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Law as a Design Consideration for Automated Vehicles Suitable to Transport Intoxicated Persons

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***Abstract*— This essay explains why an automated vehicle (AV) manufacturer should consider law during the design process for an AV intended as "fit-for-purpose" to transport intoxicated persons. It suggests that management, marketing, engineering and legal functions collaborate to develop product requirements and specifications that shield owner/occupants from criminal liability for DUI manslaughter, negligent homicide and similar charges, as well as guard against civil liability. This collaboration should occur for AV deployments in any state of the United States and in European countries.**

Keywords—automated vehicle, certification, corporate governance, cyber-physical system, DUI manslaughter, engineering ethics, intoxicated driving, machine learning, negligent homicide, safety, security, self-driving car

I. Introduction

How should management structure a top-down, bottom-up design process for a self-driving vehicle that is fit-for-purpose to transport potentially intoxicated passengers from a bar, restaurant or social event safely home? The concern is broader than simply achieving a safe journey without incident. Automation technology *in action* will fall short if a fatal accident *in route* exposes the owner/operator to criminal liability for DUI manslaughter or vehicular homicide. A truly successful design for a private self-driving vehicle will perform a "Shield Function" by protecting an intoxicated owner/occupant from criminal liability during operation.

In the following discussion, terminology matters. The term "automated vehicle" or "AV" applies to vehicles with Level 3, 4 or 5 features as specified in SAE J3016.[1] For ease of reference, the essay sometimes refers to an L3, 4 or 5 *vehicle* even though the SAE levels are features which vehicles possess. A *fully* or *highly* automated vehicle is a vehicle with L4 or L5 features. The *fully* automated vehicle can transport passengers without any human intervention because the system itself is designed to transition to a minimal risk condition (MRC) if the AV encounters an environment or situation which it is unable to safely navigate.

Advocates for the autonomous vehicle industry cite reduction in drunk driving deaths as a significant benefit flowing from deployment of vehicle automation technology.[2] One might assume that use of any *fully* or *highly* automated vehicle will perform the Shield Function as a simple byproduct of the level. But the wording and interpretation of statutes prohibiting "driving under the influence" or "driving while intoxicated" in different states (collectively, DUI statutes) paint a more complicated picture because case law in some states interprets DUI statutes to apply when a defendant is not actively driving a vehicle but merely has the power to control it. Thus, a privately owned L4 vehicle with a control feature, such as the ability to change from fully autonomous mode to manual mode "on-the-fly" mid-itinerary, may fail to perform the Shield Function.

Though we focus on interpretive details of US law (particularly state law in Florida), we note the same type of interpretive issues arise under European law (which we illustrate with two Dutch examples). We recommend that AV manufacturers consider legal considerations as part of product requirements and specifications for deployments of AVs in any state of the US and in any European country to confirm that a mismatch does not result between physical performance characteristics of the AV and legal sufficiency to perform the Shield Function.

II. Differences in Functional Requirements

The use case of transporting an intoxicated person without risk of criminal liability is a functional requirement but, perhaps, an unusual one in an engineering context because functionality for this use case is not measured purely against physical performance characteristics. Engineers are familiar with laws and regulations that specify a functional physical requirement (such as limiting permitted levels of emissions of RF energy by a transmitting device).[3] Rather, functionality for our subject use case depends on the interaction between design requirements and specifications, on the one hand, and an applicable legal system's likely treatment in context of the features of the self-driving vehicle itself, on the other hand.

Satisfaction of the Shield Function requirement does not relate to the process used to create a design (such as the model process found in IEEE 7000)[4] nor is it measured by a test in a laboratory.[5] Rather, we suggest that satisfaction of the Shield Function should be measured by receipt of a favorable legal opinion from counsel opining that operation of the vehicle will perform the Shield Function under applicable law. Failure to receive such a legal opinion should require a specific product warning to avoid false advertising claims.

The question of appropriate design process is timely against the backdrop of DUI manslaughter [6] and vehicular homicide charges [7] brought against users of Tesla automation systems. Fatal accidents have occurred, with prosecutors filing charges, when owner/occupants traveled with a Tesla automation feature engaged. For ease of reference, we refer to all current Tesla consumer automation

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features (*e.g.* Autopilot, Full Self-Driving, *etc*.) as "Autopilot."

