety	“I can't wait for that 40 car pileup in Phoenix because of Uber.”
	“Didn't a car just run over a pedestrian this week?”
	“Go ahead. Put robot trucks on the road. When they kill people, and you come running back to me? Be prepared. I won't come cheap this time.”
Belief that corporations are seeking profit	“People that are pushing for these are seeing dollar signs. There's no safety data to back up their use in public. The FMCSA is a hypocritical organization and this proves it.”
	“There is someone who has sat behind a desk for all of their life. And someone who I would punch in the nose.”
Lack of trust in the technology	“I'll be damned if I sleep while it drives.”
Cybersecurity/safety	“Someone will figure out how to remotely take control of them.”
	“Someone please tell me this is a load of horseshit. All these big companies are gonna become more dangerous now than they were when they were hiring inexperienced drivers.”
Contempt	“Just plain stupid”

Source: Responses to online articles about automated trucking on the Rate Per Mile Masters Facebook group.

After I shared these results with members of a truck driving union, the union representatives told me that the combination of a negative attitude toward autonomous trucking and a belief that it wouldn't work was common among their members. They told me that members are concerned that the new technology will replace them. They are also very worried about what will happen to their jobs during the intermediate transition of partial autonomy. One union representative talked about members' distrust of

the driver-assisted technology that already exists (i.e., adaptive cruise control, automatic braking, blind-spot detection) because they feel unnecessarily monitored.¹⁶ They question whether being in a partially autonomous truck is safe, particularly whether the driver will have enough time to switch from monitoring to engaging if a truck is in trouble.

While members of trucking unions are anxious about autonomous trucking on multiple levels, they are unsure about what the right direction forward would be. They do not trust that technology vendors who are entering the industry so they can understand trucking and the system will serve the truck driver population well. For example, there are still groups of truck drivers who have different incentives and interests and would be impacted differently by autonomous trucks: long-haul drivers are among the better paid drivers and independent operators operate very differently than operators employed by carriers. Part of the job of union representatives is to help drivers find good jobs in trucking, but some believe that automation could make trucking jobs worse. They also countered the argument of technology vendors that autonomous trucks will solve the driver shortage problem by pointing out that this solution does not get at the root cause of high turnover. The union representatives I interviewed says there is a driver shortage because truck drivers are not getting paid enough and that autonomous trucking companies have not promised to solve the issue of low wages. Instead, the new technology could fundamentally change the nature of their work in a way that increases the reasons why trucking is an undesirable job for potential drivers.

In summary, opinions about autonomous trucking among technology vendors, truck drivers, and trucking unions and motor driver associations vary widely. Technology vendors would do well to properly communicate with other stakeholders about how their technology could change the role of truck drivers and the ways they have sought to include drivers in integrative work design. They would also do well to listen to the concerns of truck drivers and union representatives.

New Roles and New Jobs for Truck Drivers

Many technology vendors believe that the new role for truck drivers will be positive once autonomous trucking becomes a reality. In the truck port model, truck drivers would drive autonomous trucks in shorter hauls so their hours and travel days would be less strenuous. However, this may not always be the case. Although there will be a major shift in the locations of the work from the deployment of transfer hubs and truck ports, the localized trucking jobs would be concentrated in certain areas geographically; in other areas, truck drivers could lose their jobs or receive lower wages. In addition, a truck port model already exists; it is called drayage, or the movement of freight over land across short distances. Drayage truckers are known to have the worst jobs in the industry. They have historically been underpaid and have faced labor abuses. Drayage truckers commonly deal with highway traffic congestion and are paid at a per-load basis. “We have to have a robust enough policy framework to ensure that workers aren’t mistreated,” says sociologist Steve Viscelli, author of *The Big Rig: Trucking and the Decline of the American Dream*. “If you have labor that is poorly paid and treated, it’ll be used inefficiently.”¹⁷

Not many interviewees have an idea of what partially autonomous trucking would actually mean for truckers. Would it enhance their role because they would be conducting logistics analysis and using technical skills to maintain the vehicle? Or would their new role be a lower-status job in which the driver would be monitored would perform mundane tasks while staying alert because of high risks? The latter scenario is one that union representatives and truck drivers fear. A union representative asks, “Does the nature of trucking change so much that the remaining good jobs are degraded or disappear? Where does it leave people with opportunity?”

