

Perceptions of Trucking Automation: Insights from the r/Truckers Community

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ABSTRACT

Recent technological advancements in automation have sparked interest in how automation will affect truck drivers and the trucking industry. However, there is a gap in the literature addressing how truck drivers perceive automation and how they believe it will impact trucking. This study aims to understand truck drivers' perspectives on automation in the trucking industry. Extending a preliminary study, we conducted a broader analysis of comments discussing automation in the r/Truckers subreddit from February 2017 to March 2021. In general, the community had negative sentiments towards automation in the trucking industry. Participants speculated when automation would become mainstream in trucking and discussed the feasibility of automation in the context of executing non-driving tasks and having accommodating infrastructure. Our findings indicate that truck drivers seek to participate in conversations about the future and to prepare themselves for when automation is more prominent in the trucking industry.

CCS CONCEPTS

• Human-centered computing → Empirical studies in HCI.

KEYWORDS

automation, trucking, online communities

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1 INTRODUCTION

Recent discussions have speculated on the possible influence that automation and AI will have on the trucking industry. Some sources claim that autonomous-driving technology could potentially eliminate millions of jobs in the trucking industry [3]. However, research

shows these estimations to be inflated [11]. Drivers will still be needed to complete non-driving tasks and take over driving in various scenarios [10]. Still, due to the impending shifts that will take place in the trucking industry [10, 27], it is essential to understand how truckers view automation, since it impacts the industry, the market, and their roles within it. Understanding truckers' perceptions will help us in creating systems that truckers can trust and that can explain their actions to them (a legal requirement by European laws). Furthermore, understanding trucker perceptions supports our comprehension of social issues and ethical dilemmas in automation, as they relate to what tasks in trucking should be automated and their ultimate impact on both the drivers' lives and society at large. As Janssen et al. [17] point out, calibrating appropriate user trust, building explainable automation, and understanding and dealing with social and ethical issues are central themes of today's human-automation interaction research. Janssen et al. also point out the need for this research to cover a wide range of users and domains. Yet, as of now, there are few studies that explore how future highly automated trucks are perceived by a key constituency: truck drivers [7, 8]. Thus, in this study, we look to gain insight into how truck drivers perceive automation and their sentiments towards it by analyzing the r/Truckers subreddit's social media posts relating to automation.

Our work extends a preliminary study [21] which, similarly, analyzed comments in the subreddit r/Truckers to gauge the perception of automation in the trucking community. The preliminary study gathered and analyzed subreddit posts and comments that were queried using the keyword "automation" that were posted from March 2017 to November 2020. In this study, we expand both the data set and the analysis. We performed queries on 13 keywords related to trends in automation and expanded the thematic analysis with a deeper exploration of subthemes to gain further insight into the trucking community's sentiments relating to automation. We commence by exploring related work.

2 RELATED WORK

2.1 Trucking Automation

Recently, more companies have begun to focus on developing automated trucking technology, though most of these projects are still under development. In November 2017, Tesla unveiled its fully electric semi truck, which was announced to go into production in 2019, noting that every semi will have autopilot as its standard [16]. In July 2018, Uber announced the shut down of its self-driving truck project [14]. Uber failed to overcome a lack of trust in the trucking industry, which was, at the time, not receptive to new technologies that could possibly put people out of work [31]. In May 2019,

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TuSimple, a global autonomous driving technology company, partnered with the United States Postal Services to pilot mail delivery self-driving trucks to transport mail across state lines [2]. In May 2019, Einride announced the first fully autonomous trucks, called Pods, to complete deliveries on public roads [4, 5]. A year later in 2020, the company unveiled a new truck type, dubbed Autonomous Electric Transport (AET), with hopes to have it on the road delivering freight in 2021 [13]. In July 2019, Walmart announced its collaboration with autonomous vehicle company, Gatik, to make middle-mile trucks in Arkansas driverless for delivery [29]. Despite these developments, studies have recognized that the impact of automation may be minimized by certain limitations. A study conducted in 2019 claims that the number of projected jobs that will be lost due to automation is exaggerated [12]. The study argues that unemployment caused by automation will be more limited than expected, and explains that the type of jobs and responsibilities of truckers may change after widespread adoption of automation in the trucking industry [12].

2.2 Truck Drivers and Automation

Several studies have explored the factors that affect the acceptance of autonomous cars and automated driving [1, 25]. However, findings from car drivers cannot be easily extended to truck drivers and their perceptions of automation, given that trucks are commercialized transport vehicles and are therefore considered workplaces [9, 23]. Results from a questionnaire conducted by Richardson et al. [23] found that over 50% of truck drivers ($n = 39$) who answered the questionnaire named higher safety and comfort as the reasons for why they would like to drive a highly autonomous truck. The study found that truck drivers were concerned about the reduction of driving pleasure and the fear of being made redundant due to automated trucks [23]. Truck drivers and their managers were both concerned about legal liability issues and the safety and reliability of highly automated trucks [23].

Given the mental and physical demands of the job, truck drivers experience high levels of mental stress which consequently induce physical fatigue and inattentiveness, which are both major causes of traffic accidents [18, 24]. Previous research has found that automation in trucks might alleviate these concerns as it provides drivers with the opportunity to exercise while driving [24], increases levels of attentiveness [28], and improves truck drivers' commitment to their companies [28]. While automation has been shown to provide such benefits, both truck companies and truck drivers have expressed distrust toward semi-autonomous trucks [28]. However, there have only been a few studies that research how truck drivers perceive autonomous driving [1, 9]. In a study with 23 German and Polish speaking truck drivers conducted by Fröhlich et al. [9], participants expressed that trust in road safety, the reliability of self-driving trucks, and the likelihood of workflow improvement were less important to their intentions to work with automated trucks. Rather, they viewed the quality of the design of the driver's cabin as highly important [9]. Still, the studies that explore truck drivers' attitudes toward automation are limited in that they do not fully consider the factors that truck drivers examine in their evaluations of automation.

