



Regulatory and Legal Review of Automated and Connected Truck Platooning Technology

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16. Abstract Commercial truck platooning is a relatively novel concept in Texas and around the country. This white paper presents the results of a review of state and federal code to identify regulatory and legislative hurdles that may delay or deter platooning operations in the State of Texas. The research team reviewed regulations at both the federal and state level, although the in-depth review of state-level searches focused mainly on Texas measures. It also provides the results of stakeholder interviews focused on identifying liability issues and potential strategies to address those issues.					
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DISCLAIMER

This research was performed in cooperation with the Texas Department of Transportation (TxDOT) and the Federal Highway Administration (FHWA). The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official view or policies of the FHWA or TxDOT. This report does not constitute a standard, specification, or regulation.

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INTRODUCTION

Commercial truck platooning is a relatively novel concept in Texas and around the country. Platooning enables commercial trucks to travel closely together while at high speeds without the worry of collisions, which can provide environmental benefits and reduce fuel and operational costs. Vehicle communications and carefully controlled automation technologies enable the system, and while the technologies are mostly mature, legal, administrative, and regulatory issues may yet prove barriers to deployment.

This white paper presents the results of a review of state and federal code to identify regulatory and legislative hurdles that may delay or deter platooning operations in Texas. The research team reviewed regulations at both the federal and state level, although the in-depth review of state-level searches focused mainly on Texas measures. It also provides the results of stakeholder interviews focused on identifying liability issues and potential strategies to address those issues.

The federal review covers regulations, recommendations, and standards from:

- The Federal Motor Carrier Safety Administration (FMCSA).
- The Federal Motor Vehicle Safety Standards (FMVSS).
- The National Highway Traffic Safety Administration (NHTSA).
- The Federal Highway Administration's (FHWA) connected vehicle program.

The federal review uncovered potentially relevant regulations at FMCSA, standards from FMVSS, and informal guidance and early regulatory movements from both NHTSA and FHWA on connected and automated vehicles (CV/AVs). The research team analyzed these areas to determine any potential applicability or conflict with the proposed platooning system. As a note, since the platooning concept is not fully developed, the research team highlighted potentially relevant regulatory and legislative areas, which enable additional evaluation as the project progresses.

The state-level review initially covered the legislation and regulations that other states have passed in recent years that specifically focus on AVs. Researchers then considered the relevant Texas laws and regulations that could affect platooning. The research team reviewed relevant sections from the Texas Transportation Code, regulations promulgated by state agencies, and recent legislative proposals.

POTENTIALLY RELEVANT FEDERAL REGULATIONS

The research team reviewed federal regulations related to CV/AVs and specific to trucks and commercial motor carriers, and sought to identify any areas that could potentially affect the proposed truck testing. Because the truck platooning concept is not yet finalized, the research team used a broad interpretation when determining potential relevance. Essentially, if it seemed a regulation or part of governmental code could plausibly affect commercial truck platooning, it was included. This provided a wide array of findings, although most are unlikely to directly affect the platooning concept. The platooning trucks will likely be equipped with production-intent equipment, which will result in minimal concerns.

As a note, this project focused on deployment, but testing is a necessary step to reach that goal. As such, this review covers regulations and legislation that also relate to testing. The terms “deployment” and “testing” are used throughout the white paper to express this necessary focus.

TRUCK-SPECIFIC REGULATIONS

The research team found federal regulations relevant to CV/AV truck testing in two main areas:

- FMCSA, which regulates commercial vehicles.
- FMVSS, which sets vehicle safety standards.

Given the understanding that the eventual pilot platooning project may change and new concerns may arise, this review addressed a wide range of regulations that could affect the eventual testing program. This section highlights potentially applicable regulations with the understanding that these and other regulations may require further evaluation as the project progresses. The research team assumed changes could be made to any part of the truck responsible for controlling the vehicle (e.g., throttle, steering, braking, transmission) and sought to identify any regulations that deal with these areas. This provides a broad scan of potential changes that could occur and ensures that most relevant regulations will be considered.

Federal Motor Carrier Safety Administration

The research team reviewed the FMCSA regulations, under 49 CFR Parts 300-399, and identified a variety of potentially pertinent areas (1). Many of the potentially relevant regulations originated from three main sections:

- Part 392: Driving Commercial Vehicles (2).
- Part 393: Parts and Accessories Necessary for Safe Operation (3).
- Part 395: Hours of Service for Drivers (4).

Table 1 shows the specific sections, a brief summary of the regulation, and the potential relevance to a proposed CV/AV truck system. Before implementing any truck testing program, it

may be helpful to review the details of these regulations. Knowledge of the specific implementation parameters will enable a more refined analysis and ensure there are no regulatory hurdles.

Table 1. Potential Relevant Sections of the FMCSA Regulations.