Some technology vendors believe that if truckers were to be displaced, new jobs would be created within the industry that truck drivers could consider switching to. Several technology vendors listed potential new opportunities such as maintaining and calibrating autonomous trucks, managing new infrastructure (sensors on the road, smart paint), coordinating loading and unloading schedules,

navigating using remote technology, annotating and labeling data, and computer vision engineering. It is unclear whether these interviewees have conducted an analysis how feasible it would be for a truck driver to switch to these roles. When I shared this scenario with a union member representative, they said, “Someone getting a truck driving education may not want to do these types of jobs. A truck driving education won’t [be] easily transformed into someone sitting behind a computer monitoring a truck, for example.” Deeper and broader research is needed on what jobs displaced truck drivers would be likely to do. In addition, research is needed on what types of reskilling programs the government, corporations, and unions should invest in now to anticipate this change.

Who Is Responsible for Finding a Solution?

When asked who should be responsible for finding solutions that would alleviate the negative impact of autonomous trucking on truckers, most interviewees didn’t have a clear answer. They disagreed about who should be responsible for this issue. A number of people felt that the government should not be too involved in building solutions because they worried that government processes would slow down progress. One interviewee said, “The market will take care of itself. The number of drivers will naturally match the supply during a 10–15 year transition period.” Another vendor believed that the government could help in the area of communication; government entities could help articulate the message to truckers that the transition to autonomous trucking will be gradual and that autonomous trucks won’t immediately replace them. Other vendors believe that there should be a mutual effort between the government and the private sector to formulate laws that will help displaced drivers but aren’t severe enough to stop the rollout of autonomous trucks.

There is also a difference of opinion among motor unions and associations. The motor association head believes the government has a role in ensuring the safety of autonomous trucks but that it should play a looser role in meeting the needs of displaced truckers. He says, “If the government has to react to every job loss because of every technological advance, then that will be a big burden. Technological change happens all the time and we have to adjust to create new jobs.” The union representative disagreed

with this position; he believed that the government needs to be involved in envisioning what this new trucking industry will look like and create policies that account for changes. He does not believe that technology vendors will take ownership because their goal is to “make money and damn the consequences.” This union representative believed that the only way to get technology vendors to care about job loss is through legislation or taxation. He sees several roles for unions during the transition process. In the immediate term, their role will focus on negotiating contracts to protect members and to communicate information about government regulations to members. In a longer term, unions want to pressure state and federal government officials to think of solutions and to look for ways to convince technology companies to take more responsibility for the needs of displaced truckers. However, unions realize their limitations: only a small portion of the trucking industry is unionized and the entire industry is decentralized. The union representative I interviewed reported that union members feel jaded; they believe that the current administration is not interested in the welfare of truckers and instead is interested in policies that will benefit trucking corporations.

Proposed Next Steps

This section presents four potential solutions drawn from feedback from the interviews, information in secondary sources, and frameworks constructed by MIT scholars. While these solutions are partial, they can help generate discussions about ways to move forward.

Rethinking Work Design

The changes that are already under way have significant implications for the content of trucking jobs. Some truck drivers prefer to keep doing what they’ve always been doing while others are open to thinking about transitioning into a different job within the industry. While some of the technology vendors I interviewed want to think more strategically and creatively about how to create real opportunities for truck drivers, we should not leave this task solely up to them. In *Shaping the Future of Work: What Future Worker, Business, Government, and Education Leaders Need to Do for All to Prosper*, Thomas Kochan argues that society needs to have an integrated work design strategy so all

stakeholders have input in discussions of how technological change could impact jobs and tasks.¹⁸ An integrated strategy includes the end user (in this case, truck drivers) in discussions about new technology design. Today, many technology vendors design a technology before considering the impact it could have on workers. When an integrative work design is implemented, bringing in a new technology is not about displacing workers but about increasing job productivity and augmenting the roles of workers.¹⁹

A relevant example is Peloton, a platooning company that is designing platoons in collaboration with the truck drivers who will be the end users of their technology. They have hired former truck drivers as part of their design and engineering team. Drivers also participate in research in the field. At the very beginning (even before starting to design their platoon), Peloton designers spent time at truck stops interviewing truck drivers about their life on the road and what types of driver-assisted technologies would make their work easier. In the next phase of development, the designers had truck drivers test their technology and collected feedback from fleet company employees, online reviews by truckers, and follow-ups with individual respondees. After implementation, they collected feedback in creative and strategic ways that included tapping into the capability and experience of their former driver workforce.²⁰ Through this integrative process, they have been able to make changes in their platooning system that would benefit truck drivers.