The issue of proper attribution of criminal liability arises when, as a defense, the owner/operator claims that he or she was not "driving" or "operating" the vehicle at the time of the accident because Autopilot was engaged. This defense asserts that the Autopilot feature was, as a legal matter, the driver or operator at the relevant time, and not the owner/operator. Identity of the driver or operator is central because, to get a conviction, the general rule in the US requires a prosecutor to prove beyond a reasonable doubt that the defendant was driving or operating the vehicle while intoxicated. The devil is in the details of state law because "driving" and "operating" come in different flavors based on statutory language, judicial interpretation and model jury instructions.

A defendant's attempt to substitute Autopilot for the owner/occupant generally has failed in the US because the Tesla Autopilot design concept requires the human owner/occupant to always monitor the on-road performance of the vehicle. An intoxicated person cannot safely do so.

Court proceedings in the Netherlands produced similar outcomes under European law when defendants attempted to substitute Autopilot for themselves in distracted driving cases, showing the widespread importance of the concept of "driver" across legal systems. In one case involving an administrative sanction, the defendant had been speaking while holding a telephone in violation of a provision of the Road Traffic Act:

> The driver of a 2017 Tesla Model X was fined € 230 in an administrative sanction for using his mobile phone while driving. Before the county court, he claimed that because the autopilot was activated, he could no longer be considered the driver, and therefore the acts of driving and using a hands-on phone did not constitute the simultaneous act prohibited [by law] … This narrative did not save the day. [8] at pp.344-45.

In a 2019 Dutch criminal case, the driver had focused attention elsewhere (and not on the road) for 4 or 5 seconds.

> "… the defendant's vehicle had swerved from its lane and collided head-on with an oncoming car. … The defendant pleaded not guilty, arguing that the threshold test for recklessness and/or carelessness had not been met, as he had taken his eye off the road for only a few seconds because he had assumed that the Autosteer System of his Tesla was activated. This position was not given any weight by the court. [8] at p. 356.

As noted in [8], "Like the Netherlands, many legal systems lack a codified definition of the term "driver," which leads courts to define the term in context." *Id*. at 345. Particularly in the absence of codified definitions of terms such as 'driver' or 'operator' a counsel opinion addressing the legal outcome in the context of accidents involving AVs with different features becomes important as a matter of consumer disclosure.

III. Relevance of Automation Levels

For legal purposes, determining whether a person is "driving" or "operating" a motor vehicle can depend on the level of control the owner/occupant has over the vehicle's operation. In many jurisdictions, the answer to this question depends on a person's ability to control the vehicle, regardless of whether the person is exercising control at the time of an accident.

Tesla classifies Autopilot as an L2 feature. The feature's design concept requires that a human driver always remain attentive with a hand on the steering wheel, able to assume complete control of the vehicle at the spur of the moment. The Tesla owner's manual discloses that Autopilot is an advanced driver assistance system (ADAS) and not an automated driving system (ADS)—technically, not an *automated* vehicle at all. This partial automation design concept does not allow the owner/operator to engage the ADAS and then read a book, watch a movie or take a nap. Autopilot is not fit-for-purpose to safely transport an intoxicated person from point A to point B because the design concept requires that the owner/operator remain vigilant with the power to assume complete operation of the dynamic driving task (DDT) on a moment's notice to ensure safe operation. An intoxicated driver cannot safely perform the task of a fallback-ready user let alone instantly respond to unsafe conditions.

Despite Autopilot's L2 design concept, on November 5, 2024, NHTSA requested information from Tesla based on concerns that Tesla conveyed mixed messages to consumers about the capabilities and proper use cases for Autopilot.[9] Potentially exaggerated performance claims and worrisome use case suggestions endorsed by Tesla on social media included mention that Autopilot might replace a human designated driver to take an intoxicated person home.[10] NHTSA also observed that Tesla's own literature suggests in places that Autopilot provides full, rather than partial, automation—perhaps leading some owner/operators wrongly to conclude that Autopilot is a suitable replacement for a designated driver.