Additional research has explored automation in trucking in the form of platooning and driver's sentiments towards platooning [6–8]. A 2016 study presented a platooning assistance system called PlatoonPal, citing that drivers felt positively while using the system [7]. Another study described two human-machine interfaces for platooning, with the goal of alleviating driver's fears of platooning and mistrust in automation [8]. While these studies do explore sentiments among truck drivers within the autonomous domain, they are limited in that they only discuss one potential method of automation in trucking. Our study aims to extend the understanding of more general perceptions of automation in the trucking community.

3 METHOD

We conducted an analysis of posts within a social media platform's community to explore the sentiments, personal views, and experiences of those within the community, using a method often cited in HCI research, specifically an in-depth thematic analysis of social media community posts [22]. Reddit is a social news aggregation, web content rating, and discussion forum that establishes a network of communities based on people's interests [30]. The r/Truckers subreddit community is self-described as "The best trucker subreddit out there." It was created on December 21, 2011, and as of May 2021 has 79.0k members. This subreddit community contains several forums that are open to the public, includes lively discussions, and is composed of members that either have connections to and interests in the trucking community or are truck drivers themselves. We chose to analyze a trucking subreddit in particular, rather than subreddits relating to automation more generally, to focus on the trucking community's sentiments towards automation as opposed to automation enthusiasts thoughts on the trucking industry. These factors make the r/Truckers community ideal for an analysis of the attitudes and thoughts of the trucking community towards automation.

3.1 Population of r/Truckers

The demographic information of Reddit members is not available, as most commenters in the social media platform are anonymous, though their anonymity is not guaranteed by the platform. We can infer that the community consists of computer literate English speakers, as all of the posts we analyzed were written in English. Although some commenters discussed the types of trucking jobs they engage in, we cannot verify the distribution of these jobs among the community. While there are different types of truck driving, such as long-haul trucking and short-haul trucking, we cannot assume that a particular type of trucking is being discussed, unless the commenter specifies. Thus, we note that the thoughts expressed by r/Truckers are not representative of the general truck driving community.

3.2 Data Collection

To obtain the posts, comments, and other meta-data information, we used Praw (a Python Reddit API Wrapper) to scrape the Reddit database. We performed individual queries for each of the following 13 keywords: "automation," "automated," "self-driving," "self driving," "self drive," "future," "driverless," "driver-less," "auto-drive," "auto

driving,” “car without a driver,” “truck without a driver,” and “Tesla.” Search requests from keywords that have the same meaning but are grammatically different (e.g. “automated” and “automation”) may overlap. These keywords were selected because they are frequently used in popular media [2, 3, 20, 27, 29].

When queries with multiple keywords returned the same post, we counted it as a single post in our data. We included posts in our analysis if they had at least three comments discussing automation in the trucking industry. This resulted in 109 posts and 2952 comments for our data analysis. The resulting posts ranged from February 2, 2017 22:25:23 to March 13, 2021 17:45:45. Using pushshift.io (a Reddit API that provides search capabilities for searching Reddit comments and posts), we found that the total number of posts made on r/Truckers during this time frame is 53,735.

3.3 Data Analysis

We first analyzed the frequency of each of the 13 keywords among the 109 posts (not including their comments) in our dataset, in three month increments from February 2017 to March 2021.

We grouped together synonymous keywords into the following categories:

- Automation+ : “automated” and “automation”
- Self-driving+ : “self driving,” “self-driving,” “self drive,” “auto drive,” “auto driving,” “driverless,” “driver-less,” “car without a driver,” and “truck without a driver.”
- Future: “future”
- Tesla: “Tesla”

Next, we analyzed the 2952 comments made under the 109 posts. Using themes established in a preliminary study [21], two taggers independently labeled each comment with at least one of seven themes: Feasibility of Automation, Timeline of Automation, Jobs, Expectations of Automation, General Questions and Answers, Positive Views toward Automation, and Personal Experience. We had a miscellaneous tag which included bots comments, comments not related to automation, or comments that merely agreed, disagreed, or were insulting without adding any additional details. Miscellaneous comments were filtered out and not considered in our content analysis. After tagging all of the comments, the two taggers discussed potential subthemes within each theme, and tagged the comments with subthemes. We defined an agreement to be the case where each tagger included one or more of the same tags in a comment. The inter coder reliability yielded 87% agreement, based on 100% of the data.

4 RESULTS

4.1 Keyword Frequency

The distribution of posts containing each of the 13 keywords were: 53% (58/109) Self-Driving+, 49% (53/109) Automation+, 25% (27/109) Future, 17% (19/109) Tesla. Posts with the keywords Automation+ were consistently among one of the most frequently posted; Figure 1 shows that issues of automation were discussed throughout the time frame we studied.

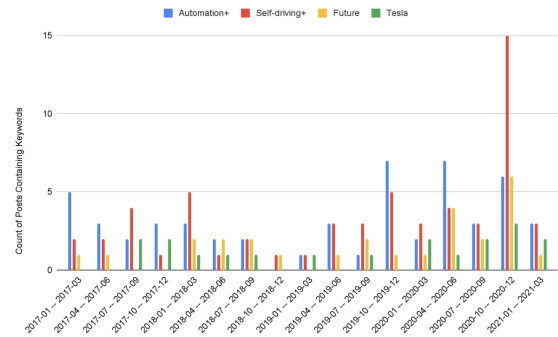


Figure 1: The count of posts containing the keywords Automation+, Self-driving+, Future+, Tesla+, from January 2017 through March 2021.