This example shows how technology vendors and truck drivers can use an integrative work design during the development of a new technology.

Investing in Reskilling Programs

The interviews revealed a range of opinions about what types of new jobs truck drivers might do. Some technology vendors believe that truck drivers will want to switch to newly created jobs such as computer vision engineering. In contrast, truck drivers and representatives of unions and motor associations do not think truckers will be willing to transfer into the types of new jobs vendors are envisioning. One interviewee firmly stated that “someone going into a trucking education would not want to go into these other types of jobs.” The key issue for truck drivers, trucking companies, unions, and

government entities should be how to become better at predicting what type of job transitions for truck drivers would increase economic growth and opportunities for everyone involved.

When discussing reskilling, it is also important to think about what tasks can realistically be replaced by automation and what cannot be replaced for a long period of time. McKinsey and Company's Global Institute has identified sectors and jobs that are most at risk of being automated. They conclude that many types of tasks in many jobs have the technical potential to become automated but the potential varies based on categories of tasks. The Global Institute has created broad categories for job tasks and ranked their potential for automation by labor market sector. For example, managing others has a low potential for automation.²¹

Figure 6. Comparison of Truck Driving Tasks to McKinsey's Estimate of Potential for Automation of U.S. Jobs

Truck Driving Tasks	Category	Technical Feasibility of Automation in the U.S.¹
Transport goods to and from manufacturing plants or retail and distribution centers	Predictable physical work (point-to-point driving)	24
	Unpredictable physical work (city driving)	24
	Applying expertise (city driving)	8
Inspect vehicles for mechanical items and safety issues and perform preventive maintenance	Data processing (inspection of vehicles with smart sensors)	14
Planning an optimal route and meeting delivery schedules	Data processing	14
Document and log hours, work/rest periods spent driving and retain fuel/toll receipts	Data collection	22
Serve as a brand advocate and ambassador in every interaction with clients and the public	Stakeholder interactions	14
Maneuver trucks into loading or unloading positions	Unpredictable physical work	24
	Applying expertise	8

Input macros into automated system for each stage of loading and unloading process	Data collection	22
Collect and verify delivery instructions	Data collection	22
	Data processing	14
Report defects, accidents, or violations	Applying expertise	8
	Data collection	22

Note

1. The numbers in this column represent the percent of time spent on activities that could be automated using existing, proven technology.