Title	Text or Summary	Potential Relevance
Part 381.4 : Waivers, Exemptions, and Pilot Programs (5)	Details the requirements relating to getting temporary relief from regulations.	A pilot program can be granted temporary relief from regulations for up to three years.
Part 392.82 Using a Handheld Mobile Telephone (6)	Drivers cannot use a handheld mobile telephone while driving a CMV.	Any modifications cannot require that a driver use a handheld mobile telephone.
393.3 : Additional Equipment Requirements (7)	Additional equipment that decreases safety is prohibited, but other equipment – as long as it does not reduce safety – is not prohibited.	Any modifications cannot decrease safety; other equipment is not necessarily banned.
393.9 : Lamps (8)	Lamps must be operated at all times and cannot be obscured by other equipment or material.	Any modifications cannot obscure lamps, or render them inoperable.
393.19 : Hazard Warning Signals (9)	“The hazard warning signal operating unit on each commercial motor vehicle shall operate independently of the ignition or equivalent switch, and when activated, cause all turn signals required by § 393.11 to flash simultaneously.”	Any modifications must leave the hazard warning signals capable of operation independent of the ignition switch.
393.28 : Wiring Systems (10)	“Electrical wiring shall be installed and maintained to conform to SAE J1292.”	Any modifications to the wiring systems must conform to these standards.
393.30 : Battery Installation (11)	This section provides detailed instructions on battery installation.	Any modifications that involve the battery must not violate these requirements.
393.40 : Required Brake Systems (12)	This section provides, in specific detail, the exact ways brakes of differing varieties must operate.	Any modifications that involve the brakes must not violate these requirements.
393.51 : Warning Signals (13)	Commercial motor vehicles must be equipped with warning signals that inform the driver when a brake system fails, and must meet certain requirements.	Any modifications that involve the brakes must not violate these requirements.
393.52 : Brake Performance (14)	Describes the manner in which braking systems must perform.	Any modifications that involve the brakes must not violate these requirements.
393.80 : Rear-Vision Mirrors (15)	Describes the requirements on where mirrors can be placed, the number of mirrors required, and other related information.	Any modifications that involve rear-vision mirrors must not violate these requirements.
393.201 : Frames (16)	Describes the requirements for frames; parts and accessories cannot be welded to the frame or chassis.	Any modifications cannot be welded to the vehicle’s frame.
393.209 : Steering	Describes the requirements and standards	Any modifications that involve

Title	Text or Summary	Potential Relevance
Wheel Systems (17)	for steering wheels and associated components.	the steering system must not violate these requirements.
395.1 : Hours of Service of Drivers (18)	This section places limitations on the maximum hours of service for drivers.	Modifications may need to consider how hours of service will change with automated systems.
395.15 : Automatic On-Board Recording Devices (19)	Authorizes and establishes requirements for on-board devices that record a driver’s hours of service.	Modifications may need to consider how hours of service recording devices will change with automated systems.
Part 396.3 : Inspection, Repair and Maintenance (20)	Establishes requirements for inspecting, repairing, and maintaining commercial vehicles. The requirements include any “parts and accessories which may affect safety of operation.”	Any modifications may be held to these requirements. Additional and more frequent inspection may be required for platooning.

Federal Motor Vehicle Safety Standards

Researchers reviewed the FMVSS to identify any pertinent standards that could affect the CV/AV truck platooning testing program (21). The research team determined that a variety of standards could be relevant, depending on how the eventual system is implemented. Standards cover areas like brakes and braking systems; mirrors, lamps, and reflective devices; and accelerator control systems.

Each standard defines the requirements for a particular vehicle feature and the implications on the truck testing program are essentially the same under each: the potential truck testing program cannot violate these standards, unless it first gets a waiver under Part 555. This part provides for temporary relief from motor vehicle safety standards for a few reasons, but most relevant to the purposes of this study is the exemption for “the development of new motor vehicle safety... features” (22). Once the final design for the testing program is determined, the research team may wish to revisit these safety standards and assess the need to apply for an exemption. Table 2 provides standards identified that could potentially trigger the need for an exemption. Since the vehicle market currently produces and sells vehicles with adaptive cruise control (ACC), which is functionally similar to the system required for platooning, the regulatory concerns to implement a similar system on commercial vehicles may be minimal.

Table 2. Potential Relevant Sections of the FMVSS.

Section and Title	Summary	Potential Relevance to Platooning
Standard No. 101: Controls and Displays (23)	This standard requires that essential controls be located within reach of the driver when the driver is restrained by a lap belt and upper torso restraint, and that certain controls mounted on the instrument panel be identified.	Modifications to vehicles must keep essential controls within the driver's reach, and any new controls must be identified.
Standard No. 102: Transmission Shift Lever Sequence, Starter Interlock, and Transmission Braking Effect (24)	This standard specifies the requirements for the transmission shift lever sequence, a starter interlock, and for a braking effect of automatic transmissions, to reduce the likelihood of shifting errors, starter engagement with vehicle in drive position, and to provide supplemental braking at speeds below 40 km/h (25 mph).	Current production ACC systems use automatic transmission shifts for deceleration (e.g., engine/transmission braking effect) under specific conditions. It is possible that the platooning system control strategy will differ somewhat in the usage of transmission braking. Any eventual modifications to transmission or the named components cannot remove or invalidate these required components and system performance.
Standard No. 105: Hydraulic and Electric Brake Systems (25)	This standard specifies requirements for vehicles equipped with hydraulic and electric service brake systems and associated parking brake systems to ensure safe braking performance under normal conditions and emergency conditions.	Any modification to hydraulics or electrical braking systems cannot remove or invalidate these required components nor result in unsafe braking performance during normal or emergency braking conditions.
Standard No. 106: Brake Hoses (26)	This standard establishes performance and labeling requirements for hydraulic, air, and vacuum brake hoses, brake hose assemblies, and brake hose fittings for all motor vehicles. The purpose of this standard is to reduce brake system failure from pressure or vacuum loss due to hose or hose assembly rupture.	Any modification to brake hoses and related systems cannot remove or invalidate these required components.

