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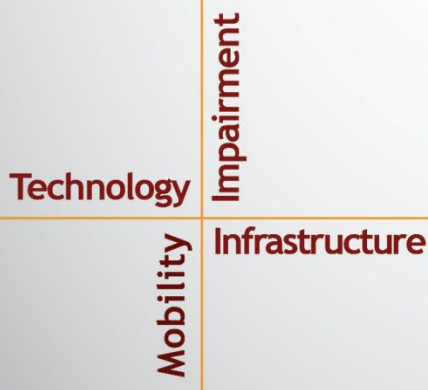
National Surface Transportation
Safety Center for Excellence

Fleet-based Driver Monitoring Systems

Accelerating Commercial Motor Vehicle and
Occupational Driver Acceptance of Driver-
facing Cameras

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EXECUTIVE SUMMARY

Across all U.S. states and territories included in 2019 Bureau of Labor Statistics data (BLS; 2020), the total number of fatal occupational injuries for workers active in a vehicular or transportation operation at the time of injury was 2,122. Nationally, the driver/sales worker and truck driver fatal occupational injury rate per 100,000 full-time equivalent workers was 26.8 (7.7 times greater than the rate of fatal occupational injuries for all workers; BLS 2021). For all occupational types, transportation incidents were the leading cause of occupational fatalities in 2019, with transportation incidents accounting for over twice the fatalities than the next leading causes of occupational fatalities. Transportation incidents accounted for 39.8% of 2019 fatal occupation injuries (Figure 1).

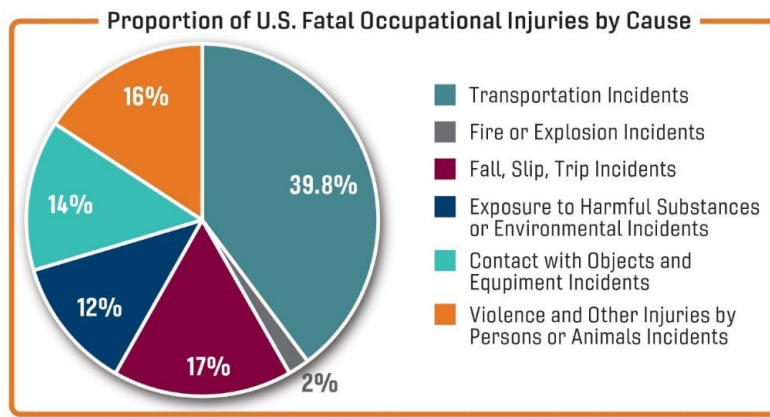


Figure 1. Chart. Proportion of national fatal occupational injuries attributable to various event or exposure types.

These data show the importance of finding solutions to reduce worked-related vehicle crashes, not just for commercial motor vehicle (CMV) operators, but for all workers who operate a vehicle as part of their job. Vehicle technologies offer promising results to prevent collisions and their resulting injuries and fatalities. One type of technology that shows promise and is gaining popularity is a driver monitoring system (DMS). DMSs include various sensors and cameras placed inside and outside the vehicle that record the environment surrounding the vehicle and, if the DMS is equipped with a driver-facing camera, what the driver is doing behind the wheel. This driver-facing camera may be critical, as crash causation research has found driver behaviors to be the critical reason for the majority of collisions across all vehicle classifications (National Highway Traffic Safety Administration, 2015) and for CMVs (Federal Motor Carrier Safety Administration, 2006).

Previous research has found that DMSs are effective in reducing heavy-vehicle CMV operator risky driving behaviors (e.g., speeding, hard braking, swerving, rapid acceleration, inattention, etc.) and involvement in safety-critical events such as a crash, a near-crash in which the driver makes an invasive maneuver to avoid the crash, or crash-relevant conflict (Boyle et al., 2016; Hickman & Hanowski, 2010), CMV crashes (Camden et al., 2019), and occupational medium-duty and light-duty vehicle driver risky driving behaviors and safety-critical events (Bell et al., 2016). Further investigations revealed that the effectiveness of DMSs was dependent on how the

fleets used the data collected from the DMS for driver coaching and follow-up (Bell et al., 2016; Boyle et al., 2016; Hickman & Hanowski, 2010).

These studies focused on the traditional DMS, which often relies on accelerometers to flag potential safety-critical events. Each potential safety-critical event is then reviewed by a human to determine if the event was valid and in order to code behavioral and environmental factors that were present at the time. With advancement in machine vision and artificial intelligence (MV/AI), many newer DMSs have incorporated MV/AI to detect environmental and behavioral factors in real-time using the driver-facing and road-facing cameras. Detecting these factors in real-time may allow drivers to receive in-cab alerts associated with inattention and other driver errors found to be significant contributors to crashes.

OBJECTIVE

The effectiveness of DMSs in capturing objective data related to driver behavior relies on the use of a driver-facing camera, including new DMSs with MV/AI to detect driver inattention. However, previous research also found that drivers are resistant to their use. The purpose of this project was to discuss driver-facing cameras with CMV and occupational light-vehicle drivers to identify their concerns and recommendations (if any) that fleet management could use to reduce resistance.

RESULTS

Researchers conducted four focus groups with up to nine drivers per focus group. A total of 24 drivers participated across the four focus groups. The focus groups concentrated on three key concerns related to driver-facing cameras: driver privacy, micromanagement, and a lack of perceived safety improvements associated with driver-facing cameras. Although drivers often expressed resistance to driver-facing cameras, they did provide 12 recommendations that they believed would significantly reduce their resistance:

- Involve drivers early in the process of DMS implementation.
- Establish a driver advisory group.
- Use DMS data for performance recognition.
- Use DMS data for safety competitions.
- Be honest about the capabilities and functionality of driver-facing cameras.
- Follow the data use policy.
- Use a third party to review DMS data.
- Ensure drivers understand what behaviors flag an event.
- Ensure drivers know when an event was detected.
- Give drivers leeway to correct behavior before management is notified.
- Use data to show how DMSs improve safety.
- Limit audio recording.

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LIST OF ABBREVIATIONS AND SYMBOLS

BLS	Bureau of Labor Statistics
CMV	commercial motor vehicle
DMS	driver monitoring systems
FMCSA	Federal Motor Carrier Safety Administration
MV/AI	machine vision and artificial intelligence
NHTSA	National Highway Traffic Safety Administration

INTRODUCTION

The Federal Motor Carrier Safety Administration reports that, in 2019, there were 5,237 commercial motor vehicles (CMVs) involved in fatal crashes (FMCSA, 2021). Although CMVs are often believed to cause most crashes, previous research found that drivers of passenger cars are predominantly at fault in 71% to 91% of fatal crashes involving a CMVs (Klco, 2019). In addition, Hanowski et al. (2007) investigated light-vehicle/heavy-vehicle interaction and found that 78% of all safety-critical events (i.e. a crash, near-crash in which the driver makes an invasive maneuver to avoid the crash, or crash-relevant conflict) were initiated by light vehicles. Even though these data suggest that CMV drivers may not be responsible for light-vehicle/heavy-vehicle crashes, CMV drivers still may have contributed to the crash in some way. Furthermore, CMV carriers are often sued when a crash occurs, regardless of fault.