4.2 Themes

We explored themes that were developed in a preliminary study [21]: Feasibility of Automation, Timeline of Automation, Jobs, Expectations of Automation, General Questions and Answers, Positive Views toward Automation, and Personal Experience. Of the 2952 comments analyzed, we obtained the following percentages for each tag: 52% (1540/2952) Miscellaneous, 13% (398/2952) Feasibility of Automation, 13% (390/2952) Timeline of Automation, 10% (299/2952) Jobs, 3% (88/2952) Expectations of Automation, 1% (34/2952) General Questions and Answers, 1% (28/2952) Positive Views toward Automation, and 1% (23/2952) Personal Experience. 13% (385/2952) of comments resulted in no agreement between the two taggers.

After removing 1540 miscellaneous comments and 385 comments that did not yield agreement from the analysis, we were left with $2952 - 1540 - 385 = 1027$ total comments for the analysis. We yielded the following percentages for each theme: 39% (398/1027) Feasibility of Automation, 38% (390/1027) Timeline of Automation, 29% (299/1027) Jobs, 9% (88/1027) Expectations of Automation, 3% (34/1027) General Questions and Answers, 3% (28/1027) Positive Views toward Automation, and 2% (23/1027) Personal Experience. Comments could be tagged with multiple themes. Following, we elaborate on each of these themes. A description of the themes and subthemes is shown in Figure 2.

4.2.1 Feasibility of Automation. The comments in the Feasibility of Automation theme discussed practical issues surrounding automation in the trucking industry and challenges involved in making automation mainstream. 39% (398/1027) of the analyzed comments were tagged under the Feasibility of Automation theme.

Practical Issues. Within the Feasibility of Automation theme, 40% (159/398) of comments cited practical issues that will keep automation from becoming the norm in the trucking industry. These comments included discussions of costs required to implement automation, infrastructure issues, and policy changes. One commenter wrote about the costs related to the widespread adoption of automation: “A bad infrastructure and a massively expensive cost to replace fleets of trucks are the biggest things holding back automated trucks right now.” Commenters mentioned legal concerns, especially around liability laws and insurance, and how this would

Themes (with sub-themes)	Description	Percentage (with counts)
Feasibility of Automation	Speculation on the feasibility of automation being implemented; infrastructure, policy, reliability.	39% (398/1027)
Practical Issues	Cost, work, infrastructure, and policy changes (e.g. liability laws) required to make automation mainstream.	40% (159/398)
Reliability and Limitations	Questioning the reliability and capabilities of automation (weather conditions, maneuvering the vehicle, truck maintenance, robberies in unmanned trucks, etc.)	32% (129/398)
Technological Limitations	Technology feasibility issues (GPS issues, hacking the truck, programming ethical issues, etc.)	32% (126/398)
Safety Concerns	Concerns about the safety of automated vehicles	5% (18/398)
Advancements of Technology	Technology is advancing and will be able to (or already can) make automation mainstream, or it's more reliable than a human	8% (33/398)
Timeline of Automation	Discussions on when automation would take place (to any degree).	38% (390/1027)
Automation is a Long Ways Ahead	The widespread adoption of automation is more than 5 - 10 years away. It may not happen in our lifetimes.	46% (179/390)
Comparison to Other Industries	The timeline of the adoption of automation will depend on other automation in other industries.	17% (66/390)
Automation Will Happen Soon	Automation adoption will happen soon. The timeline is closer than people believe.	12% (45/390)
Explanations and Speculations	Matter-of-fact explanations on the timeline for automation.	8% (33/390)
Automation Will Never Happen	Automation will never become mainstream.	6% (24/390)
Automation is Already Happening	Automation is already happening in the trucking industry.	5% (20/390)
Discontinued Automation	Automation will be discontinued after its adoption.	1% (3/390)
Futility in Prediction	Predicting the timeline of automation is a futile exercise.	1% (2/390)
Jobs	Speculation on how jobs will be impacted in trucking or how they are already impacted.	29% (299/1027)
The Necessity of Humans	What the human's role will be in working with automation, if any.	42% (127/299)
Impact on Truck Drivers	How truck driver's job responsibilities, salaries, and day-to-day operations will change as a result of automation.	30% (91/299)
Job Replacement	Concerns related to job replacement of truckers.	10% (30/299)
Adapting to Automation	Discussions about truckers adapting to automation, acquiring new skills, etc.	8% (25/299)
Future of Truck Drivers' Careers	How automation will impact the long term future of the trucking career.	4% (11/299)
Non-Driving Tasks	Discussions on the non-driving tasks drivers engage in and how they would be impacted by automation.	2% (7/299)
Expectations of Automation	Neutral or matter-of-fact explanations on how automation will impact the industry.	9% (88/1027)
Division of Labor and Tasks	Division of labor/tasks between humans and automated trucks	38% (33/88)
Advancement of Automated Trucks	Discussions on the advancement of automated trucks and the order in which trucking jobs that will be automated	19% (17/88)
Productivity of Automated Trucks	How productive and/or efficient automated trucks will be.	11% (10/88)
General Questions and Answers	General questions or responses of how automation works.	3% (34/1027)
Positive Views toward Automation	Hopeful or happy comments about automation.	3% (28/1027)
Economic Benefits	Automation will be good for the economy.	18% (5/28)
Quality of Life with Automation	Automation will improve people's quality of life.	18% (5/28)
Safety	Automation will make driving safer.	14% (4/28)
Tasks are Made Easier	Automation will make trucking jobs easier with all their assistive features.	14% (4/28)
Personal Experience	Personal anecdotes related to automation.	2% (23/1027)