Section and Title	Summary	Potential Relevance to Platooning
Standard No. 108: Lamps, Reflective Devices, and Associated Equipment (27)	This standard specifies requirements for original and replacement lamps, reflective devices, and associated equipment. Its purpose is to reduce traffic crashes and deaths and injuries resulting from traffic crashes, by providing adequate illumination of the roadway, and by enhancing the conspicuity of motor vehicles on the public roads so that their presence is perceived and their signals understood, both in daylight and in darkness or other conditions of reduced visibility.	Any modification to lamps, reflective devices, and associated equipment cannot remove or invalidate these required components. Current production ACC systems apply the brake lamps when the system brakes. The platooning systems will need to consider this and turn signal application during lane changes. Other elements of FMVSS 108 may also apply.
Standard No. 111: Rearview Mirrors (28)	This standard specifies requirements for the performance and location of inside and outside rearview mirrors. Its purpose is to reduce the number of deaths and injuries that occur when the driver of a motor vehicle does not have a clear and reasonably unobstructed view to the rear.	Any modification to the vehicle for platooning cannot remove or invalidate these requirements for rearview mirrors.
Standard No. 121: Air Brake Systems (29)	This standard specifies performance, equipment, and dynamometer test requirements for braking systems on vehicles equipped with air brake systems, including air-over-hydraulic brake systems, to ensure safe braking performance under normal and emergency conditions.	Any modification to air brakes and related systems cannot remove or invalidate these required components or result in unsafe brake system operations under the stated conditions.
Standard No. 124: Accelerator Control Systems (30)	This standard establishes requirements for the return of a vehicle's throttle to the idle position when the driver removes his or her foot from the accelerator control, or in the event of a severance or disconnection in the accelerator control system.	Any modification to accelerator control systems cannot remove or invalidate these system requirements; however, we note that current production cruise control and ACC systems continue to apply throttle control with the driver's foot off of the accelerator.
Part 555: Temporary Exemptions from Motor Vehicle Safety Standards (22)	This regulation provides a means by which manufacturers of motor vehicles may obtain temporary exemptions from specific safety standards on the grounds of substantial economic hardship, facilitation of the development of new motor vehicle safety or low-emission engine features, or existence of an equivalent overall level of motor vehicle safety.	This section lays out the availability and requirements for acquiring an exemption from FMVSS requirements.

Exemptions from the FMVSS are governed under [Part 555](#), which are given in the cases of “substantial economic hardship to a manufacturer, the facilitation of the development of new motor vehicle safety or low-emissions engine features, or the existence of an equivalent overall level of motor vehicle safety” (22).

Exemptions are given to a “manufacturer of motor vehicles or passenger motor vehicles” under three conditions:

1. On the bases of substantial economic hardship;
2. Making easier the development or field evaluation of new motor vehicle safety or impact protection or low-emission vehicle features; or
3. Compliance with a standard would prevent it from selling a vehicle with an overall level of overall level of safety or impact protection at least equal to that of nonexempted vehicles.

It is unclear if the current project would qualify for exemptions, as neither the Texas A&M Transportation Institute nor the Texas Department of Transportation are a manufacturer of motor vehicles. However, the uniqueness of the current project may qualify the team under the second condition. Platooning can potentially reduce emissions and might improve safety, which could potentially qualify the project for exemption.

NHTSA RECOMMENDATIONS ON AUTOMATED VEHICLES

Currently, there are no federal regulations on AVs. Like the application of most technologies, the federal government has thus far taken a cautious and limited approach to regulating AVs, choosing to let states take the lead in regulating the AV industry rather than taking a direct role. In 2013, NHTSA released a document entitled “Preliminary Statement of Policy Concerning Automated Vehicles” addressing the burgeoning AV technology (31); the document laid out the agency’s research agenda, a taxonomy for AVs (see Table 3), and proposed guidelines for states wishing to regulate AVs. Importantly, rather than proposing regulations on AVs, the agency chose to develop guidelines that states could voluntarily follow when regulating the AVs.

Table 3. NHTSA Automation Levels (from 3I).

NHTSA Automation Level	Description
Zero: None	The driver is “in complete and sole control of the primary vehicle controls (brake, steering, throttle, and motive power) at all times, and is solely responsible for monitoring the roadway and for safe operation of all vehicle controls” (p. 4). The vehicle may have the ability to monitor the environment but only for driver support, information, or convenience systems.
One: Function-Specific	The vehicle has “one or more specific control functions are automated,” but the driver still has “overall control” of the vehicle and is responsible for its safe operation (p. 4). If multiple control systems are engaged, they operate independently. The vehicle may “assist or augment the driver in operating of one of the primary controls—either steering or braking/throttle controls (but not both).”
Two: Combined-Function	Two or more of the “primary control functions” work in automated unison to monitor the road and control the vehicle (p. 5). The driver maintains primary responsibility for safe operation road monitoring and must be available to take over control at any time without advance warning.
Three: Limited Self-Driving	The vehicle controls all “safety-critical functions under certain traffic or environmental conditions” (p. 5). The driver need not constantly monitor the roadway and can rely on the vehicle to do so. If the situation changes and the vehicle cannot operate safely, it provides sufficient advanced warning to the driver—who must be available—to take control.
Four: Full Self-Driving	The “vehicle is designed to perform all safety-critical driving functions and monitor roadway conditions for an entire trip” (p.5). The driver may need to provide directions for navigation but does not need to control the vehicle at any point. The vehicle could be unoccupied or occupied, and is solely responsible for safe operation.

NHTSA begins the recommendations by establishing the boundaries under which regulations should occur (see Table 4). The agency expresses its concern that premature or misguided regulations could harm the nascent AV industry, stating that all regulations must “appropriately balance the need to ensure motor vehicle safety with the flexibility to innovate” (p. 10). To avoid such harm, the agency encourages states to take a cautious approach when regulating. For example, the agency encourages states to only regulate NHTSA level 3 and 4 vehicles for testing purposes, and not authorize automation for any other purposes.