One type of technology that addresses preventable crashes and protects the carrier against false claims is a commercial driver monitoring system (DMS), also known as an in-vehicle monitoring system or onboard monitoring system. These systems record driver behavior, vehicle data (e.g., speed, acceleration, braking, and safety belt use), and following distance and lane departures (if the DMS is equipped with artificial intelligence software). These types of systems may have one or two cameras. One camera records the forward road and shows what the driver can see through the front windshield. The second camera (if equipped) faces the driver and records how they behave behind the wheel and respond to driving circumstances. The combination of visual and kinematic data provides a wealth of information to pinpoint problems, including safe and unsafe behaviors (Camden et al., 2017). Most carriers describe dashcams as an investment to keep the company and drivers safe from liability in the event of a collision. The benefits associated with driver-facing cameras include exonerations from potential lawsuits after collisions, as well as driver training that can reduce crashes, distractions, and other dangerous situations.

Despite growing support of video-based DMSs in work-related vehicles, many drivers are reluctant to drive a vehicle equipped with a video-based DMS. This reluctance is primarily related to driver-facing cameras. Although fleets can purchase a video-based DMS that only contains a road-facing camera, many of the safety benefits related to improved driver behavior are only attainable with a driver-facing camera. Some of this pushback from drivers may be avoided by using the Virginia Tech Transportation Institute's implementation guide for DMS programs (Camden et al., 2015). However, the implementation manual only focuses on the managers' perspective. Additional data, resources, and outreach are needed to address drivers' concerns regarding video-based DMSs.

OBJECTIVE

The goal of this study was to collect data directly from CMV and other occupational drivers regarding their opinions and perspectives of driver-facing cameras and DMSs. Specifically, the objective of this project was to document the major concerns drivers have regarding driver-facing cameras and identify solutions or management practices (if any) that a company could use to overcome driver resistance.

BACKGROUND

The reported benefits to using DMSs that appear in the literature have shown that video-based DMSs and coaching reduce motor vehicle crash rates. For example, Hickman and Hanowski (2010) found that the combination of a DMS along with behavioral coaching was responsible for a significant reduction in safety-related events in two CMV carriers. The study also highlighted that the drivers with severe safety-related events garnered the most benefits by combining the DMS and driver feedback. In a follow-up to this original study, Boyle et al. (2016) assessed the effectiveness of DMSs in a field operational test with over 300 CMV drivers. They found that DMSs were effective at reducing involvement in safety-critical events; however, the results were dependent on how the carrier used the data to coach drivers. They found that using DMS data to coach drivers consistently within a week of the coachable event was most effective at reducing involvement in safety-critical events. Bell et al. (2016) found comparable results in two medium- and light-duty vehicle fleets, specifically in relation to the positive benefits associated with using the data from DMSs to provide feedback to drivers on their driving performance. Further, Litschi et al. (2014) found that DMS were effective in improving safety within a transit fleet. More recently, Camden et al. (2019) analyzed the strategies used by nine CMV carriers to significantly reduce crashes. Eight of the nine carriers used a video-based DMS paired with positive driver coaching (and other safety culture improvements) to reduce crashes between 31.7% and 66.3%.

Socolich and Hickman's (2014) study showed the potential safety benefits of video-based DMSs on all large trucks in the U.S. by comparing the safety benefits found in Hickman and Hanowski (2010) to NHTSA's large-truck crash database, the General Estimates System. Findings suggest that DMSs paired with driver coaching could prevent an average of 727 fatal truck and bus crashes (20.5% of the total fatal crashes) and save 801 lives (20.0% of the total fatalities). In addition, this pairing could reduce an estimated 25,000 truck and bus injury crashes (35.2% of the total injury crashes) and eliminate approximately 39,000 injuries (35.5% of the total injuries) each year. Similarly, Camden et al. (2017) found that video-based DMSs in CMVs could prevent 112 to 293 fatalities, 4,740 to 12,371 injuries, and 19,389 to 50,604 property-damage-only crashes each year.

The literature highlights other benefits, such as research showing a 60% reduction in speeding when a video-based DMS is used (Twilhaar et al., 2000). This statistic is important because, for every 1 mile per hour decrease in speed, there is a corresponding 5% reduction in crash frequency (Taylor et al., 2000). In addition, another study of 250 emergency vehicle drivers was conducted to determine whether DMSs could improve driver behavior. The study found that, when DMSs were used, safety belt violations dropped from 13,500 to 4 per month, and the number of speed violations decreased from 550,353 to 2,709 per month (Levick & Swanson, 2005).

Overall, the published research indicates that a video-based DMS reduces risky driving behaviors that often lead to a collision and therefore reduces their associated injuries. Knipling (2009) noted several other benefits of video-based technologies in fleet vehicles, such as having drivers receive positive feedback and rewards for good driving behavior and the ability to provide drivers with feedback and evaluations that are objective, timely, and frequent. In addition to safety considerations, carriers and drivers could use the technology to improve

productivity and efficiency, aid with compliance and regulations, and identify situations where liability might be a concern (Horrey et al., 2011).

RESISTANCE TO DRIVER-FACING CAMERAS

Even with well-documented benefits from DMSs, drivers still have resistance to the installation of in-cab video technologies (Staples et al., under Agency review). Drivers report that DMSs are an invasion of their privacy and foster the feeling that the company does not trust its drivers (Camden et al., under Agency review; Staples et al., under Agency review). There is also a misconception held amongst drivers that the cameras record them all the time. However, in reality, the video is only saved and uploaded to the provider or carrier when triggered by a crash or an event like hard braking, lane departure, or following too closely (Beach, 2021). Further, drivers express concerns that the video footage is available to carriers and other unknown individuals without drivers having any say. In addition, the trucking industry has struggled with driver shortages in the past decade. The current trucking industry forecast predicts that there may be a shortage of 100,000 drivers in the next 5 years and of 160,000 drivers in 2028 (Costello & Karickhoff, 2019). As a result, carriers often worry that it may be even more challenging to find drivers if they introduce in-cab video technology.

Another common complaint against driver-facing cameras is that they allow carriers to micromanage drivers' decisions. Work relationships are based on trust, and many experienced drivers do not want to be micromanaged. For example, Amazon delivery drivers reported that they were slowed down by the cameras, which would ding them for infractions like speeding or distracted driving. Often these drivers would speed, not wear a seatbelt, or roll through stop signs to finish their route quickly. However, as per Amazon's pilot study data, crashes decreased by 48%, stop-sign violations decreased by 20%, incidents of drivers not wearing seatbelts decreased by 60%, and distracted driving decreased by 45% with the implementation of DMSs in company vehicles (Hartmans & Taylor, 2021).