Though we cite cases involving Tesla systems, the same analysis applies to Ford's BlueCruise and GM's hands-free OnStar Super Cruise because they also are L2 features.[11] No L2 vehicle is an "automated" vehicle within J3016 terminology because that level is not designed to perform the entire DDT for sustained periods of time. A similar analysis applies to the Mercedes-Benz DrivePilot feature, though Mercedes classifies that feature as L3. An L3 feature is an ADS (not an ADAS) because its design intent contemplates performing the entire DDT for sustained periods of time. However, for safe operation, the L3 design concept requires the presence of an owner/operator to respond to a "takeover" request to assume control of the vehicle if required for safety (*i.e*., function as a fallback-ready user). The L3 ADS is designed to issue a takeover request to the human owner/operator when it encounters environments or situations for which the ADS has not been "trained" to navigate within its operational design domain (ODD). The ADS also may initiate a takeover request upon an impending exit from its ODD.

Unlike an L2 feature, an L3 feature is designed to give owner/operators some of their time back because the L3 design concept allows a person to attend to other tasks during an itinerary, such as reading, watching a movie or playing a video game so long as the owner/occupant remains seated behind the steering wheel, able to promptly respond to a

takeover request from the ADS. The L3 use case does not, however, include taking a nap in the back seat of the vehicle.

Just as an intoxicated person cannot safely assume control of an L2 vehicle on the spur of the moment, an intoxicated person cannot reliably and safely respond promptly to a takeover request from the ADS. For this reason, the L3 vehicle is not fit for purpose to transport intoxicated persons safely home—just as the L2 vehicle is not fit.

The analysis placing liability on the intoxicated driver in an L2 or L3 vehicle operating with the automated driving feature engaged is consistent with prior US case law. The auto industry's introduction of cruise control in the 1970's provided an opportunity for drivers to argue that they should not be responsible for speeding tickets by placing blame on the cruise control feature—a defense rejected by courts. [12]

> A motorist who entrusts his car to the control of an automatic device is driving the vehicle and is no less responsible for its operation if the device fails to perform a function under which the law [they are] required to perform. The safety of the public requires that the obligation of a motorist to operate his vehicle in accordance with the Traffic Act may not be avoided by delegating a task he normally would perform to a mechanical device. [13]

Case law had similarly concluded that autopilot systems in aircraft do not absolve pilots of responsibility. [14] The negotiated pleas in recent cases involving Tesla supports this analysis. Other legal observers note that this level of responsibility creates risks for owner/operators. [15] [16]

NHTSA expressed concern that Tesla's online behavior gave the false impression to consumers that Autopilot functioned like a chauffeur or robotaxi. Vigilance by both L2 and L3 owner/operators is critically important for safety because neither design concept requires that the vehicle achieve a minimal risk condition (MRC) solely by operation of the ADS. Absence of a requirement to achieve an MRC without human intervention prevents the vehicle from performing like a chauffeur or robotaxi. Only an L4 or L5 vehicle must achieve an MRC without human operator involvement. The requirement that the vehicle achieve an MRC without human intervention is the feature that allows a person to take a nap in the back seat of the vehicle while the L4 feature is engaged. Arguably, the ability to achieve an MRC is the feature which relieves the owner/operator of supervisory responsibility once the ADS is engaged. (Importantly, achieving an MRC does not technically equate with safety despite its reference in legislation which often makes that implicit assumption. Achieving an MRC does not imply safety per the SAE J3016 terminology.)[17]

Though not yet available for purchase by consumers, Cruise (formerly) and Waymo operate robotaxis with L4 features. Just as we would consider an intoxicated person prudent if he or she took a conventional taxi home after a party (rather than drive), so too should we approve of an intoxicated person taking a robotaxi home instead. One would expect a similar result if an intoxicated person activated the L4 feature in his or her privately owned AV rather than using a commercial robotaxi to go home. But the legal status of private L4 vehicles is not so clear, for the reasons explained below.