The agency recommends that states avoid developing specific safety standards or regulating the safety of self-driving vehicles for purposes beyond testing. This poses somewhat of a conflict and difficulty for states, as states traditionally regulate drivers, and the federal government traditionally regulates vehicle safety. AVs could upset this balance; an AV that is responsible for the driving task becomes the driver and blurs the line between regulating driver and vehicle.

Table 4. NHTSA Recommended Regulatory Boundaries.

Regulations should	Regulations should not
<ul style="list-style-type: none"> • Focus on NHTSA level 3 and 4 vehicles only • Focus on “licensing, driver training, and conditions for operations related to specific types of vehicles” • Ensure that only original equipment manufacturers employees or designees can operate test vehicles, and only for testing purposes 	<ul style="list-style-type: none"> • Permit “operation of self-driving vehicles for purposes other than testing” • Develop detailed regulations on the safety of self-driving vehicles for purposes other than testing • Regulate the technical performance of AVs

Following the initial recommendations, the agency includes four broad recommendations, each with associated sub-recommendations. The first focuses on ensuring the “driver” of the AV is adequately trained and knows how to operate the vehicle. The second recommends states focus their regulations on the circumstances under which testing will occur: ensuring that testing minimizes risks to other road users, is monitored for any problems, and occurs under road conditions the AV can handle. The third recommendation lays out principles guiding AV testing, like ensuring “the process for transitioning from self-driving mode to drive control is safe, simple, and timely.” The final recommendation the organization offers is that states should not develop regulations for purposes other than testing, but if they do, they recommend that (at a minimum) (31):

The state should require that a properly licensed driver (i.e., one licensed to drive self-driving vehicles) be seated in the driver’s seat and be available at all times in order to operate the vehicle in situations in which the automated technology is not able to safely control the vehicle.

Impact on Truck Platooning Testing

These recommendations are likely to have limited or no direct influence on the proposed platooning program for a few reasons. First, these are recommendations and not regulations; because NHTSA has chosen to not yet pass regulations, states are free to establish rules for automation as they deem appropriate. Additionally, platooning is likely a level 2 automated system, which NHTSA does not recommend states regulate.¹ None of the states to enact laws on automation have addressed level 2 systems, and most specifically avoid regulating these and other advanced driver assistance systems. Finally, Texas has not yet chosen to adopt any regulations on AV testing or operation. As shown in the following sections, some preexisting laws governing vehicles may make platooning challenging, but none relate to automation, per se.

¹ Combined Function Automation, or NHTSA Level 2 Automated Vehicles have “at least two primary control functions designed to work in unison to relieve the driver of control of those functions” (33). A driver in a Level 2 vehicle can safely have “his or her hands off the steering wheel AND foot off the pedal at the same time,” although the automated system “can relinquish control with no advance warning and the driver must be ready to control the vehicle safely.”

FEDERAL REGULATIONS ON CONNECTED VEHICLES

Platooning requires some form of vehicle communications to prevent platoons from breaking down or colliding when traveling at high speeds (32). Instantly communicating a change in status, like braking, allows following vehicles to also respond instantly, keeping all vehicles moving in unison. One of the most likely candidates for such communication is dedicated short range communication (DSRC) radios, using vehicle-to-vehicle (V2V) communications. The U.S. Department of Transportation selected this technology and developed associated standards and protocols for use in vehicles to relay safety-critical information with very low latency and high availability. Other communications systems (like Wifi or cellular) can have higher latency, which slows information transmission, and lower availability, which results in messages not being reliably conveyed in a timely manner. These disadvantages disqualify these communications systems for safety-critical information transmission. These same criteria make DSRC a likely candidate for platooning systems. The use of DSRC at the dedicated 5.9 GHz spectrum ensures messages are sent quickly and reliably. As such, it is worth reviewing regulations and guidance promulgated by the federal government on the CV system to ensure the research team is abreast of any potential regulatory hurdles.

Since many aspects of the CV system are not yet ready for deployment, FHWA, NHTSA, and other federal agencies have not released final regulations for the system. The first formal regulations for CVs are under development at NHTSA, which would mandate the deployment of CV systems on all new light vehicles. In August 2014, the agency released the Advanced Notice of Proposed Rulemaking, which publically proclaimed NHTSA's intent to eventually create regulations (propose rulemaking) for the CV system (33). The proposed rule would create a new FMVSS: FMVSS No. 150, which would "require vehicle-to-vehicle communication capability for light vehicles (passenger cars and light truck vehicles) and to create minimum performance requirements for V2V devices and messages" (34). NHTSA is also assessing whether to mandate the system on commercial vehicles, and stated during the 2015 ITS America Annual Meeting that the agency would "have an announcement [on moving forward with the regulatory steps needed for a mandate] as soon as this year [2015]" (35). Additionally, a NHTSA report on the agency's priorities for vehicle safety and fuel economy states that it expects to "complete research necessary to support an agency decision on heavy vehicle V2V" and issue a decision in 2015 (36).

NHTSA occasionally receives questions on its rules from the public. When this happens, its Chief Council will interpret the agency's rules and respond with a letter of interpretation. These letters are considered the opinion of the agency *at that time*, and as such are not binding and do not set precedent. Nonetheless, the agency states these interpretations "may be helpful in determining how the agency might answer a question that you have if that question is similar to a previously-considered question" (37). This resource may be worth reviewing when or if questions regarding NHTSA regulations arise.