Another argument from fleet owners and drivers is that driver-facing video instruction may only temporarily make drivers more careful or reduce their speeding. Similar arguments are found in Toledo et al.'s (2008) study, which recognized that drivers reduced their risky behaviors only in the first month after the initial DMS installation. After the first month, researchers observed that the risky driving behavior remained stable. Additionally, drivers suggest that coaching could be done by reviewing only forward-facing video clips with a driver without the invasiveness or perceived invasion of privacy of the camera pointed directly at them. However, coaching would not be based on complete information from the scenario without the video captured by the driver-facing camera. The forward-facing cameras would not capture the driver's behavior and reactions to a scenario. These data are critical to understanding the driver-related contributing factors to safety-critical events and could be used for coaching drivers on risks and correct actions to perform in specific conditions. Without video documenting driver behavior, fleet managers or law enforcement would need to infer or make subjective assumptions what the driver was doing behind the wheel at the time of the safety-critical event.

An industry poll reported that 90% of drivers said they would not accept a new job with a carrier with a driver-facing camera. Furthermore, if DMSs were to be installed by their current employer, drivers reported the possibility of quitting (Nalepka, 2016). These opinions were

echoed in Camden et al. (under Agency review). However, not many drivers actually end up quitting. For example, after initial resistance to driver-facing cameras, out of 150 drivers at the Sharp Transport carrier, only three quit the company after in-cab cameras were installed (Stinson, 2021). On the other hand, while evaluating drivers' opinions and perceptions of a DMS that provided driver feedback, Huang et al. (2005) noted that drivers are more willing to accept the feedback if they perceive more significant benefits and receive few reports on their driving. They also emphasized that if drivers do not see any benefits in the system, they are likely to tamper with the system or quit. Thus, carriers do need to clearly lay out the safety benefits to their drivers.

STRATEGIES TO OVERCOME RESISTANCE

Few studies and web-based articles discuss driver acceptance of driver-facing cameras after initial resistance since their use is often dependent on a carrier's relationship with their drivers and the culture within the company. Many suppliers and advocates of in-cab video point out that carriers should focus on recognizing good driving behaviors instead of using the cameras to only catch drivers behaving incorrectly and/or unsafely (Camden et al., 2015). Additionally, advocates suggest that use of driver-facing cameras focus on improving fleet performance and stress the potential for exoneration while educating the drivers about the monitoring systems.

A clear policy of communication between the carrier and its drivers will help retain their trust and support. One way to retain this trust and support is by developing a dashcam policy that can provide structure to the drivers and make them more comfortable (Roney, 2021). Netradyne (n.d.), an in-cab video technology provider, offers some best practices to get drivers on board. Following are some of the key points:

- Explain why the company is installing cameras and be transparent with the goals and guidelines of the company.
- Explain how the technology works, who has access to the footage, and how long videos are stored.
- Create a collaborative environment through driver feedback, survey, or one-on-one conversations.
- Highlight the benefits for the drivers (e.g., lower insurance premiums or exoneration in case of a non-fault accident).
- Use the data to recognize good driving behavior.
- Show the drivers their videos to bring a change in their driving behavior. Similar to how professional athletes use video to improve their performance, professional drivers can use video to improve their driving performance.
- Roll out the program slowly. Do a trial period or start with forward-facing cameras and then introduce drivers to inward facing cameras.
- Incentivize the program to increase/encourage participation.

An additional approach while creating a policy is to have drivers review that policy and sign a formal DMS policy agreement to acknowledge that they have reviewed, understand, and will comply with it. The company should also consider providing its drivers with the necessary training and materials and giving them a platform to share concerns and feedback regarding the cameras through a preliminary survey (Roney, 2021). These are all ways that carriers planning to

install in-cab cameras can help create positive attitudes towards the technology by mitigating the privacy concerns and highlighting the values of the DMS in reducing crashes and violations, which will benefit the drivers and their families as well (Peng et al., 2012).

Companies that successfully implemented driver-facing cameras have reported significant safety improvements and reductions in distracted driving. One trucking company, Bison Transport, reported the following safety improvements after implementing a Seeing Machines system (Seattle Truck Law, PLLC, 2020):

- 67% reduction in fatigued driving
- 40% reduction in distracted driving
- 97% reduction in cell phone use

Through transparency and open communication channels with the drivers, Nussbaum trucking company implemented in-cab video technology. They created a driver performance program that scored drivers on smooth driving, speed management, space management, and following-distance observations using SmartDrive (SmartDrive, n.d.). As per reports, Nussbaum has improved its Compliance Safety Accountability Crash Indicator Behavioral Analysis and Safety Improvement Category Score by 73% in the “crash indicator” category. In addition, the company was able to improve its SmartDrive Safety score by 40% and reported zero preventable DOT-recordable accidents and major loss-of-control accidents within the first 6 months of implementation (Crissey J. , 2017).

BACKGROUND SUMMARY

There is evidence that using a DMS reduces crashes and promotes safe driving behavior practices. However, the literature shows that though drivers have been supportive towards the implementation of road-facing cameras, they remain reluctant to accept driver-facing cameras, citing privacy concerns and feelings that they will be micromanaged. In addition, existing data show there are misconceptions about who has access to the video data and the specific safety benefits associated with cameras. Thus, there is a need to better understand driver perceptions and concerns regarding driver-facing cameras. Moreover, there is a need to gain recommendations from drivers on how to overcome initial challenges and resistance to DMSs and driver-facing cameras.

METHODS

For this study, researchers conducted four 2-hour long focus groups with up to nine drivers per focus group to gain insight on the barriers to acceptance of driver-facing cameras via a discussion of driver thoughts and concerns. The four different focus groups were comprised of CMV drivers who had experience with driver-facing cameras, CMV drivers who did not have experience with driver-facing cameras, occupational drivers who operated other types of vehicles as part of their job (i.e., referred to “occupational drivers” hereafter) and who had experience with driver-facing cameras, and occupational drivers who did not have experience with driver-facing cameras.

PARTICIPANT RECRUITMENT

Researchers recruited participants for the focus groups via two different methods. A recruitment advertisement was placed in the Virginia Tech Daily News for interested drivers to contact a researcher and learn more about the project. In addition, researchers used an existing database of individuals interested in participating in studies. A researcher called individuals from the database and gave them a brief overview of the study. If individuals were interested in participating, researchers screened them for eligibility. Individuals were eligible if they were either professional CMV drivers or light vehicle occupational drivers who were 18 years or older. If individuals were eligible, they were invited to participate in the appropriate focus group depending on their work and experience. Participants participated virtually via a recorded Zoom session.