Figure 2: An overview of all the themes and subthemes in the results. The main themes are highlighted, while the sub-themes for each of the main themes are listed below them. The counts for the main themes are based on the total number of comments, minus the miscellaneous comments and the comments that did not yield agreement.

affect automation. One commenter outlined potential legal hurdles to overcome in this domain: “*The real problem here is that this is all new territory for the courts and for insurance companies. The US court system is based on legal precedent and there isn’t any set in the arena.*” Several commenters posed the question of who would be liable if the automated vehicle was involved in fatal accidents, as one commenter wrote: “*Someone also needs to be held responsible in case of an accident or death. Even when these things run themselves they will still throw someone in the truck just so that someone is liable when these trucks kill people.*”

Reliability Concerns and Limitations in the Capabilities of Automation. Of the comments in the Feasibility of Automation theme, 32% (129/398) of comments discussed concerns relating to the reliability

of automation and the limitations in what tasks they are capable of completing. These concerns included discussions of how highly autonomous vehicles would navigate during inclement weather conditions, potential difficulties maneuvering the vehicle in difficult driving areas, how the vehicle would perform self-maintenance, and robberies in unmanned autonomous trucks. One commenter wrote about how truck drivers can handle various situations, such as severe weather or route changes, that an autonomous system may have difficulty with: “*And what about all the various decisions we make regarding routes, weather, conditions, schedules, etc? Most of that is based on experience and details that a remote operator or automatic system won’t be able to obtain.*” Another commenter wrote about maneuvering their truck in difficult set ups: “*I drive a cement truck and I have to go off road and back into weird awkward areas daily. Trying to make a computer that can do that without tipping or getting it stuck is a very long way off.*” One commenter wrote: “*Slash the tires at a stop and loot. Vandals could cut the lines, oil the brakes, torch the cab, etc to make it a rolling death machine lawsuit,*” citing how it would not be difficult to compromise the cargo in an autonomous vehicle that did not have a human in it.

Technological Limitations. In the Feasibility of Automation theme, 32% (126/398) of comments expressed technological limitations and failings for why autonomous vehicles cannot be feasibly implemented in the near future. These comments included those that discussed GPS navigation capabilities, cases in which the autonomous truck could be hacked into, and programming for ethical and moral dilemmas. As one commenter stated: “*...programming morality. What will the software do when there’s an unavoidable crash. It’s the Trolley Dilemma philosophical question - send your truck of one into the ditch to save a minivan of five.*” Another commenter described issues with hacking into autonomous vehicles: “*Fact remains self driving vehicles will be networked, and open to outside actors maliciously hacking into them en masse to do harm, perhaps fatal harm.*”

Safety Concerns. Within the Feasibility of Automation theme, 5% (18/398) of comments covered potential safety concerns with automated trucks. One commenter wrote “*...the US has been pretty quiet on the idea of it since a Tesla owner was killed simply because the sensor couldn’t detect a giant semi truck,*” which attests to safety issues they see regarding autonomous vehicles.

Advancements of Technology in Automation. Contrary to comments questioning the capabilities of autonomous vehicles, 8% (33/398) of comments in the Feasibility of Automation theme expressed that technology is advancing and will be able to (or already can) make automation mainstream. One commenter wrote: “*There are successful autonomous vehicles out there, airport buses that run a simple circuit with repetitive stops and clear tracks as well as emergency stop cords that ‘people’ can pull if something goes haywire. I truly believe AI will become more and more mainstream and eventually even self driving cars may be a thing.*” Commenters mentioned how technology is not the biggest hurdle in the widespread adoption of automation: “*Interestingly, I think the lowest barrier will be technological. Eventually, the technology will become advanced enough to do many driving tasks.*” Additionally, commenters noted that these automated vehicles could be more reliable than a human

driver alone: “No doubt improvements can and will be made, but a computer doesn’t get sleepy after driving for 10 hours straight. Computers can almost completely avoid human error by using the best technology that the world has to offer.”

4.2.2 Timeline of Automation. The Timeline of Automation theme included comments speculating on when automation will be mainstream in the trucking industry. 38% (390/1027) of all analyzed comments were categorized into this theme.

Automation is a Long Ways Ahead. Within the Timeline of Automation theme, 46% (179/390) of comments shared the sentiment that automation will be mainstream far into the future. Commenters wrote that although automation might be popularized in the trucking industry, truck drivers will still be necessary: “Honestly don’t see it happening anytime soon anyway. Even if trucks go driverless, they will need someone behind the wheel to be able to take over as needed plus deal with other things.” Similarly, one commenter agreed that human drivers will be necessary; however, the commenter added that automation will inevitably enter the trucking industry and continue to grow: “You’ll still need a driver for a while, but the ability to recognize and react to changing road conditions is going to advance exponentially as sensors progress. Either way, we’re probably all secure for a while. Just be ready to adapt. Those who accept change and can adapt and find a niche are going to do alright. Those who deny it will probably be SOL if this happens sooner than a bunch of half educated truckers on an internet forum believe.”

Comparisons to Other Automation in Other Industries. Among the comments in the Timeline of Automation theme, 17% (66/390) of comments made claims about the timeline of automation in the trucking industry by discussing the progress of automation in other industries. 40 comments mentioned automation in trains, 37 comments mentioned planes, 18 comments mentioned flying cars, and 11 comments mentioned ships. Commenters referred to other types of automation to claim that the implementation of such automation will happen before trucking is automated: “lol nothing will be automated kiddo. there are reasons why trains, ships, and planes all have people operating them, all of which would be far easier to ‘automate’ than driving.” Contrary to the view that automated trucks will be implemented after other automation, one commenter wrote that automated trucks will be used before the success of fully automated ships and planes: “I think we’re closer to self driving trucks than we are to 100% autopilot on ships or planes.” Commenters speculated what truck drivers’ roles might look like by comparing them to pilots in planes and conductors in trains: “I believe soon (as in 10-20 years) we’ll have something similar to a plane, autopilot. Trucks will still require a driver, but once the driver is on the highway he/she will have the ability to hit cruise, and the truck will drive itself highway only. Its totally possible.”