POTENTIALLY RELEVANT STATE LEGISLATION AND REGULATIONS

The research team reviewed state legislation and regulations that were specific to AVs and commercial trucks. Since Texas has not passed a law related to AVs, researchers looked at enacted legislation and regulation in other states. The review of commercial vehicle legislation and regulation, however, focused entirely on Texas since it is the focus of the study.

AV-SPECIFIC LEGISLATION AND REGULATIONS

To date, six states (California, Florida, Michigan, Nevada, North Dakota, and Tennessee) and Washington, D.C., have passed laws authorizing AVs for operation and/or testing (see Table 5). These laws specifically do not regulate low-level automation—such as collision prevention, lane keeping, or automatic parking—but instead focus on high-level automation, such as NHTSA level 3 or 4 vehicles (see Table 3 above for definitions).

Table 5. Enacted AV Laws.

State	Law	Passage Date
California	<u>SB 1298 (38)</u>	9/25/2012
District of Columbia	<u>B19-0931 (39)</u>	1/23/2013
Florida	<u>CS 1207 (40)</u>	4/16/2012
Florida	<u>SB 52 (41)</u>	5/29/2013
Michigan	<u>SB 169 (42)</u>	12/26/2013
Michigan	<u>SB 663 (43)</u>	12/27/2013
Nevada	<u>AB 511 (44)</u>	6/17/2011
Nevada	<u>SB 140 (45)</u>	6/17/2011
Nevada	<u>SB 313 (46)</u>	6/2/2013
North Dakota	<u>HB 1065 (47)</u>	3/20/2015
Tennessee	<u>HB 0616 (48)</u>	5/6/2015

The laws governing AVs vary considerably across the states; they authorize AVs for public use, for testing by private companies only, or allow some combination of both public use and private testing (see Table 6). Several states passed an initial law establishing the legal framework for AV testing, but then also directed their Departments of Motor Vehicles (DMVs) to develop a program overseeing testing and/or public operation.

Only authorizing AVs for testing allows original equipment manufacturers or other approved entities (such as component manufacturers or software developers) to test their vehicles on state roads, or other areas, as authorized by the state. The impetus for this sort of authorization originates with the perception that AVs are not yet fully developed or safe, and regulating vehicle testing would enable a state to oversee the activities taking place on its roads. Such

oversight would hypothetically make the roads safer by requiring testers to abide by certain rules, report infractions or crashes, operate in certain conditions, or other restrictions. California, for example, requires AVs record and report data to the state relating to any crashes that might occur on test vehicles.

Table 6. Legislative Overview.

Policy Aspect	CA	FL	MI	NV	D.C.	ND	TN
Permits Testing	X	X	X	X	X	X	
DMV to Develop Regulations	X	X		X	X		
Permits Public Operation	X	X			X	X	
Silent on Public Operation				X			X
Bans Public Operation			X				

While most of the states explicitly authorize AVs for testing purpose, they take very different approaches to public use. Several states either explicitly authorize or ban public operation, while others are less clear about public operation. Tennessee, for example, only prohibits political subdivisions (like counties or cities) from “prohibit[ing] the use of a motor vehicle within the jurisdictional boundaries of the political subdivision solely on the basis of being equipped with autonomous technology” (48). The state chose not to explicitly authorize the vehicles, but instead banned local governments from prohibiting their use. Nevada took a similar approach, by remaining silent as to whether or not they authorize public use.

This ambiguity is likely intentional, as a state that does not specifically ban automated vehicles is essentially rendering them legal to operate by the general public. As Smith explains in his paper *Automated Vehicles are Probably Legal in the United States*, a longstanding and fundamental legal principle holds that “everything is permitted that is not prohibited” (49). In other words, everything is legal, unless there is a law that prohibits it. Smith argues that this basic legal principle renders automated vehicles legal, unless they are specifically made illegal. It follows that the states’ silence on whether or not the public can operate AVs renders them legal to operate publically. Only one state specifically banned automation, Michigan, which restricts operation to “automation manufacturers” when testing their vehicles (43, 50).

Because Texas has not yet passed any laws or regulations related to AVs, the vehicles are legal to operate in the state. Any eventual testing program using automation does not need to consider state laws or regulations specifically related to automated driving.

TRUCK-SPECIFIC STATE REGULATIONS

Researchers reviewed the Texas statutes with the purpose of identifying existing laws that could affect the CV/AV truck platooning pilot. The research team found state regulations with potential relevance in two areas:

1. The Texas Transportation Code, which regulates transportation activities.
2. The Texas Administrative Code, which sets administrative standards for state agencies.

Given the understanding that the eventual pilot platooning project may change and new concerns may arise, this review addressed a wide range of regulations that could affect the eventual testing program. This section highlights potentially applicable regulations with the understanding that these and other regulations may require further evaluation as the project progress. The research team assumed changes could be made to any part of the truck responsible for controlling the vehicle (e.g., throttle, steering, braking, transmission) and sought to identify any regulations that deal with these areas. This provides a broad scan of potential changes that could occur and ensures that most relevant regulations would be considered.

Existing state regulations related to the truck platoon testing are summarized in the following section.

Texas Transportation Code

The research team reviewed the [Texas Transportation Code](#) regulations and identified a variety of potentially pertinent areas. The highest concentration of potentially relevant regulations originated from two main sections:

- Title 6 – Roadways (51).
- Title 7 – Vehicles and Traffic (52).