DATA COLLECTION

Due to Covid-19, all participants participated via Zoom. During the focus group sessions, a researcher gave participants background information on the history of safety technology for drivers and how driver-facing cameras can aid in road safety. The researcher then opened the discussion to drivers and asked for their thoughts on driver-facing cameras as related to three main areas: driver privacy, micromanaging decisions, and the actual improvement in safety. Participants discussed their concerns about driver-facing cameras as they related to these areas as well as possible solutions that could help alleviate potential driver concerns. After discussing the three main topics, the researcher opened the discussion to any other concerns not yet examined regarding driver-facing cameras.

DATA ANALYSIS

Researchers performed a content analysis of the focus group transcripts. Researchers reviewed each focus group and gleaned the subthemes that drivers reported as concerns of driver-facing cameras within each of the topics presented during the interview. Researchers also recorded the number of CDL drivers and light vehicle occupational drivers who voiced and/or supported these concerns. In addition, researchers noted all the solutions that drivers offered for their concerns and the number of drivers in support for each proposed solution.

RESULTS

A total of 24 drivers participated in the focus groups. The CMV drivers were further divided into two groups—one group had experience with driver-facing cameras and the other group did not have experience with the driver-facing cameras. Similarly, the occupational drivers were divided into groups of experience with driver-facing cameras and no experience with these cameras. Table 1 shows the breakdown of drivers per grouping.

Table 1. Breakdown of drivers that participated in the focus groups.

Camera Experience	CMV Drivers	Occupational Drivers
With Driver-Facing Cameras	7	6
Without Driver-Facing Cameras	6	5

Focus group participants in each group were asked the same overarching questions on three main topics of interest as identified in the literature review: (1) privacy concerns, (2) micromanagement by the company, and (3) whether cameras improve safety. A large portion of the focus groups was also devoted to identifying strategies that a carrier could implement to reduce driver resistance due to these concerns. Finally, participants were provided the opportunity to provide additional comments on other topics not covered previously. Results from these discussions are presented below.

PRIVACY CONCERNS

Three subthemes emerged during the discussion of privacy concerns that drivers expressed about the driver-facing camera—audio recording, “big brother watching,” and management trust.

Table 2 shows the subthemes and the number of CMV and occupational drivers who voiced concerns about each of the subthemes that emerged during the discussion of privacy concerns with driver-facing cameras.

Table 2. Number of drivers with privacy concerns per subtheme.

Subtheme	Count of CMV Drivers Voicing Concern	Count of Occupational Drivers Voicing Concern
Audio Recording	2	4
Big Brother Watching	5	6
Trust Issues	5	2

Audio Recording

One of the first concerns about privacy centered around the capabilities of some DMSs to record audio in the cab. Both CMV and occupational drivers voiced concerns about audio recording. The majority of these comments focused on the concern that audio recordings may capture the discussion of personal information or private information. For example, drivers mentioned that

audio recordings may capture phone conversations with a spouse discussing finances or a conversation with a doctor or pharmacist discussing medical issues.

The two CMV drivers with concerns about audio recordings did not have camera experience but indicated that audio should not be allowed. In contrast, the drivers with camera experience did not express any pressing concerns. However, one driver did mention that the company had informed them that the camera was recording only video, but a co-worker was fired after bad-mouthing the manager while driving the truck. This driver expressed that they felt that audio recording was an invasion of privacy and indicated their belief that the DMS captured the conversation which led to the co-worker's firing. Two drivers from the no camera experience group also expressed the desire for audio recording to be disabled.

Drivers offered some ideas to overcome privacy concerns related to audio recordings (Table 3). Drivers indicated that their concerns would be alleviated if the carriers disabled audio recordings. Drivers also indicated that the DMS could be equipped with an incident button that a driver could press to record an audio explanation in case of an incident.

Table 3. Recommendations to overcome resistance to audio recordings.

Recommendations	CMV Drivers in Support	Occupational Drivers in Support
Audio recording should be off	2	2
Have an incident button to record audio in case of crash	-	2

Illustrative quotations from the focus group

“Our camera records video and audio, everyone is very careful what they are speaking since camera has been placed.”

“In regard to [a driver] being able to voice recording if there is an incident: Being able to give [the incident] some context...is definitely beneficial.”

“I think there are a lot of private things said in cab—someone monitoring could fire you if offended. I don’t think it adds to safety to know what they are saying.”

“Big Brother” Watching

The most common privacy concern voiced by drivers was related to their company always watching what they did behind the wheel. Most of the CMV and occupational drivers felt like they were being watched all the time with a driver-facing camera in the cab. Four of the CMV drivers with camera experience indicated that they were very concerned that they are unaware when the camera started and stopped recording and who had the access to the video feed. One CMV driver had a strong opinion about the driver-facing camera being turned off during break hours. This driver emphasized the breaks as “my time” throughout the discussion.

Drivers offered several different ideas that would alleviate their concerns to a degree (Table 4). Many of the CMV participants within the camera experience group agreed on the need for the camera to be turned off during break hours. In the discussion with the no camera experience group, five CMV drivers expressed that they would like to know when the camera is recording and the parameters on the triggers which lead to recording. Nearly all of the participants indicated that they did not know the specifics of what triggered the video to begin recording. They also mentioned a desire for the cameras to be integrated with their electronic logs.

Two occupational drivers with driver-facing camera experience reported that they knew that the only time the video gets reviewed is when there is an incident. There was one driver who expressed a desire for an indicator on the camera which would let the driver know when the camera is recording. Overall, occupational drivers from both groups expressed that any company implementing the use of driver-facing cameras needs to have guidelines and communicate those clearly with regard to when the camera records, who has access to the recorded videos, and whether the data would be deleted within a certain period if no incident occurred.

Table 4. Recommendations to overcome driver resistance due to concerns about ‘big brother’ watching.

Recommendations	CMV Drivers in Support	Occupational Drivers in Support
Video recording should be off when parked	-	2
Integrate a red/green light so the driver is aware when the camera is recording	8	1
Integrate the camera system with electronic logs	4	-
Camera should only record when there is an incident	3	-
Clear guidelines on who has access/limited people should have access	1	3
The data should be deleted if there is no incident	-	3

Illustrative quotations from the focus group

“There are safety guys who go through these videos. They tell you that we monitor you in case there is an event. I have seen safety guys bring up footage of drivers doing something wrong to everyone. The driver was never told that his video would be shown to everyone. You can’t do that to people.”

“We were told camera would start recording when there is a trigger, I walked into my boss’s office and found that camera was recording on a 30-day loop.”

“Not so much [against video recordings identifying drivers] doing things that are irresponsible, but for private moments you have while you're driving down the

road...something you might not necessarily want somebody to be laughing at in their office later on in the day.”