Automation will Happen Soon. Within the Timeline of Automation theme, 12% (45/390) of comments expressed that automation in the trucking industry will be popularized soon. One commenter perceived automation, which they refer to as “robots,” to take over the industry as soon as 2 or 3 weeks: “I wouldn’t even bother, at most you’ll get 2 or 3 weeks before the robots take over completely.” Another commenter wrote that trucks can become driverless in 15 years with the implication that 15 years is fairly soon: “And I

wouldn’t be surprised if trucks begin to go driverless in under 15 years. Ok if you’re just getting in and out, not great if you want to build a career.”

Matter-Of-Fact Explanations and Speculations. Among the comments in the Timeline of Automation theme, 8% (33/390) of comments discussed when automation would be popularized in the trucking industry without expressing any particular sentiment about how they perceive the time frame. One commenter was uncertain about the timeline, but speculated when self driving cruise control would be mainstream: “My guess is not yet, but I’d like to see an obstacle course of sorts for one to see how they do, perhaps in 5 years or so we’ll have self driving cruise control?” Another commenter explained why automation may take 30 more years: “Well, they have tech that can keep your vehicle moving in the lane you’re in without issues (Dynamic cruise, lane keeping, blind spot, cross traffic, etc). They only need a computer to put them together. But corners safely, change lanes, negotiate traffic, adverse weather, etc is a problem that will be harder to overcome. I give out maybe 30 years before we see something worthwhile.”

Automation will Never Happen. Within the Timeline of Automation theme, 6% (24/390) of comments explained that some aspects of trucking will never be automated. Eight comments briefly stated that automation will never happen, but did not elaborate on the reason: “Aside from straight up robots I don’t see that happening.” Four comments reflected on the reasons why automation will never happen, comparing progress in automation to other transportation vehicles such as planes or trains, and identifying failures in technology: “Simple answer; never. There is no way any AI could predict what some dumbass 4 Wheelers do. It would be chaos and destruction.” Seven comments specified tasks or types of trucks that will never be automated, such as last-mile, city driving, and flatbed. Three other comments implicitly or explicitly explained varying levels of automation: “May I suggest that y’all need to move away from the ‘All or Nothing’ mindset? **Parts** of the driving **will** be automated – maybe in 2 years, maybe in 20 – and some parts will **never** be.”

Automation is Already Happening. Within the Timeline of Automation theme, 5% (20/390) of comments explained that automation in the trucking industry is underway. Six comments provided general explanations that automation has already entered the trucking industry to varying degrees: “Some of it is already automated.” Ten comments referred to specific cases of existing automation in trucking to substantiate their claims that automation is already happening. Among those, two comments alluded to Tesla’s semi truck with an autopilot feature: “It’s already happening...Half a decade is a long time in tech and development. And leaps in tech are only going to get bigger,” and “Well, it’s out there now in Tesla autopilot. It works pretty damn well.” Two comments mentioned Walmart as an example of a company that has been employing automated trucks: “Walmart is already using automated delivery trucks and estimate it will save them 1 trillion (that’s with a T) in shipping costs. And that’s just on the middle mile.”

Automation Will be Discontinued. Only 1% (3/390) of comments in the Timeline of Automation theme suggested that although automation could be implemented in the trucking industry, it will

be discontinued. Two commenters explained that automation will be discontinued after accidents are caused by automated trucks: *"...All it will take is a single incident of a self-driving truck smashing into cars during traffic. Even the Tesla has yet to master certain road conditions and that's cream of the crop..."* One commenter wrote that the automotive industry will ruin Tesla's chances of surviving as a company and will halt the production of automated trucks: *"...Tesla is simply just beat. Also its not common for a 'new' manufacturer to survive in this time and age. So Elon has a lot of work. This is only the beginning for Tesla. The automotive industry will rain down on Tesla to test the company's will to survive..."*

Futility in Prediction. Only 1% (2/390) of comments in the Timeline of Automation theme expressed that predicting the timeline of automation is a futile exercise: *"Neither of us can really answer this question until a few more years into the future. We will just have to wait and see."*

4.2.3 Jobs. The Jobs theme encompassed comments discussing automation and its potential effects on responsibilities, employment, treatment of truck drivers, and adapting to workplaces with automated trucks. 29% (299/1027) of the analyzed comments were tagged under this theme.

The Necessity of Humans. Of the comments tagged under the Jobs theme, 42% (127/299) of comments expressed that even though automation might change the trucking industry, humans will always be required and jobs for humans will exist. Commenters expressed that truck drivers cannot be automated for liability and safety reasons: *"nothing to worry about at all, someone will always be in a truck so that there is someone to blame when the truck kills people."* Commenters discussed certain responsibilities that will not be automated, such as loading and unloading, flatbed, and beverage and convenience store delivery: *"Mine will stay the same. As we haul hazmat and have to be in attendance on the load at all times, a driver will have to be aboard, plus loading and unloading. Besides, I also run the QA/QC lab for our facility (drive only a few loads a week as needed), so I think I'm good."*