Table 7 includes the specific sections, a brief summary of the regulation, and the potential relevance to a proposed CV/AV truck platooning system. Before implementing any truck testing program, it may be helpful to review the details of these regulations. Knowledge of the specific implementation parameters will enable a more refined analysis and ensure there are no regulatory hurdles.

Table 7. Potential Relevant Sections of the Texas Transportation Code.

Section	Regulation Title	Summary	Potential Relevance to Platooning
224.1541 (53)	Exclusive Lanes	Exclusive lanes can be designated for the use of a particular class of vehicles to enhance safety, mobility or air quality.	A platooning project that includes dedicated lanes may be applicable under this regulation.
541.001 (54)	Persons	This section defines terms for this subtitle including “operator” and “person.”	Depending on interpretation, entities involved in platooning could be considered as operator or person involved and subject to the regulation.
542.302 (55)	Offense By Person Owning or Controlling Vehicle	A person who owns a vehicle or employs or otherwise directs the operator of a vehicle commits an offense if the person requires or knowingly permits the operator of the vehicle to operate the vehicle in a manner that violates law.	Depending on interpretation, an entity involved in platooning could be considered an owner and subject to the regulation.
545.002 (56)	Operator	“In this chapter, a reference to an operator includes a reference to the vehicle operated by the operator if the reference imposes a duty or provides a limitation on the movement or other operation of that vehicle.”	Vehicles have the same responsibilities and duties as human vehicle operators, so CV/AV trucks must adhere to the same rules of the road as all other drivers.
545.062 (57)	Following Distance	“An operator shall, if following another vehicle, maintain an assured clear distance between the two vehicles so that, considering the speed of the vehicles, traffic, and the conditions of the highway, the operator can safely stop...” “An operator on a roadway outside a business or residential district driving in a caravan of other vehicles or a motorcade shall allow sufficient space between the operator and the vehicle preceding the operator so that another vehicle can safely enter and occupy the space. This subsection does not apply to a funeral procession.”	The first section requires vehicles to leave enough room between vehicles to ensure the operator can safely stop, which could potentially be construed as a legal hurdle to platooning. This requires that vehicles traveling in “caravans” outside a business or residential district leave sufficient space between vehicles to allow another vehicle to merge between the vehicles. The legislative code seems to ban platooning in this specific situation.
545.417 (58)	Obstruction of Operator’s View or Driving Mechanism	This section disallows any load or additional passengers from obstructing the operator’s views.	Any modifications that could obstruct the operators view must consider these requirements.

Section	Regulation Title	Summary	Potential Relevance to Platooning
545.425 (59)	Use of Wireless Communication Device in a School Crossing Zone	This section restricts the use of commercial wireless communication devices ² in a school zone.	Any testing that involves wireless communication devices must not violate these restrictions while in a school zone.
547.401 (60)	Brakes Required	A motor vehicle, trailer, semitrailer, pole trailer, or combination of those vehicles shall be equipped with brakes.	Any modifications that involve the brakes must not violate these requirements.
547.402 (61)	Operation and Maintenance of Brakes	This section provides, in specific detail, the exact ways brakes of differing varieties must operate.	Any modifications that involve the brakes must not violate these requirements.
547.615 (62)	Recording Devices	Regulates the use of recording devices ³ in a vehicle and the use of the collected data.	Any modifications that include information recording devices may need to consider these requirements.
621.101 (63)	Maximum Weight of Vehicle or Combination	This section includes restrictions and requirements for motor vehicles and truck-tractors.	Any modifications may be held to these requirements.
621.205 (64)	Maximum Length of Vehicle Combinations	This section includes restricts coupling trucks and tractors to a maximum combined length of 65 feet.	This section seems targeted to trucks that are physically coupled, but may be worth considering further.
646.001 (65)	Motor Transportation Brokers	This section defines motor transportation broker as a person who “sells, offers for sale, provides, or negotiates for the transportation of cargo by a motor carrier operated by another person.”	Depending on interpretation and implementation, an entity involved in platooning could be considered a broker and subject to the regulation.

² In this section, a wireless communication device is defined according to [47 U.S.C. Section 332](#), which defines commercial mobile service as “any mobile service that is provided for profit and makes interconnected service available to the public or to such classes of eligible users as to be effectively available to a substantial portion of the public, as specified by regulation by the Commission” **Invalid source specified.**

³ State code defines a recording device as “a feature that is installed by the manufacturer in a motor vehicle and that does any of the following for the purpose of retrieving information from the vehicle after an accident in which the vehicle has been involved: records the speed and direction the vehicle is traveling; records vehicle location data; records steering performance; records brake performance, including information on whether brakes were applied before an accident; records the driver’s safety belt status; or transmits information... to a central communications system when the accident occur.”

Perhaps the most relevant sections from the code are found in section 545, where the code requires vehicles traveling in caravans outside a business or residential district leave sufficient space between vehicles to allow another vehicle to merge between the vehicles. This specific situation is one where platooning would be restricted from occurring. Another noteworthy potential hurdle from the same section requires vehicles to leave enough room between vehicles to ensure the operator can safely stop, which could potentially be construed as a legal hurdle to platooning.

Texas Administrative Code

The Texas Administrative Code (TAC) was reviewed for potentially relevant regulations. Title 43 of the TAC represents administrative regulations that relate to transportation and all related agencies. A review of this title did not find specific regulations with direct implications for truck platoon testing, but a couple of sections may be relevant for reference during the project. Part 1 outlines the regulations for implementing lane use restrictions for congestion relief and/or by class of vehicle, which is listed in Table 8.

Table 8. Potential Relevant Sections of the Texas Administrative Code.