Uncertainty over the ability of some L4 vehicles to perform the Shield Function explains why the question of "fit for purpose" cannot be answered solely by evaluation of the functional capabilities of the ADS in an AV. Per one recent observer:

> If manufacturers focus on the development of new technologies rather than on the legal frameworks within which their products are going to be handled, any opacity as far as product information is concerned can lead to someone, somewhere, avoiding compliance with the law. [8] at 340.

The law in a state may render an AV not fit-for-purpose based on legal categories and definitions rather than the functional capabilities of the vehicle because motor vehicle laws can take different approaches to the assignment of liability for an accident, both within a single state across categories of crimes and among the several states. Differing language used in statutes and model jury instructions might assign liability to the human owner/occupant, to the AV manufacturer or even, potentially, to the AV itself (a problematic result because an AV is not a legal person).

Assignment of liability may depend on the capabilities and level of autonomy as well as the driver's actions. The automobile manufacturer's choice of driving automation level, and capabilities within a level, thus may depend on a combination of legal, marketing, and engineering considerations.

IV. Relvant Legal Liability Categories

Case law in the US generally interprets "drive" and "driving" more narrowly than "operate" or "operating"—with "drive" and its cognates requiring motion of some sort, while "operate" and its cognates do not typically require motion. Case law also suggests that the facts required to satisfy either category may be the mere capability to drive or operate the vehicle even if that capability is not exercised. For example, if an intoxicated person enters her vehicle and starts the engine, a conviction for intoxicated operation of a motor vehicle may be upheld in the US.

DUI Manslaughter: In general, an owner/operator has liability for actions taken while "driving" or "operating" a vehicle. When an ADS is performing the DDT, it is tempting to believe that the owner/operator is not driving or operating the vehicle. This view is bolstered by state statutes which provide that the ADS is the "operator" of the vehicle when it is engaged. Florida law provides an example:

> 316.85 Autonomous vehicles; operation; compliance with traffic and motor vehicle laws; testing.— ***
>
> (3)(a) For purposes of this chapter, unless the context otherwise requires, **the automated driving system, when engaged, shall be deemed to be the operator of an autonomous vehicle**, regardless of whether a person is physically present in the vehicle while the vehicle is operating with the automated driving system engaged. (Emphasis supplied) ***

Notice that an L3 feature, such as Mercedes' DrivePilot, is an "automated driving system" and the vehicle in which it is installed is an "automated vehicle" within J3016. Yet the "context otherwise requires" when an owner/operator is intoxicated because no intoxicated person can responsibly

serve as a fallback ready user for an L3 feature. Moreover, despite statutes such as this, under the details of the law, engaging the ADS does not always have the legal effect of insulating an owner/operator from liability. This is the case with DUI Manslaughter in Florida. The Florida Statute for DUI Manslaughter provides:

> 316.193 Driving under the influence; penalties.--
>
> (1) A person is guilty of the offense of driving under the influence and is subject to punishment as provided in subsection (2) if the person is driving **or in actual physical control of a vehicle** within this state and: (emphasis added)
>
> (a) The person is under the influence of alcoholic beverages, any chemical substance set forth in s. 877.111, or any substance controlled under chapter 893, when affected to the extent that the person's normal faculties are impaired; … ***

The Florida Standard Jury Instruction for DUI Manslaughter approved by the Florida Supreme Court has broad application, including situations in which an operator is not performing the dynamic driving task:

> Actual physical control of a vehicle means the defendant must be physically in [or on] the vehicle and have the capability to operate the vehicle, **regardless of whether [he] [she] is actually operating the vehicle at the time**. (emphasis added)

From the statutory language, as interpreted by the jury instruction, it follows that an operator of an L2 Tesla (Autopilot) and an L3 Mercedes (DrivePilot) can be guilty of DUI Manslaughter even if, at the time of the fatal collision, the ADAS (Tesla) or the ADS (Mercedes) is engaged.

Though the ADS is "driving"—by performing the entire DDT in the Mercedes—as a legal matter, the operator is in "actual physical control" of the vehicle because, per the jury instruction, physical control includes the "capability" to operate the vehicle regardless of whether the operator is operating the vehicle at the time. Indeed, the design concepts of both Tesla and Mercedes automation systems require that the operator be prepared to assume control of the vehicle at any time during any itinerary.