“I think it would be nice to know when they are recording. There is no kind of indicator in [our] new camera system.”

Driver Trust

Another common concern, especially from CMV drivers, was related to mistrust of how their company would use the data collected from the driver-facing camera. Most of the CMV drivers with camera experience expressed that they did not trust their company and that supervisors “would lie repeatedly.” Two drivers reported that they believed that their company looked at all video from up to 30 days prior even though they were informed that the camera only records when a triggering event occurs. The other privacy concern mentioned by the CMV drivers who had camera experience was the amount of access that litigation and insurance companies have to the video footage. Two CMV drivers who did not have camera experience expressed their concern about how supervisors or management may be able to watch the video feed any time (even live stream) and report a disciplinary action on the driver just because they do not like the driver.

There was a general consensus from all participants that driver trust regarding driver-facing cameras could be repaired with transparency and clear communication guidelines from the management or leadership regarding the use of cameras (Table 5). Specifically, carriers need clear communication and transparency in terms of what is being recorded and when the video is being saved. Additionally, three CMV drivers suggested having an advisory board with driver representation to assist with infractions revealed through driver-facing camera footage. The advisory board would review disciplinary actions resulting from incidents that occurred on camera and driver representation may be able to help explain certain driving situations to management, which would help drivers feel more at ease with the recordings.

Table 5. Recommendations to overcome driver resistance due to trust issues.

Recommendations	CMV Drivers in Support	Occupational Drivers in Support
Clear company guidelines communicated to drivers about the decision to use the camera and collected videos.	-	2
Transparency from the company—lay out parameters about what triggers the camera and what happens when a triggering event occurs.	8	-
Implement an advisory board that reviews disciplinary situations with drivers on the board. This way drivers know they have representation.	3	-

Illustrative quotations from the focus group

“Company should consider being forthcoming and tell us what really they record, how they deal with it. If you told me the truth, then we can still work with it. But when you are working for any large company, the trust level goes down.”

“There is an integrity gap between what they are saying and what we are hearing”

“I’ll reiterate the communication and the education from the top-down being important, but also consistency from leadership...one thing that has really helped our situation over the years has been [that] when they do pull footage for incidents or these issues that they have set forth that they were going to pull footage for, they stuck with those. They haven’t pulled it for punitive issues. And then when they do find something that somebody has done well. They’ve used the footage not only for negative, but they’ve used the footage for positive to say ‘hey while we were reviewing for this negative incident, we also saw this and we really appreciate that.’ Knowing that they’re valuing that has really helped out as well.”

MICROMANAGEMENT

When asking drivers about whether having a camera would make them feel micromanaged or if they had any concerns with micromanaging by their company’s management, one major subtheme was consistent across all the focus group discussions: participants believed that driver-facing cameras allowed their management to overly criticize drivers and focus on assigning fault, or on nitpicking (Table 6).

Table 6. Number of drivers with concerns that driver-facing cameras lead to micromanagement.

Subtheme	CMV Drivers Voicing Concern	Occupational Drivers Voicing Concerns
Fault finding/Nitpicking	7	6

Fault-finding and Nitpicking

Five CMV drivers with camera experience voiced concerns that their safety managers would use the camera to find issues with drivers and criticize what drivers believed to be non-safety-critical behavior. The participant indicated that their safety managers would find problems with the normal things that drivers would do behind the wheel, like “eating a granola bar” or “having lunch.” Other CMV drivers indicated that management and dispatch have used data collected by DMSs to nitpick driver choices, which ultimately led to drivers’ termination. Furthermore, two CMV drivers expressed concern that the cameras could be used by safety managers to find faults. Similarly, three occupational drivers with camera experience indicated that they felt driver-facing cameras made them feel micromanaged and that their companies used video footage to terminate employees.

Several drivers did offer some ideas to overcome these concerns (Table 7). Two of the CMV drivers responded that the driver-facing cameras needs to be used correctly, and that coaching and training should only be provided when there is an actual issue (instead of to simply nitpick non-safety-related behaviors). One CMV driver suggested that DMSs should be configured to provide immediate feedback and give warnings to drivers. Warnings would give drivers a chance to correct their behavior on their own before management is notified. Other drivers indicated that this strategy would alleviate many of their concerns about feeling micromanaged. A third suggestion offered by a CMV driver focused on the importance of positive reinforcement from safety managers; safety managers should use the driver-facing cameras to identify examples of safe driving instead of only using it to “catch” drivers doing things wrong. Three occupational drivers expressed that they would prefer a third-party review of the video footage to avoid constant nitpicking by the safety managers. Finally, one driver suggested that carriers should always share video with drivers when being coached or when disciplinary action is taken.

Table 7. Recommendations to overcome driver resistance related to feelings of being micromanaged.

Recommendations	CMV Drivers in Support	Occupational Drivers in Support
Provide coaching to drivers when there is an actual problem.	2	-
Provision of immediate warning/feedback and give a chance for drivers to correct their behavior.	1	3
Positive enforcement from dispatchers to recognize good driving behavior.	1	-
To avoid office politics or favoritism, a third party should review incidents. Supervisors should only be notified if the driver keeps repeating the same mistakes.	-	3
Give access to drivers to watch videos in question.	1	-

Illustrative quotations from the focus groups

“Managers or safety guys...they get this authority that they can watch your every move. They think that they need to babysit and forget that you are an adult who has been trained to operate the vehicle. You don’t have to micromanage every aspect of me being behind the wheel.”

“People could watch video just to look for faults...maybe with a supervisor who uses it for retaliation.”

“Let the drivers do their job. Drivers that are going to have problems, it is going to be the same drivers having same problems over and over. Those become coachable moments. Wait for a problem to occur with the driver before you give a solution.”

“When I worked for another company, they would get you for every little thing. I have extremely negative experience with [driver-facing cameras].”

“If you get told you have been doing a good job it is easier to accept when you get critiqued as well.”

DO DRIVER-FACING CAMERAS IMPROVE SAFETY?

The last topic of discussion in each focus group session explored the driver’s opinion and perspective on whether the driver-facing cameras actually play any role in safety improvement. Three subthemes—(1) inaccuracy of technology, (2) they can improve safety (if used correctly), and (3) driver-facing cameras are to punish drivers, not improve safety—emerged in four focus group discussions. Two subthemes—benefit of a road-facing camera vs. driver-facing camera and the lack of situational context with only the driving facing camera—emerged in only two of the focus group discussions (Table 8).

Table 8. Number of drivers with concerns that driver-facing cameras do not improve safety.