Part 1 – Texas Department of Transportation			
Chapter 25 Traffic Operations	Subchapter C (66)	Congestion Mitigation Facilities	This chapter presents regulations for high occupancy vehicle lanes, including how to limit the use of lanes to particular vehicles.
	Subchapter J (67)	Restrictions on Use of State Highways	This chapter presents the regulations guiding how a local jurisdiction or the department of transportation (DOT) can implement highway lane use restrictions, included by class of vehicle.

While these sections may not restrict platooning, some may be worth heeding due to their potential relevance to other aspects of platooning that might be considered. For example, the provision on congestion mitigation strategies allows for the limitation of lanes for particular vehicles, which could potentially serve as a test bed for platooning trucks. This section allows the Transportation Commissioner to designate an exclusive lane and finance its construction if it will “improve transportation safety, mobility, or air quality.” Since platooning could improve at least two of these areas, it is possible that this designation could apply for platooning vehicles.

Recent Relevant Legislation

One proposed [bill](#) related to truck following distance was introduced to the Texas Legislature in 2013 and is currently “pending in committee” (68). The bill suggests the following addition to Chapter 642 of the Transportation Code:

Sec. 642.004. TWO OR MORE COMMERCIAL MOTOR VEHICLES TRAVELING IN CONVOY

All trucks traveling in convoys of 2 or more with gross vehicle weight of 26000 pounds or more must maintain a minimum following distance of 150 feet between each vehicle when traveling on two lane state highways.

LIABILITY ISSUES AND CONCERNS

This section documents the investigation of potential truck platooning liability issues and the discussion of strategies to address liability issues. The research team reviewed relevant literature related to liability from commercial truck platooning and conducted a series of interviews with subject matter experts on the topic to gauge the current industry perspectives on the issue. The findings from both activities formed the basis for strategies to address the liability concerns. The following sections summarize the results of the assessment of potential truck platooning liability issues in Texas from the perspective of critical stakeholders and subject matter experts.

INTERVIEW METHODOLOGY AND PROCESS

As part of the effort to identify and document regulatory or legislative roadblocks that could hamper or facilitate introduction of platooning into the commercial fleet operation, the research team conducted a set of interviews with various stakeholders and subject matter experts. The objective of these interviews was to identify the operational challenges and risks associated with the project in order to consider countermeasures and mitigate the future risks related to truck platooning.

The research team contacted potential interviewees via email and conducted the interviews over the telephone. Interviewees were sent the questions in advance of the interview to help them prepare and ensure they were able to answer the questions. One researcher conducted the interview while another was available to take notes. The interviews were not recorded, and each lasted about 30 minutes. The stakeholders and experts identified for the interview process represented a range of perspectives. The areas of expertise include, but were not limited to:

- Trucking industry association representatives.
- Motor carrier safety experts.
- Legal experts.
- Insurance representatives.
- Public sector agency representatives (e.g., DOT, metropolitan planning organization).
- Toll road operators.

The researchers contacted 15 individuals during the initial recruitment. Ultimately, six interviews were conducted, representing a 40 percent response rate. This number fell short of the team's internal goal of 10 interviews, but the final set of interviewees was considered satisfactory. The diversity and expertise of the sample ensured its overall robustness.

KEY CONCERNS

Based on the interviews and the literature reviewed previously, concerns surrounding liability and platooning originate from a few areas of uncertainty. The following section summarizes the

results of the interview process in terms of three main areas of concern. The summary reflects a synthesis of the interviewees' perspectives on these issues, as well as complementing the interview material with related findings from the literature. The three main areas discussed in this section are:

- Private liability concerns.
- Governmental liability considerations.
- Possible strategies to address liability.

Private Liability Concerns

Previous literature suggests that liability associated with any automated vehicular control systems will generally shift from the driver to the vehicle or technology manufacturer, but the magnitude of the shift will roughly correlate with the distribution of responsibility for the driving task (69). The concept of truck platooning requires that trailing drivers relinquish some degree of control of their vehicle to both the automated system(s) on their vehicle and to the driver in the lead vehicle of the platoon. Given those conditions, low-level, partially automated vehicles will have different implications for the distribution of liability than high-level or fully automated vehicles.⁴

Several of the subject matter experts echoed this viewpoint; they agreed that the liability will likely shift from the trailing driver that relinquishes control to manufacturers of the automated system and the lead driver controlling the vehicles.⁵ One of the concerns, however, is that there is no certainty or guarantee that this transfer of liability will happen, so trucking companies may be reticent to engage in platooning without improved clarity in how liability will be apportioned.

One trucking industry respondent pointed out two related concerns: the variance in liability laws across states and perceived inequities in apportioning liability based on negligence. The individual cited Minnesota law as an example of these concerns, which holds that a commercial trucking company involved in a crash could be found only 20 percent negligent for the actions that caused the crash, but held 100 percent liable for harms that occur. The individual went on to argue that the inconsistency in liability laws across states and this perceived inequitable treatment would discourage the company from engaging in platooning. Furthermore, the concerns regarding liability may even extend to using connected or other AV systems. The individual argued that tort reform was needed before truckers would adopt these technologies.

A legal expert interviewee countered this viewpoint, arguing that the law would not change to exempt truck drivers from liability if they were platooning; that no matter the technology

⁴ Platooning systems are, depending on their configurations, either a level 2 or 3 (NHTSA) automated system.