Even though an owner/operator should not use an L3 vehicle while intoxicated because of the need to assume control of the vehicle per the L3 design concept, the owner/operator would have liability even if an accident occurred that was unrelated to the intoxicated status of the owner/occupant (for example, because the accident occurred before the AV initiated a takeover request).

Thus, L2 and L3 vehicles are not fit-for-purpose to transport intoxicated owner/operators for *both* legal reasons, as well as engineering reasons based on the design concepts of the ADAS and ADS.[18] What may surprise some, however, is that a highly or fully automated L4 vehicle similarly may not be fit-for-purpose either—but entirely for *legal* reasons. This depends on the context presented by particular features of the L4 vehicle.

In the US, courts likely will interpret the scope of DUI Statutes against the backdrop of a concern about sanctioning behavior that poses an unreasonable risk to public safety. Intoxicated persons often make bad choices—and a decision by an intoxicated person to switch from automated mode to manual mode mid-itinerary is a signature example of a bad choice that risks public safety during operation of an L4 vehicle with features that permit this flexibility.

The biggest issue for L4 vehicles is a consumer-oriented model (not a robotaxi) which allows the owner/operator to disengage the ADS during a trip, reverting to manual control. This flexibility may be a critical marketing feature for potential purchasers. To keep the L4 vehicle fit-for-purpose, a design team might consider an "impaired" or "chauffeur" mode which, when activated, prevents an owner operator from assuming control mid-itinerary. [20]

A borderline case might be an L4 vehicle that contained no steering wheel or gas pedal. This vehicle would appear fit for the purpose of transporting intoxicated persons just as a robotaxi. However, if this L4 vehicle had an emergency feature, such as a panic button, that allowed an occupant to terminate an itinerary, causing the vehicle to maneuver into an MRC, it would be for the courts to decide whether this modest level of vehicle control amounted to "capability to operate the vehicle," thus exposing the occupant to potential liability for DUI manslaughter. A design team might consider eliminating the panic button for this reason. As an alternative, the AV manufacturer might seek an opinion from the attorney general of a state (in this example, Florida) seeking clarification if the design team concludes that, on balance, the panic button feature mitigates harm, and its retention creates both a positive risk balance and a marketing benefit.

Reckless Driving and Vehicular Homicide: A US prosecutor will resort to a vehicular homicide charge in cases of distracted driving and cases in which evidence of intoxication may be successfully challenged.

The Florida statutes that govern reckless driving and vehicular homicide differ in structure from DUI manslaughter because they do not contain language referencing "actual physical control" nor a jury instruction which indicates that actual physical control does not require present control of the vehicle. An argument can be made, based on this statutory construction, that an accident which occurred while an ADS was engaged did not create vehicular homicide liability for an owner/operator because the relevant statutes seem to require a finding that the owner/operator actually drove and operated the vehicle.

> 316.192 Reckless driving.—
>
> (1)(a) **Any person who drives** any vehicle in willful or wanton disregard for the safety of persons or property is guilty of reckless driving. (emphasis added)
>
> 782.071 Vehicular homicide.—"Vehicular homicide" is the killing of a human being, or the killing of an unborn child by any injury to the mother, **caused by the operation of a motor vehicle by another** in a reckless manner likely to cause the death of, or great bodily harm to, another.

The applicable Florida model jury instruction contains no definition for "drive" in the definition of reckless driving or of "operation of a motor vehicle" in the vehicular homicide statute. The suggestion that a person should not be convicted of vehicular homicide while traveling with the L4 ADS engaged may be bolstered by comparison with the definition

of "operate" applicable to the crime of *boating* while intoxicated (as opposed to *driving* while intoxicated). The definition of "operate" states:

> § 327.02(33), Fla. Stat. **Applicable only to Vessel Homicide**. (Emphasis supplied.)
>
> "Operate" means to be in charge of, in command of, or in actual physical control of a vessel upon the waters of this state, to exercise control over **or to have responsibility for a vessel's navigation or safety while the vessel is underway** upon the waters of this state, or to control or steer a vessel being towed by another vessel upon the waters of the state. (Emphasis supplied.)