Subtheme	CMV Drivers Voicing Concerns	Occupational Drivers Voicing Concerns
Inaccuracy of technology	5	1
Can improve safety (if used correctly)	3	4
Focus appears to be for punishment compared to an improvement of safety	5	1
Road vs. driver-facing camera	3	2
Driver-facing camera may not consider situational context	-	5

Inaccuracy of Technology

Four CMV drivers with camera experience suggested that DMSs with road-facing cameras have inaccuracies in detecting safety-critical events, and that these inaccuracies may bleed over to the driver-facing cameras and hence not help improve safety. Drivers cited incidences where the road-facing camera would detect an unsafe event when nothing had actually occurred, but the camera detected a shadow to be another vehicle. These drivers indicated that these “false alerts” reduced their trust in the system and would not lead to drivers performing safety-related behaviors more frequently. Similarly, one CMV driver and one occupational driver who had no previous camera experience expressed the concern that technology is not flawless, which may put a driver’s career and safety at risk. Overall, occupational drivers provided very few comments about the inaccuracy of driver-facing cameras. No participants offered suggestions on how to overcome this barrier that may limit acceptance.

Illustrative quotations from the focus groups

“Some systems are really ‘touchy’ or sensitive or not accurate and marking events that aren’t as serious as [the] system thinks.”

“You are risking [the] driver’s career [with] what at this point is an unreliable technology as far as the incident triggers are concerned.”

They Can Improve Safety (If Used Correctly)

None of the CMV drivers who had camera experience felt that having the driver-facing cameras in the cab resulted in a safety improvement. However, three CMV drivers without camera experience indicated that cameras could help improve safety by encouraging drivers to perform safe driving practices more frequently (e.g., wearing seatbelts). There were four occupational drivers with camera experience who reported that their camera did help them perform more safe driving behaviors like wearing a seatbelt, keeping their hands off cellphones, and other general safe driving practices. There were no recommendations on how to address this concern with drivers hesitant towards driver-facing cameras.

Illustrative quotations from the focus group

“As far as safety is concerned, with cameras being there, most drivers started wearing seatbelts and the camera keeps you more focused.”

“I will say, and I hate to say it, but the cameras have changed my driving habits....”

“Knowing that they are watching helps us to be on [our] best behavior.”

Driver-facing Cameras Are to Punish Drivers, Not Improve Safety

Two CMV drivers with camera experience and three CMV drivers without camera experience believed that driver-facing cameras did not include any features to reward safe driving behavior. Instead, these drivers believed driver-facing cameras could only be used to punish drivers. There were very few comments from occupational drivers on this subtheme. Two occupational drivers and four CMV drivers suggested fleets should develop incentives based on the driver-facing camera rather than only using it to find flaws in drivers (Table 9).

Table 9. Recommendations to overcome driver resistance related to perceptions that driver-facing cameras are only used to punish drivers.

Recommendations	CMV Drivers in Support	Occupational Drivers in Support
Reward safe driving behavior.	4	2

Illustrative quotations from the focus group

“Maybe they could have a safest driver incentive...that way it is more positive reinforcement rather than just the stick coming after everybody.”

“One thing nobody has mentioned is that there is nothing in these cameras that is there to reward safer drivers. So let’s say...[company name] has 62 triggers or 30

triggers, whatever they have now...well if you have none of these triggering events throughout the month, you get a safety bonus.”

“Everyone wants a good old pat on the back.”

Benefit of a Road-facing Camera vs. a Driver-facing Camera

Both CMV and occupational drivers with camera experience believed that road-facing cameras would be more helpful in improving safety compared to driver-facing cameras. Three CMV drivers expressed that road-facing cameras with various viewing angles are more helpful for the company when a crash occurs than are driver-facing cameras. Similar opinions were raised by the group of occupational drivers with camera experience. However, one CMV driver with camera experience voiced his belief that driver-facing cameras do ultimately lead to safer driving and that younger drivers may have less reluctance to their integration than older drivers.

Overall, drivers also had a few concerns for company use of driver-facing cameras. One driver noted that there is currently a commercial driver’s license driver shortage and companies that do add driver-facing cameras may experience difficulties retaining qualified drivers. These drivers may leave and seek employment elsewhere to avoid the driver-facing cameras altogether. Another driver also mentioned that sometimes drivers engage in activities that are perhaps against company policy (e.g., taking a phone call while driving) but may be needed to do the job effectively. Using driver-facing cameras and reprimanding drivers for engaging in this behavior, while still driving safely, may cause stress and confusion on competing demands of their allotted hours. There were no suggested recommendations to overcome these concerns.

Illustrative quotations from the focus group

“[Driver] cameras won’t make much difference. Cameras on the outside with different views and different things with what is around you, if an accident happens then the police or the company could go back and see.”

“It seems like [road]-facing cameras are our allies. They are going to capture footage that will help us whereas the [driver]-facing cameras seem more likely to catch us doing something bad and end up not being our friend.”

“I believe it is probably a lot safer to have these [driver-facing] systems.”

Driver-facing Camera May Not Consider Situational Context

All of the occupational drivers without camera experience voiced the opinion that having driver-facing cameras may get drivers in trouble with management for engaging in behaviors that, though deemed overall unsafe, were the safest option for that particular situation. Drivers were concerned that these cameras would not fully understand the context surrounding the behavior and that drivers would be punished for making what they believed to be good decisions.

Drivers offered several recommendations to overcome concern about carriers and cameras not understanding the context surrounding a behavior (Table 10).

Table 10. Recommendations to overcome driver resistance related to perceptions that the safest behavior is considered not safe by a camera.

Recommendations	CMV Drivers in Support	Occupational Drivers in Support
Give drivers adjustable thresholds of rules.	-	4
Use road-facing cameras to help understand relationship to context and driver behavior.	-	3

Illustrative quotations from the focus group

“There’s not gonna be one right answer all the time. What’s safe at sometimes is going to be up to the discretion of the driver.”

“It almost becomes a reverse-safety issue where I am doing what I am supposed to do based on the laws of the road and speed limit, but I am actually creating ...more of a hazard on the interstate by driving slow instead of driving with the flow of traffic.”

DISCUSSION

Previous research has demonstrated the safety benefits of DMS use in fleets, in particular, the efficacy of DMSs with a driver-facing camera (Bell et al., 2016; Boyle et al., 2016; Hickman & Hanowski, 2010; Litschi et al., 2014). However, adoption of driver-facing cameras lags behind the adoption of DMSs with road-facing cameras and other safety technologies designed to prevent crashes or reduce risk driving (Staples et al., under Agency review). Much of this may be attributed to real or perceived resistance and objections of drivers (Staples et al., under Agency review). Hesitancy or refusal to adopt DMSs with driver-facing cameras may leave fleets with crashes (and their associated injuries and fatalities) that could have been prevented. Further, the adoption of these systems may provide fleets with critical evidence in the event of a collision and/or litigation. Additionally, many DMS products now include the added feature of in-cab, real-time alerts for risks, which were previously not available. For example, many DMSs now offer machine vision with artificial intelligence that can detect and alert drivers to tailgating, inattention, lack of seat belt use, the threat of an impending collision, lane drifts, and drowsiness. These new features are all based on the use of a driver-facing camera. Although the efficacy of these new features has not been evaluated through independent testing, they offer an unprecedented solution to address and correct many risky driving behaviors that research has shown to be primary contributors to crashes and near-crashes (NHTSA, 2015).