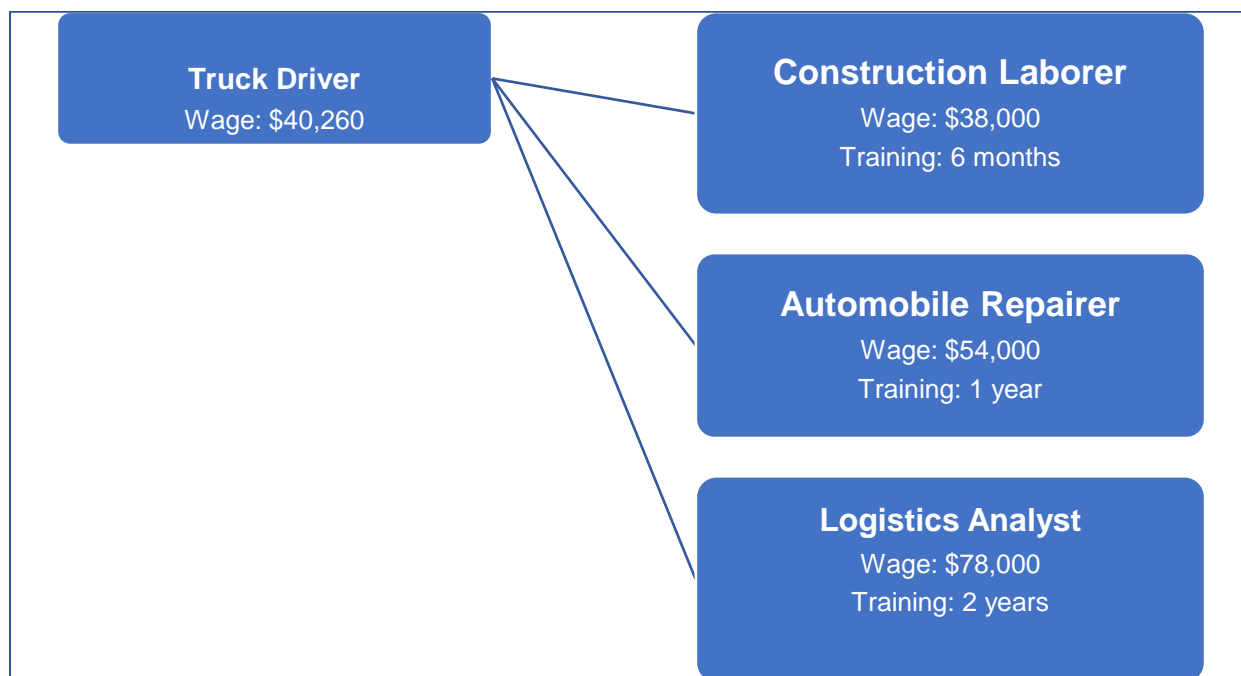
Sources: “Truck Driver Responsibilities and Duties,” n.d., <https://www.indeed.com/hire/job-description/truck-driver>; “Truck Driver Job Description,” n.d., <https://resources.workable.com/truck-driver-job-description>; McKinsey and Company, “The Technical Potential for Automation in the US,” n.d., <https://www.mckinsey.com/~media/mckinsey/business%20functions/mckinsey%20digital/our%20insights/where%20machines%20could%20replace%20humans%20and%20where%20they%20cant/sector-automation.ashx>.

After examining a current job and its skills, the next step is to locate other jobs that use similar or transferable skills. The World Economic Forum has developed a methodology for locating potential new jobs during a reskilling process using sources from the Occupational Information Network of the US Bureau of Labor Statistics and Burning Glass Technologies (a provider of big data about labor market technologies). Using this methodology, the World Economic Forum has mapped future opportunities for workers transitioning out of a job and provides guidance for workers who want to upskill to a better job (i.e., a job with higher wage potential and greater employee satisfaction).²² They broke down three components of a job: content (work activities), aptitudes (knowledge, skills, abilities), and experience (time spent in education, years of work experience, and years of job family experience). They then derived similarity scores between a starting job and target jobs. For each job, the World Economic Forum provides information about the job content and the type of reskilling needed. As a next step toward a solution for the trucking industry, I propose that a group conduct a similar analysis for truck driving and map out similarity scores and pathways for other type of roles, tasks, or jobs.

Once new tasks and new jobs are identified, shipping companies, unions, technology companies, and government entities can think about investing in reskilling programs. These activities need to start

now; some reskilling programs will take several years (for certification, a new degree, or extended training).

Figure 7. Prototype of Sample Job Pathways for Displaced Truck Drivers



Source: Wage and training data from World Economic Forum and The Boston Consulting Group, *Towards a Reskilling Revolution: A Future of Jobs for All* (Geneva: World Economic Forum, 2018).

Government Policies That Can Alleviate the Negative Impact of Autonomous Trucking on Truckers

Government entities can play a role in creating policies that would alleviate the negative impacts of job displacement. SAFE's Autonomous Vehicles and Mobility Innovation produced a report that brainstorms about government policies to protect truck drivers during the transition to autonomous trucking. The authors propose multiple layers of government initiatives that could ease displaced truckers' transition to new jobs. These include modifying and improving how data is shared and coded between employers, unemployment insurance agencies, and employers; works councils that would serve as vehicles for employee input in employer decision making; worker training accounts--loans by employers to employees for retraining; and programs to help local economies attract new employers.²³ The report emphasizes the importance of generating and sharing information about who is unemployed, what jobs

are available, and what jobs are needed. The authors argue that this information should be shared at all levels: among employers, community college administrators, state government agencies related to employment and unemployment, and federal government entities such as the Bureau of Labor Statistics. It notes one study that found that currently the private sector (employers) spends two to three times as much on worker training as the public sector (federal and state government agencies). This has the effect of skewing job training resources toward higher-educated and higher-paid employees such as executives and managers.²⁴ Job training programs funded by federal or state governments would help redress this imbalance because they would focus on the employment needs of a state or the entire nation rather than on the needs of a specific employer.