Speculation of Automation's Impact on Truck Drivers. Within the Jobs theme, 30% (91/299) of comments discussed potential changes that would happen to truck drivers, such as their salary and job responsibilities. 20 comments discussed changes to payment, in which commenters speculated that wages would decrease after the popularization of automated trucks. One commenter wrote that while pay will decrease, automation will result in an increase of jobs: *"There will end up needing a lot more support workers and different points which will actually result in more jobs, not less. Probably lower paid though."* Two commenters wrote that jobs may look differently due to automation and acknowledged that changes will occur in truck drivers' workplaces: *"...The total number of trucks on the road will be more or less the same, so there won't be *new* manufacturing jobs. Just different ones..."* One commenter wrote about how the treatment of truck drivers will worsen due to automation: *"The jobs will be there, but the industry is absolute garbage. The pay isn't great, companies treat drivers like robots..."*

Job Replacement. Among the comments in the Jobs theme, 10% (30/299) of comments discussed the eventual replacement of humans and their jobs due to automation. Commenters wrote that automation will eventually replace many jobs, but complemented this speculation with the claim that the great loss of jobs is far into the future: *"it will utterly destroy the lives of millions and millions of people through economy death. but i don't see this happening anytime soon for the reasons you mentioned but also because of how poorly our existing infrastructure supports such a thing."* Commenters oftentimes referred to past examples of technology replacing and changing the way jobs look: *"Wages Will stagnate more than they already have...Companies will try to replace as many people as possible with tech...the usual."*

Adapting to Automated Environments and Acquiring New Skills. Within the Jobs theme, 8% (25/299) of comments discussed ways in which current and potential truck drivers should approach the trucking industry, given the possibility that automation could be mainstream. Commenters claimed that an adaptation into working with automated truckers is necessary. One commenter implied that they can avoid unemployment because they have college degrees: *"I graduated from college with my BA and chose to be a trucker anyway...But one day when they start to automate our jobs away I'll have an education I can fall back on if I need to..."* Three comments suggested that truck drivers should acquire new skills in order to remain and succeed in the industry, specifically recommending finding a specialization: *"...Find something dedicated, either regional or local/semi-local. As long as you do anything remotely specialized you'll be safe."* This recommendation is in line with the advice from Kevin Roose in his recent book "Futureproof." Roose [26] notes that workers who are highly specialized in a set of tasks will often be necessary to keep automation working well, and to keep it from making costly mistakes.

Concerns about Future Truck Drivers' Careers. Under the Jobs theme, 4% (11/299) of comments expressed concerns about the possibility of losing their careers, oftentimes asking other subreddit commenters to offer their insights. Seven commenters concerned about the future of truck driving either identified themselves as truck drivers or mentioned prospective truck drivers they knew. Often, commenters also wrote their age in the comments; at the time when these comments were written, the commenters' ages ranged from 17 to 22. These comments either asked other commenters if trucking is a good career choice or expressed their worries about job replacement: *"I'm 22 and I was seeing if this career was a good option because all that I hear from people is that it's all gonna be automated and it's too late to have a full career out of."* Four other commenters discussed their concerns over wage changes due to automation.

Non-Driving Tasks. Within the Jobs theme, 2% (7/299) of comments shared the sentiment that there is more to truck driving than driving, and oftentimes argued that non-driving tasks cannot be automated: *"But drivers do more than just drive."* Three commenters specified what kinds of non-driving tasks exist: *"What many forget is that drivers don't just drive. We are also the customer service representative. We are the face of the company. Take that away and"*

the entire company just becomes soulless corporate shells to the public. They will especially take notice given the recent shift to 'people' driven workplaces. Additionally, the presence of one human is a crime deterrent, regardless of physical capabilities, it adds a dynamic a lot of would be criminals aren't willing to face. Take that away and I would wager freight theft increases. There will always be somebody on these trucks."

4.2.4 Expectations of Automation. The Expectations of Automation theme included discussions on the roles automated trucks will fulfill, in the types of trucking that automated trucks will be used for, and how productive automated trucks will be. This theme encompassed 9% (88/1027) of the analyzed comments.

Division of Labor and Tasks between Truck Drivers and Automated Trucks. Within the Expectations of Automation theme, 38% (33/88) of comments elaborated on how labor and tasks would be divided between truck drivers and automated trucks. 15 comments suggested that truck drivers will serve as autopilots in the truck or perform monitoring and inspections of trucks: *"The trucks will still need drivers for emergency take overs (like airplanes) and docking/backing more than likely. Also I bet we still get the fun of detaching and attaching trailers and fuel stops. Plus someone will have to take care of the trucks on a daily basis if they want them to keep running safely."* Seven commenters wrote about "hub to hub" driving that they expected automated trucks to fulfill, where humans would take over driving when necessary, including driving at the very beginning or driving the last mile. Three comments explained that automated trucks will require drivers under complicated situations, such as delivery and driving on difficult roads: *"In the future, companies may only need a driver to handle inner-city deliveries and other areas until computers are sufficiently advanced."* Four comments expressed that truck drivers will conduct physical work that the automated truck itself cannot do: *"...drivers will be there to pick up the load, secure it, and shut the doors..."*

The Gradual Advancement of Automated Trucks. Under the Expectations of Automation theme, 19% (17/88) of comments wrote about the gradual advancement of automated trucks and the order in which trucking jobs will be automated. 13 comments specified which jobs in trucking would be the first to be automated. Among those, five comments mentioned that OTR (over-the-road) truck driving jobs would be among the first to be automated. Other commenters mentioned terminal to terminal truck jobs, steering wheel holders, dry van trucks, and mega carriers. For example, one commenter wrote: *"I think the first thing to go will be yard moves or some other short distance trucking that goes only from point A to point B. Next to go will be OTR that only goes A to B over a set route. I figure those are at least 20 years in the future. P&D jobs might never go."* Four commenters took into consideration the type of routes and roads that automated trucks will drive on: *"...first they'll just roll out on more established well-mapped routes, then gradually branch out to fill in the other niches."*