Driver resistance to driver-facing cameras has been documented as a barrier to the adoption of DMSs (Camden et al., under Agency review); however, research to identify strategies to overcome this resistance is lacking. Thus, the purpose of this project was to talk with CMV drivers and other types of occupational drivers to identify their main concerns with driver-facing cameras and identify strategies (if possible) that a fleet may use to address and overcome concerns and resistance. Specifically, this project conducted four focus groups with fleet drivers with and without experience operating a vehicle equipped with a driver-facing camera.

Drivers' comments in the focus group aligned with the primary concerns identified in industry publications. Most of the comments were related to concerns about reduced privacy, feelings of being micromanaged, and a belief that driver-facing cameras are an overreach not supported by the claim of an improvement in safety. Regarding privacy, drivers discussed concerns over audio recording, management watching drivers' every move, and a mistrust of how their company would use the technology. Drivers discussed how they may have private phone calls or conversations with family members, passengers, or doctors in the vehicle that management would not otherwise know about. This was a particular concern of CMV drivers. Another major concern related to privacy was the feeling that management was always watching. These drivers compared it to having a camera pointing at an office worker all day while they are working on their computer. Drivers believed that they should be trusted to do their job properly on a daily basis, and that constant supervision from management suggested a lack of such trust. Finally, many drivers expressed frustration and concern that management seemed to use or access the data from the driver-facing cameras in ways that were unknown. Further, drivers seemed to not understand when the DMS was recording video or what behaviors triggered an event.

Similarly, many drivers expressed concern that driver-facing cameras allowed fleet management to micromanage driver behavior and decisions. Specifically, the drivers indicated that many managers use the data from driver-facing cameras only to assign fault and blame. Further, drivers

believed that management used the data from driver-facing cameras to nitpick choices and behaviors not related to actual driving. Several of the drivers also believed that video footage from driver-facing cameras had been used as grounds for termination of their co-workers.

Finally, many of the drivers did not perceive safety benefits associated with driver-facing cameras. It appeared that most of these perceptions were founded in the view that driver-facing cameras were often only used for punishment. Drivers also believed the DMS inaccurately flagged behaviors or events as unsafe without context surrounding the behavior. For example, several drivers explained situations where the DMS indicated that they sped; however, the drivers indicated that they needed to speed to maintain a safe space buffer around their vehicle. Thus, the drivers indicated that the cameras may not show the entire context of the situation and why the behavior occurred. This perception reinforces the need for management to follow-up with drivers to gain context and to gather feedback. Finally, drivers indicated that DMSs with road-facing cameras provided more safety. However, these perceptions seemed to be based on driver protections in the event of a crash caused by another vehicle. Although most of the drivers indicated that they believed driver-facing cameras did not improve safety, some drivers indicated that, if used appropriately, driver-facing cameras could reduce risky driving and prevent crashes.

Results from the focus groups confirm some of the myths and barriers identified in previous research (e.g., FMCSA's Tech-Celerate Now and others). These results suggest that CMV and occupational drivers do not make the connection between driver-facing cameras and improvements in safety. This is an important barrier. If drivers do not believe the DMS helps to keep them safe, it is difficult to justify the perceived invasion of privacy. It was unclear why drivers did not make this connection. Some possible explanations include: (1) fleet management did not effectively communicate the safety benefits of the DMS; (2) misuse of the data clouded the drivers' perceptions of benefits; (3) drivers' experience with the DMS was only negative, as management only used the data for punishment and to catch drivers; (4) fleet management did not provide information and data on why the DMS was deployed across the fleet; and (5) the DMS was in fact not improving safety at their fleet. Although the fifth explanation is plausible, previous research points to this explanation as unlikely (Camden et al., 2019; Hartmans & Taylor, 2021; Hickman & Hanowski, 2010). What is more likely is a combination of the first four plausible explanations. Although the drivers did not provide a specific reason for their beliefs, responses to other questions offer some explanations.

It appeared that data from the driver-facing cameras were primarily used for punishment. This placed drivers on the defensive and significantly impacted their ability to perceive any benefit. These drivers suggested that building the data from driver-facing cameras into a reward and recognition program could help reverse this concern. These drivers mentioned the possibility of a financial reward program for the safest drivers; however, previous research on the effectiveness of financial rewards is mixed (Abernathy et al., 1982; Geller, 2001; Hickman et al., 2007; Mortimer et al., 2018). When designing a reward program, Hickman et al. (2007) suggested working with a driver advisory group to identify meaningful, small rewards.

The other main take away from these focus groups is that drivers do not understand the capabilities and functionality of the DMSs. The results indicated that most of the drivers were not trained on the behaviors that triggered video to be saved. Many of the drivers were unsure when the cameras recorded and why. They did not understand the specific capabilities of the

DMS in their vehicles. Some of this confusion may have been the result of experience with previous generations of the technology, or perhaps a different DMS at their current fleet or with a previous employer. Regardless of the reason, these data show the importance of fleet management providing a comprehensive training on the DMS; explaining why the DMS is important, what it does and does not do; noting who has access to the data; and providing data to support its effectiveness.

FLEET MANAGEMENT BEST PRACTICES TO OVERCOME DRIVER RESISTANCE

While this project did confirm barriers to driver acceptance of driver-facing cameras, the participants offered a multitude of suggestions that fleet management could use to help alleviate their concerns. Many of the 12 recommendations given by drivers are supported by previous research on DMSs (Camden et al., 2015), and other recommendations offer new insights for fleets to consider. These 12 recommendations are described in detail below (in no particular order).

1. Involve Drivers Early (Prior to Implementation)

Involving drivers early in the process of deploying a DMS will allow the drivers to learn about the technology, why it is being implemented, ask questions, and provide feedback. This can help increase driver buy-in and help to alleviate concerns that the systems are implemented without any input from drivers. Management should talk to drivers about the decision to deploy the driver-facing cameras, share data on previous crashes and violation histories, and the costs associated with the crashes and violations. Discussing the DMS's implementation early and often with drivers will help alleviate concerns, dispel myths, and generate driver buy-in. Further, if pilot test data is available, management should share these data with drivers. Drivers who participated in the piloting of the DMS may also provide feedback about their experiences with other drivers to dispel myths about the driver-facing cameras. Finally, management should actively listen to driver feedback on how the data from the cameras should be used, including how the data can be incorporated into reward and recognition programs.