A proposal by Neera Tanden and colleagues suggests just such a program, which they call a “Marshall Plan for America”: a large-scale program of public employment for those impacted by job displacement. These workers would go through intensive reskilling programs for occupations that are high in demand and have guaranteed jobs in the public sector upon completion of the training program.²⁵ Another proposal is wage insurance: a program whereby earnings would be topped up for those who have lost their jobs due to autonomous trucking and have been forced to take a job that has significantly lower pay.²⁶ Other ideas include universal basic income and flexicurity.²⁷

Other priorities for government entities would address the root causes of why there is a driver shortage: low wages, misclassified workers, decentralized representation, and demanding and unpredictable schedules. State and federal governments should address these problems immediately. If jobs and wages are not managed well, it is possible that autonomous trucking will create a vicious cycle of erosion of job quality that will lead to increased turnover and shortages of drivers.²⁸ Finally, governments should ensure that autonomous trucking technology is safe. Government entities should put in place regulations and protocols to monitor the new technology that include strict, reliable, and valid safety tests.

Collaboration among Industry Stakeholders

There is clearly a broad range of perspectives and attitudes among technology vendors, truck drivers, and members of unions and motor associations about autonomous trucking. Many feel that something needs to be done, but currently no institution exists that could serve as a forum for working on the issues related to this new technology. It is clear that trucking companies do not have a clear incentive to begin this work, and truckers do not have the capacity to do so. While members of unions and motor associations have been thinking about the issues, they do not know how to begin. No one institution or entity is going to take action on its own, but if they all work together, next steps can get accomplished. There may not always be one agreed-upon solution or even consensus. However, with increased information sharing and collaboration, stakeholders in the industry can start working toward incremental steps and strategies.

There are effective ways to bring these three stakeholder groups together. One way would be to create a trucking industry stakeholders' group. An industry leader or a union such as the Teamsters could create a consortium that consisted of representatives from stakeholder groups such as technology companies, truck drivers, unions, motor associations, and university research centers. The consortium could identify key issues and facilitate a path toward a solution. Other members could take on secondary consultative roles under a focus area or a tertiary role that would include being informed and providing feedback. Below is a prototype of the various focus areas and respective roles of stakeholders in such a consortium for the trucking industry.