Productivity of Automated Trucks. Out of the comments in the Expectations of Automation theme, 11% (10/88) of comments discussed how productive automation in trucking would be, or the level of ease of incorporating automation into specific tasks. Three comments discussed how automation would prove to be inefficient:

"I also don't see them doing well in big cities or NE areas in the first several years of operations." Six comments explained that automation can enhance driving, prevent accidents, and ease the process of obtaining licences: *"The thing about self-driving trucks or any autonomous vehicles, is that when they begin to communicate with one another, they will instantly 'learn' everything the other has...Once this gets going there will be thousands of vehicles 'learning' and it will instantly be available to each and all the others. Which truck will be the best driver? All of them."*

4.2.5 General Questions and Answers. Within the comments analyzed, 3% (34/1027) were tagged under the theme Questions and Answers. This theme included matter-of-fact comments that asked questions pertaining to automation in the trucking industry and comments that answered these questions. For example, in a post about platooning, one of the commenters asked: *"Platooning? Isn't it called drafting?"* In response to the question, another commenter replied, *"Drafting is the goal of platooning. The idea is there is an active driver in the first truck but the others trucks are automatically following it, letting following drivers rest..."*

4.2.6 Positive Views toward Automation. Only 3% (28/1027) of analyzed comments were tagged as Positive Views toward Automation. These comments expressed positive sentiments towards automation in the trucking industry.

Economic Benefits. Within the Positive Views theme, 18% (5/28) of comments mentioned the economic benefits that automation would bring into the trucking industry: *"I firmly believe that the transition into self-driving semis and cars in general is A. inevitable B. ultimately good for the consumer C. bad for truckers/drivers temporarily...Many may lose jobs in the short term, but not at a pace that destroys the US economy, and only rarely in a way that destroys any one family. These are growing pains of social evolution."*

Quality of Life Improvements with Automation. Out of the comments in the Positive Views theme, 18% (5/28) of comments cited quality of life improvements that would come with automation in the trucking industry. One commenter summarized these sentiments: *"...You shouldn't have to drive a giant machine 80 hours out of the week. You should have opportunities that enable you to maximize your creative and intellectual potential, and serve your family and community in a way that really leaves a mark...I only speak for a hypothetical 'better future' we all hope we're striving for...It's all our children have to look forward to. This is the future we are building for them."*

Safety. Among the comments in the Positive Views theme, 14% (4/28) of the comments discussed safety benefits that come with automated trucks: *"...in the vast majority of situations, they'll be safer than humans...A computer doesn't get fatigued, drunk, drugged, it pretty much just does its job."*

Tasks are Made Easier. Within the Positive Views theme, 14% (4/28) of comments discussed that driving and work tasks could be made easier with the assistance of automated vehicles. As one commenter wrote: *"I wouldn't mind [an assistive driving feature for reversing] like this when I shift into reverse. I always have to turn the radio down when backing."* Another commenter mentioned that automated trucks could provide an "automated solution" to existing

problems: “Guys who pull those kinds of doubles have to break them down and back them into docks individually. It would be cool to have an automated solution to that problem.”

4.2.7 Personal Experience. Only 2% (23/1027) of analyzed comments mentioned personal experiences with automation, including autopilot and other assistive driving technologies. 57% (13/23) of comments in the Personal Experience theme described unpleasant and frustrating experiences, 9% (2/23) of comments mentioned a mix of good and bad experiences, and 9% (2/23) of comments recounted good and useful experiences with automated vehicle technology. One commenter discussed difficulties with assistive driving features: “[My truck] occasionally thinks I’m gonna hit something when there’s nothing but air in front of me, then it sends a 30 second video to the company for someone to review. It’s also one of the ones that brakes when it detects a collision. Always have to slow down on right curves if there’s a left turn lane/suicide lane or else it’ll brake and set my tank a rocking.” Another commenter discussed their experience using cruise control and makeshift platooning: “Basically I set the following distance really close and let the cruise control work and followed. I could see the benefits of some automation since the truck would manage the braking and speed until any passing took place but if I followed close enough it would still work. Lane assist and the impact alarm worked still but I’d need to take over. I could picture a line of trucks linking up and the leader setting the tempo while the others fell in line. The downsides were basically anything you would encounter on a normal day driving. Shitty merges, anyone that dove in between would ruin it or worse not be picked up on the sensors, tons of hard engine brake, hard downshifts etc.”

5 DISCUSSION

In this paper, we present insights into how those in the trucking community perceive automation in the trucking industry based on a social media content analysis of the r/Truckers subreddit. Although our findings are qualitative and are not representative of the entire truck driving population, we contribute valuable insights into the attitudes and perceptions of truck drivers, who are vulnerable stakeholders in an evolving industry.

Among the members of r/Truckers who had negative attitudes towards automation in the trucking industry, the most discussed topic was practical concerns with the implementation of automation, including cost, work, infrastructure, and policy changes required to facilitate the widespread adoption of automation, all of which were mentioned in the Feasibility of Automation theme. This suggests that the trucking community sees the largest hurdle for automation in the industry as not merely the advancement of the technology itself, but external factors that contribute to the delay in adoption. Questions of liability, who would take the blame when autonomous vehicles cause accidents on the road, were among the most debated topics. However, there were still a sizable portion of comments that questioned the reliability of automation and technical limitations, which demonstrates trust issues with autonomous vehicles. These concerns – who is liable in a crash, and is the automation safe – are similar to the ones reported by Richardson et al. [23] and by Trösterer et al. [28]. Persistent concerns with liability are certainly no surprise, given that legal frameworks to govern automated vehicles are still under development [15].