⁵ As with AVs, shifts in liability are likely to correspond with the degree of control that the driver cedes to the vehicle.

involved, motorists involved in crashes with commercial vehicles will still seek compensation from commercial vehicle drivers and operators. This individual went on to argue that the adoption of platooning technologies will be driven by market forces. In other words, if platooning is safer and saves trucking companies money, companies will adopt it. Those that do not adopt the capital-saving technologies will be at a competitive disadvantage to the early adopters, which would create pressure on others to also adopt the technology to level the economic playing field. Still, another respondent argued that it is not clear that increased fuel efficiency will be a sufficient incentive (especially given recent decreases in fuel costs) to take on new risks in light of the generally low-profit margins for commercial trucking and the potentially very high costs that could arise from increased liability.

Governmental Liability Considerations

Liability for government agencies from platooning activities is not likely to increase for a few reasons. First, interviewees and the literature agree that government agencies receive sovereign immunity or protection from prosecution because the state is sovereign. This protection is only waived in very specific circumstances, such as when government actors are negligent in a specific manner (70). An example might be if the government is informed that a part of the CV system is malfunctioning (like a roadside unit), but fails to repair the equipment in a timely manner. If harm occurs as a result of the malfunction, the government could be found negligent and lose its sovereign immunity protections as a result of the notice and failure to act.

A second reason governmental liability is unlikely to increase is the likelihood that the CV system, which platooning may or may not ultimately use, “does not create new or unbounded liability exposure for industry” (71). NHTSA argues that the connected vehicle system, (the development of which the federal government has funded, in which it has participated, and which state and local governments will likely implement) “from a products liability standpoint... analytically, are quite similar to on-board safety warning systems found in today’s motor vehicles.” The agency goes on to argue that it “does not view V2V warning technologies as creating new or unbounded liability exposure for industry” and as a result, does not have “a current need to develop or advocate the liability limiting agenda sought by industry in connection with potential deployment of V2V technologies” (71).

Possible Strategies to Address Liability

Perhaps the largest liability issue is the uncertainty that surrounds platooning and private companies. Based on existing law and analysis of similar cases, reasonable assumptions can be drawn about how liability for crashes will be handled. However, without either legal arrangements that directly outline liability or a real case that examines these issues at trial, this uncertainty will likely linger. One interviewee felt that federal regulations addressing this uncertainty would make the trucking industry “much more comfortable” with platooning. Another respondent pointed out that NHTSA’s eventual decision on mandating DSRC for

commercial vehicles will allay some of the uncertainty but, critically, if it does not specifically address liability issues, the respondent felt the industry's concerns will only grow.

Most interviewees said their organizations were not taking any steps to address liability concerns related to platooning, other than monitoring the issue for any developments. Some were aware of industry working groups that assess aspects of platooning but none that specifically focused on liability.

The research team asked respondents about a few hypothetical strategies to decrease this uncertainty and manage liability. Again, most respondents had not heard of industry attempts to address liability associated with platooning, but several proffered potential strategies seen in other industries. Several individuals pointed to ideas that involve insurance markets or policies. A legal expert explained that a lead driver could purchase an insurance policy that would insure against any liability associated with platooning. The lead driver would then charge individuals that join the platoon a fee to recoup insurance costs. This insurance coverage could even be an extension of an existing policy, where the truck would inform the insurance company about the platooning system, and the insurance company would price the premium based on the driver's and system's combined risk. The interviewee warned that the benefits from platooning would have to outweigh the insurance premiums for the system to be financially viable.

An insurance expert pointed to two different types of insurance groups that perform a similar function: insurance purchasing groups and risk-retention groups. The individual explained that a purchasing group is composed of members with similar risk exposures, who create a group to use their combined purchasing power to purchase insurance from a company. In a retention group, a group of similar members come together and create a pooled fund into which the members pay premiums, take losses, and collectively share risk. Both of these ideas stem from federal law, are legal, and currently exist in Texas (72, 73). Trucking industry associations, for example, sometimes offer purchasing groups for their members.

Another legal expert pointed to the idea of "risk shifting" through "contract-based risk management." Under such an arrangement, trucking companies and fleet operators (perhaps through an industry group) would develop a generalized agreement or contract wherein the members would agree to follow a set of rules governing inter-company platooning, including rules governing risk. The individual pointed out that risk shifting through contract-based risk management already occurs in other industries. In construction, for example, many subcontractors working on a single site will form an agreement covering site use and associated risks.

FINAL REMARKS

A high amount of uncertainty exists surrounding the liability impacts of truck platooning as revealed in both the interviewees and the literature. Furthermore, many unresolved questions remain that create uncertainty for the industry.

For the trucking industry, the uncertainty that surrounds platooning and related technology may leave companies hesitant to invest in these technological changes. Today, the trucking industry operates despite being faced with the costs and risks associated with current liability and existing tort law. The intervention of a government agency or other external actor could reduce the uncertainty or mitigate the risks.

While platooning technologies may shift the distribution of liability among owners and manufacturers, it was suggested that the current legal and insurance institutions are equipped to absorb these changes into its current structure. If the latter is true, the future of platooning will be driven by market forces.

Interviewees pointed to various forms of insurance that suggest ways to mitigate risks and lessen uncertainty. Another individual suggested contracts that establish rules governing platooning and risk sharing. Several other interviewees argued that government actions could help reduce uncertainty: the forthcoming NHTSA ruling mandating DSRC for commercial vehicles, developing federal regulations governing platooning and risk, and state tort reform. Other respondents felt tort reform would be unnecessary and unhelpful.

Finally, it is unlikely that platooning will not increase governmental agencies liability, as these agencies have sovereign immunity. This protection is only waived in a few special circumstances, like governmental negligence leading to harm.

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