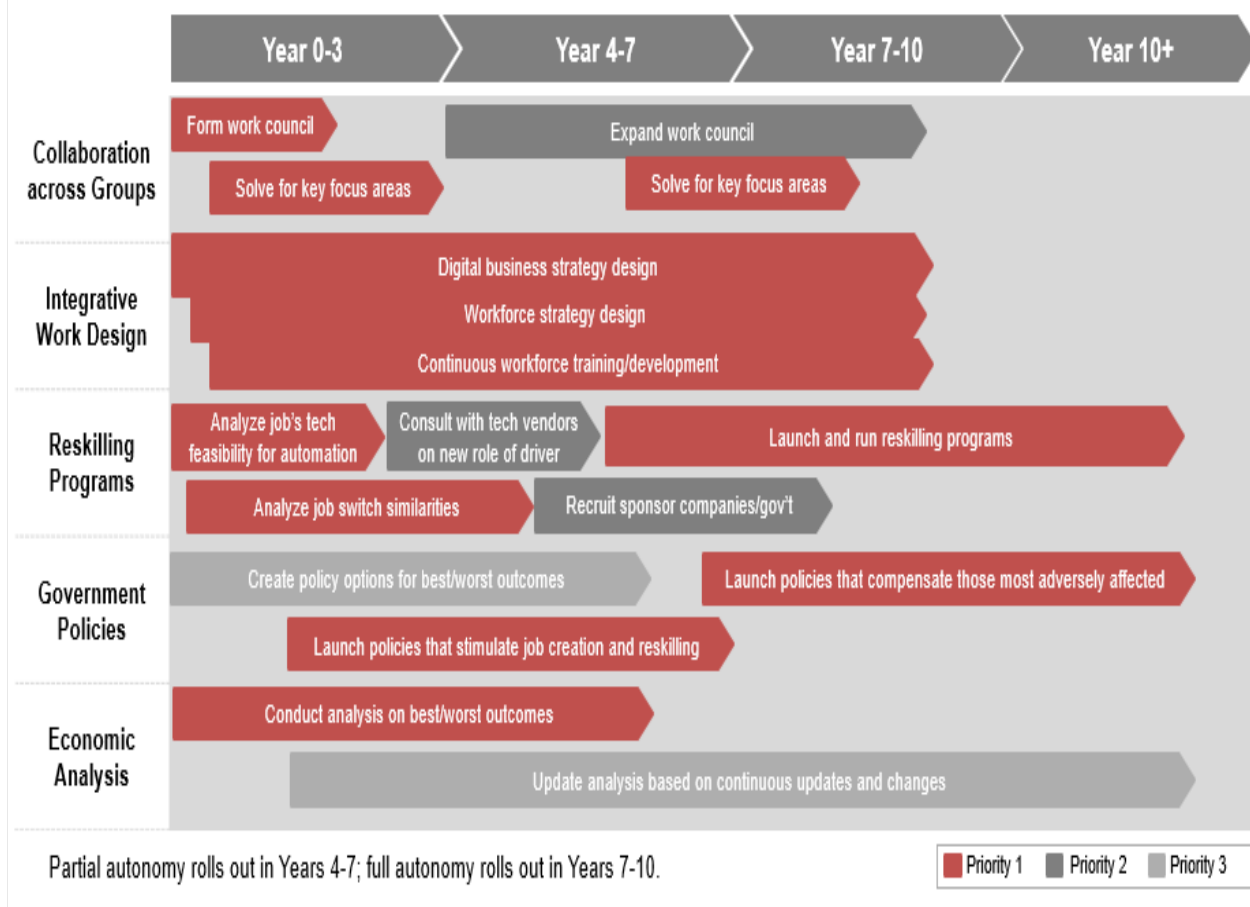
Figure 8. Prototype of Roles of Stakeholders in a Consortium on the Future of Trucking

Consortium Focus Areas							
	Tech Developments	Timeline Rollout	Driver Wages	Work Conditions	Reskilling	New Job Role	Government Policies
Technology companies	Lead	Lead	Inform	Inform	Consult	Consult	Inform
Truck Drivers	Consult	Consult	Lead	Lead	Lead	Lead	Consult
Unions	Inform	Consult	Lead	Lead	Consult	Consult	Lead
Motor Association	Inform	Inform	Consult	Consult	Inform	Inform	Lead
University Research Centers	Inform	Inform	Inform	Inform	Inform	Inform	Consult

Another idea would be to bring groups of people with diverse perspectives together to events and workshops that focused on constructing solutions. For example, Virginia Tech Transportation Institute and the National Science Foundation are hosting an Automated Truck Workshop in June 2018 to help identify key issues related to the effect autonomous trucks will have on the U.S. economy and workforce and come up with potential solutions.²⁹

Although the timeline for the rollout of autonomous trucking will likely be long, many immediate and intermediate tasks need to be done. Below is a sample timeline of various activities that need to happen over the course of ten years. The intent of this isn't to demonstrate what should be done but rather to emphasize that planning should happen today so the concerns about autonomous trucking and its impact on truckers will be addressed proactively rather than reactively.

Prototype of a Rollout of Automated Trucking That Centers on Needs of Truckers



This technological change is coming. It will involve significant rethinking across the whole industry, including changes in operations strategies, changes in skill requirements, and changes in work design. People will have to learn how to be successful in new jobs. All stakeholder groups have roles to play during this transition. Labor unions can minimize the pain of the transition. Government entities have a responsibility to ensure that the new technology is safe and that jobs are created and workers are transitioned to new jobs. Truck drivers should be aware of the current and future state of their jobs and participate in reskilling programs when they become available. Technology companies can design

technology that is user-centric, construct a transparent and long transition period, and create good jobs that are beneficial to society, including jobs for truckers who will be displaced by the technology they create. There is time. Industry stakeholders should use it wisely and effectively.

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⁶ Walker, “Self-Driving Trucks—Timelines and Developments.”

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