The argument against liability observes that the definition of "operate" with respect to boating appears intended to have broader scope than the mere use of the word "operate" in the case of a motor vehicle. In the case of boating, mere responsibility for navigation or safety suffices. An owner/operator of an L2 or L3 vehicle has responsibility for safety. A safety driver in a prototype or test L4 vehicle similarly has responsibility for safety even when the ADS, rather than the safety driver, is performing the DDT. In the private L4 vehicle, however, the design concept does not assign responsibility for navigation or safety to the owner/occupant while the ADS is engaged because of its ability to achieve an MRC without human involvement.

The *legal* outcome in vehicular homicide (in contrast to the *engineering* design concept and performance-based outcome) turns on the question of whether an owner/operator may *legally* delegate responsibility for the dynamic driving task to a highly automated vehicle (and by such delegation relieve himself of liability by virtue of the delegation). Importantly, engineering design concept responsibility may not track legal responsibility.

Case law suggests that a pilot remains responsible for the safe operation of an aircraft when autopilot is engaged.[14] And, drivers have been found responsible for speeding tickets when cruise control was set because the driver remained responsible for operation of the vehicle within the speed limit. [13] The delegation of the task to automation in those cases did not simultaneously create a release for the aircraft pilot or absolve the driver using cruise control of liability. The case of the boat captain may be similar insofar as the captain may use automation as a tool, but the captain retains ultimate responsibility for the voyage if that tool fails.

This reasoning explains the liability of the safety driver in the 2018 Uber fatality in Arizona.[19] Although the vehicle involved had an engaged L4 feature, it was a prototype vehicle and, as such, the safety driver had responsibility for the operation of the vehicle just like the captain of a vessel or the pilot of an aircraft retains responsibility. The safety driver owed a duty of care to other road users.

An owner/operator of a private L4 vehicle would have a strong argument that he or she could effectively delegate driving responsibility to the ADS (and release his or her responsibility) *if* the law provided that the ADS itself owed a duty of care to other road users—a point conceded in a responsive pleading by GM in a non-fatal collision of its AV with a motorcycle. [21] One of us has argued that legislatures should confirm this legal status by statute. [22] Once a duty of care has been established for the ADS, the task remains to assign responsibility for that duty of care. It was suggested in [22] that responsibility for a breach of this duty of care should fall upon the AV manufacturer, rather than the owner/operator. Placing liability on the owner/operator based simply on ownership status limits the value of the Shield Function if a large civil penalty can be assessed for negligent driving even if criminal liability is avoided.

V. Liability based on Vehicle Ownership

Management should initiate a risk analysis at the start of the design process, whether they contemplate using a traditional "V" model or other methodology. Legal officers should identify how the applicable law allocates residual liability for accidents to determine whether the owner/operator can avoid civil liability if the vehicle can perform the Shield Function under criminal law. It will be cold comfort to the owner/operator of a private L4 vehicle if the law absolves him of responsibility to oversee safety during ADS operation, but civil liability nevertheless attaches through the back door by assigning residual liability for accidents to the owner of the vehicle. This question arises because neither an L4 vehicle nor an ADS has status as a legal person. The law will seek to place liability on a legal person rather than allowing liability to evaporate.

To ease administration and regulation of automated driving, it may make policy sense to require the owner of the AV to pay liability insurance premiums. But a rule which creates strict liability or vicarious liability for the owner of the AV in excess of policy limits whenever the ADS fails to perform as intended (i.e. by violating a duty of care to other road users) does not fully achieve the purpose of the Shield Function. Even if the owner/operator cannot be convicted of DUI Manslaughter, the law needs to be clear that the owner does not retain vicarious liability—otherwise the intoxicated owner/operator is at risk for civil liability (if not some lesser flavor of vehicular homicide) by mere ownership. This possibility creates an uneasy journey home for the intoxicated owner/operator of a fully featured private L4 vehicle.