While commenters implicitly or explicitly referred to the levels of automation, their conceptual notions of automated trucks were inconsistent. Typically, when commenters denied that automation would happen at least anytime soon, they referred to the replacement of truck drivers, implying that their thoughts are limited to level 5 automation (i.e. full automation), that will not necessitate human interaction or attention. In response to such comments, several commenters reminded others about the consideration of lower levels of automation that will require human involvement. Consequently, the inconsistency of the conceptual notions of automation affected how commenters speculated about the timeline of automation, the responsibilities of automated trucks, and the impact of automation on truck drivers’ jobs.

Among the comments pertaining to the theme Timeline of Automation, 17% (66/390) of comments mentioned automation in other transportation industries to speculate about when automation will gain widespread adoption in the trucking industry. The general sentiment was that automation in trucking will occur after automation in planes, ships, and trains. This finding suggests that truck drivers perceive the adoption of automation in other industries to be easier than adoption in trucking. While other industries also carry big responsibilities, commenters perceived truck driving as a more difficult task to automate. As Kevin Roose points out in “Futureproof” [26], people are more likely to view their own jobs as impossible to automate than the jobs of other people. One vital reason why truck drivers thought truck driving would be difficult or nearly impossible to fully automate is the various non-driving tasks involved in the job. Commenters thought non-driving tasks were not adequately considered in discussions about automating the trucking industry. In essence, truck drivers argue that their jobs are futureproof, to use Roose’s term, because of the human element that is indispensable. We tend to agree – transporting goods is more than driving a truck; it includes negotiations as well as problem-solving related to the cargo. Very importantly, we expect that driving will require human intervention both for technological and legal [15] reasons for the foreseeable future. However, with advanced automation in trucks, truck driver jobs might change significantly, and potentially for the worse. Specifically, truck drivers are currently skilled workers who control large machines, interact with customers and co-workers, and enjoy a great deal of autonomy; with advanced automation, their core task might turn into boring supervision of automation, losing not only skills but also some of their job autonomy.

The theme Positive Views toward Automation was among one of the least tagged themes, in which only 3% (28/1027) of analyzed comments were tagged. The few positive comments were hopeful of the future possibilities automation technology could bring into the industry, improving the quality of life of truckers, and outlining potential benefits to the economy. However, the overwhelming majority of the trucking community does not see a hopeful, positive outcome for a future where they can coexist with automation. Therefore, researchers and designers of this technology should strive to communicate to truckers how this technology could fit into the future of the industry.

Only 2% (23/1027) of comments were tagged with the theme Personal Experience, which described personal experiences with automation that were by and large negative. Most commenters saw the technology, particularly those of automated brakes, to

be unreliable, inconvenient, and potentially dangerous. The negative perceptions within the personal experiences of truckers with these assistive driving technologies could indicate pushback in accepting the technology. With these sentiments in mind, designers should work to address the issues of acceptance and trust within the trucking community. With regards to partial automation, and specifically the automated braking assistance, researchers should reassure drivers that these features are safe and beneficial in their jobs. Researchers should also work to explain the circumstances in which these assistive features are appropriate to use. For example, drivers must stay alert and focused on the driving task even with these assistive driving features, as they do not function perfectly in all conditions. Training with the assistive functions for truck drivers is imperative, as truck drivers' livelihood are dependent on driving. We claim that explainable automation [19] could benefit truck drivers' experiences with automated trucks and contribute to building trust, allowing truck drivers to perceive automated features as collaborative and assistive rather than competitive. Several commenters noted that they were disturbed or surprised by an automated feature (e.g. automated braking) and decided to turn off the feature to avoid unexpected surprises. We encourage researchers and developers of automation to explore how automated features and functions could be better explained to truck drivers.

Taken together, our findings indicate that to address the changes and challenges facing the future of the trucking industry, researchers should address technical and technological aspects of automation not as isolated solution, but rather as embedded elements in new economical, political, and social frameworks for empowering drivers.

5.1 Limitations and Future Work

As we do not have demographic information for Reddit users, our findings are not representative of the opinions of truck drivers in general. Additionally, this particular subreddit and the comments analyzed were in English and Western-centric, which does not take into account cultural and infrastructural differences that can contribute to perceptions of automation. Although our analysis was limited to one subreddit, r/Truckers, on Reddit, the analysis could be expanded to include other subreddits or other social media platforms, such as Twitter or trucker-specific forums. Additionally, a survey focused on investigating trucker's perceptions of automation, including follow-up interviews, would provide more insight into the initial sentiments outlined in this paper. It would also allow for demographic information, including the specific trucking jobs participants engage in (e.g. OTR or local driving). There is also potential for analyzing other subreddits, such as r/Futurology, to investigate what those involved in the automation (rather than trucking) community perceive to be the future of the trucking industry.

6 CONCLUSION

Recent advancements in automation and the gap in the literature regarding truck drivers' perceptions of automation and automated vehicles make this research especially pertinent. Workers are key stakeholders in the future of automation in the trucking industry and recognizing their concerns is essential to fostering trust and

the acceptance of automation in the public sphere. In this study, we present our findings from an analysis of comments from February 2017 to March 2021 on the r/Truckers subreddit trucking community of the social media platform Reddit. We contribute insights regarding seven discussion themes, along with subthemes, including: feasibility of making automation mainstream, the impact automation will have on trucking jobs, timeline for the widespread adoption of automation, positive views toward automation, personal experiences with automated technologies, general questions and answers related to automation, and expectations for the future of automation. Our findings indicate that while technological solutions such as explainable automation could address some of the issues related to the acceptance and trust of automation, given the challenges and changes caused by automation it is critical to integrate technological solutions with economical, political, legal, and societal frameworks which empower truck drivers.

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