2. Establish a Driver Advisory Group

One way to ensure driver engagement is through a driver advisory group/committee. A driver advisory group helps drivers to have a place at the table. This advisory group can help inform the fleet's policies surrounding the use of driver-facing cameras. For example, the driver advisory group can be tasked with identifying who should have access to the DMS data, when and how that data should be used, the incorporation of DMSs into reward programs, and to bring anonymous driver comments and concerns to fleet management. Additionally, the driver advisory board could review triggered video if there are disputes between a driver and their manager. Members of the driver advisory group should be well respected drivers within the fleet who have a demonstrated passion for safety. These drivers will help bridge the gap between fleet management and drivers.

3. Use DMS Data for Driver Recognition

Data and video from driver-facing cameras can be invaluable in identifying safe driving behavior and examples of proper responses to near-crashes. However, some managers only use the data to

look for instances of bad behavior. This leads to some of the driver perceptions that were captured in these focus groups: driver-facing cameras are only useful for punishment and to catch drivers doing something wrong. Instead, management should review the video data to identify instances where drivers were doing everything correctly to prevent a crash. These videos should be included during coaching sessions and built into a driver recognition program.

4. Use DMS Data for Safety Competition

Similarly, data from DMSs and driver-facing cameras can be integrated into driver scorecards and driver safety competitions. Safety competitions help get drivers engaged in the safety process and can generate buy-in from drivers if one purpose is to use the driver-facing cameras for rewards and recognition. It helps to illustrate that data from driver-facing cameras can be used for positive feedback rather than solely for punishment.

5. Be Honest about Driver-facing Cameras

Honesty and transparency regarding the capabilities of the DMS and the driver-facing cameras are critical to reducing driver resistance. As discussed above, many of the drivers who participated in the focus groups believed that their fleet had not been honest about when and why video was saved, how that video was accessed, when video was accessible, and how the video was used. Management must ensure the DMS policy clearly describes when data from the DMS is saved and how the data may be used in the future. However, having the policy is only one piece of the puzzle. Management must walk drivers through the policies, provide examples, and ask follow-up questions to make sure each driver understands the system's capabilities and limits. Management should review this information with drivers as soon as possible once it is available, preferably before equipping the vehicle with the DMS or at the time of hire for new employees.

6. Follow the DMS Data Use Policy

Having an DMS policy and reviewing the policy and information with drivers is one component of reducing resistance. However, management must ensure that the data use policy is strictly followed. The drivers in the focus groups had personal experiences where their management had a policy to only access driver-facing video during triggered events; however, several had witnessed management accessing video from driver-facing cameras in real-time. This capability was never disclosed to the drivers and was not included in the data use policy provided to the driver. Not following the policy led to this driver not trusting management and resisting acceptance of the driver-facing camera. The takeaway from this anecdote is the importance of fully disclosing how the data are captured and how the data will be accessed. Management should not use data from the driver-facing cameras in ways not previously discussed with drivers.

7. Use a Third-party Reviewer

Another suggestion provided by drivers was to have an independent third party review the video from the driver-facing camera. Drivers suggested this may help remove bias that a manager may have against specific drivers. Although this may not be possible with all DMSs or fleets, it may help overcome some resistance due to fear that the data could be used inappropriately.

8. Ensure Drivers Know What Behaviors Trigger an Event

Several drivers mentioned that they did not understand which behaviors or situations triggered an event where the video was saved and sent to management. Without knowing which behaviors triggered an event, drivers were unclear what could trigger coaching or discipline. Driver training should include information on each behavior and event that may cause a video to be saved. This information should be communicated to drivers regularly, not just one time when the program is implemented or when a driver is hired.

9. Ensure Drivers Know When an Event is Triggered

Another common comment was that drivers did not know when an event was triggered. Some drivers indicated that their DMS did not include an indicator light to tell drivers a risky event was detected. Since drivers did not know when an event was recorded, it was difficult for them to understand what to improve. This may have been the result of myths or a lack of understanding of the DMS. Most DMSs do have lights to show when an event was triggered. Management should include this information in training and show a demonstration of the indicator light.

10. Give Drivers Leeway to Correct Behavior Before Notifying Management

An additional popular suggestion mentioned during the focus groups was allowing drivers a chance to correct behavior prior to sending videos or alerts to management. This helps drivers to self-coach to self-correct before requiring a formal coaching session. Some DMSs offer an option where management alerts are not transmitted until more than one event is generated. However, if a DMS system does not have this option, fleets may create a policy that management will only consider the second or subsequent instances of an event for coaching.

11. Use Data to Show Safety Benefits of DMSs

As mentioned previously, many of the drivers in the focus groups did not understand the safety benefits of driver-facing cameras. Management should collect pilot data showing safety improvements with the use of driver-facing cameras. If pilot data is not available, most DMS companies can provide case studies and data to share with drivers. Further, there are independent research results (Bell et al., 2016; Camden et al., 2019; Hickman & Hanowski, 2010) that can be used. These data can help supply evidence that the DMS does help drivers prevent crashes. Additionally, management should emphasize the benefit of driver exonerations with DMSs and driver-facing cameras. The driver-facing cameras can serve as their eyewitness in the case of false allegations. Examples from a company's fleet (if available), from their insurance company, or from other fleets can be used to show the benefits of driver-facing cameras.

12. Limit Audio Recording

Many of the drivers, especially the CMV drivers, had significant resistance to audio recordings. They suggested limiting the recording of audio as much as possible. One solution is to only offer audio recording when an event is triggered or when a driver presses an incident button. Some DMSs may offer data collection without audio or may have the ability to limit audio recordings.

STUDY LIMITATIONS

Although this study offered new insights into drivers' opinions and perceptions of DMSs with driver-facing cameras, there are some limitations. First, these focus groups were limited to a total of 24 drivers. Other drivers may have different experiences, different opinions, and offer different solutions. A second limitation was that the research did not collect which DMSs were used by the focus group participants. Other DMSs not captured here may have different benefits or limitations. A third limitation was that some barriers and experiences were very specific to the drivers' fleets. Other fleets may not use the data or DMSs in the same way as these drivers' fleets. Finally, this study did not collect data on the effectiveness of these recommendations or solutions in reducing concerns. Additional research is needed to investigate how effective these strategies are in improving acceptance.

CONCLUSIONS

This study attempted to systematically collect CMV and occupational drivers' opinions and perceptions of driver-facing cameras. Although many DMS companies offer suggestions to increase driver buy-in, there is limited scientific research that examines acceptance and gathers recommendations to overcome resistance directly from drivers. Results from this study confirmed that many drivers do not fully understand how DMSs with driver-facing cameras operate. Management needs to carefully consider how DMSs operate and how drivers are trained on the devices. Although many of the drivers indicated resistance to the driver-facing cameras, 12 recommendations and solutions were provided to help overcome resistance and increase acceptance.

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