VI. Design Requirements to Avoid Legal Liability

AV manufacturers cannot passively assume that any L4 or L5 vehicle will perform the Shield Function because the Shield Function is not a mere byproduct of the automation level. Rather, performing the Shield Function must be a conscious design requirement specified for a project with a view to legal categories and requirements.

Design risk is one category of consideration in requirements analysis. Design time, non-recuring engineering or NRE cost, and manufacturing cost are all instances of design risk for management to address early in the design process. Conceptually, legal costs should be bundled with NRE cost because the identification of design features that simultaneously satisfy marketing, engineering and legal considerations should be incorporated into the requirements analysis. If management determines that law reform should be pursued (or clarification sought from state authorities) to expand the scope of available features, design time risk will increase. By its nature, successful design

requires iterative collaboration among management, marketing, engineering and legal staff.

First management and marketing must confirm that the model under design is intended to perform the Shield Function. Second, they must identify those additional features desired in the model. Third, management and marketing must specify the target jurisdictions for deployment of the new model of vehicle (whether one state or multiple states). Management might make the business decision to produce a model which can perform the Shield Function across several jurisdictions or adopt a strategy which makes specific models tailored for each state. The legal officers must then compare the list of desired features to the applicable laws in the target jurisdictions and identify those features that are inconsistent with the Shield Function.

Suppose one desired feature is the ability of the owner/occupant to switch from autonomous mode to manual mode in the middle of a trip but the legal officers determine this feature is inconsistent with the Shield Function because it gives the owner/occupant too much control. Management and marketing must then decide whether to pursue a design "work around" to retain some portion of this flexibility. The engineers will consider the feasibility of any proposed work-around using traditional design considerations. Design risk, including cost considerations, will factor in any decision.

For example, a possible solution might be to create a "chauffer" mode which an owner/operator might select for a trip home from a social function. The chauffer mode would lock the human controls for the trip—making the private L4 AV function like a robotaxi or a private AV without human controls. If the legal officers confirmed that a "chauffer mode" would solve the control problem under state law, then the engineers would determine how to implement this feature. For example, steering by a human driver might be disabled whether the steering is electronic (steer by wire) or via a physical steering column using the existing anti-theft lock included in conventional vehicles (typically engaged when the vehicle is parked).

The process must be repeated each time a feature is added or removed from the product requirements. The following is a non-exclusive list of factors for consideration.

Absence of Control: The presence or absence of the ability to control the AV will be central. Elements of control should be considered broadly. Termination of autonomous mode mid-itinerary with a shift to manual mode, termination of a trip mid-itinerary via an emergency panic button, the ability to honk a horn, the ability of the occupant to issue voice commands—all may be relevant under state law. The engineers must evaluate the impact on safety of eliminating a feature, such as an emergency panic button, and how best to maximize a positive risk balance.

Nature of Data Recorded: The electronic data recorder (EDR) required in conventional vehicles records limited information. The required data was specified before the arrival and deployment of automation technology. The nature of the information recorded, together with the frequency of recording, should be updated to reflect the new technology, and specified with a view to helping an owner/operator avoid legal liability (both for impaired driving and otherwise). AV manufacturers should advocate for more robust recording and avoid an impulse to limit data and frequency of collection to hinder proof of a design defect. The continuing engagement of the ADS should be recorded in narrow increments. Moreover, the ADS should not disengage immediately prior to an accident (as has been reported with respect to Tesla's automation systems) when engagement limits liability.

Maintenance Data: Even if an owner/occupant has no control over the vehicle, the owner/occupant may have liability for failure to maintain various systems on the AV, including failure to keep sensors both clean and unobstructed. Failures of system maintenance in an AV provides an analog to impaired driving in a conventional vehicle. The design team should consider how to measure and record maintenance data for the AV, and whether to prevent operation of the AV altogether in the absence of required scheduled maintenance, as well as maintenance needed in response to warning lights or indicators.

Operational Design Domain: Marketing must identify states in which the model under design can perform the Shield Function to facilitate accurate consumer advertising. Some have noted the importance of legal considerations.

> Suppose an ADS is of US American design. **Surely the designer has US American law at the back of his mind during construction?** Does such a vehicle fully comply with the demands of civil-law European systems …? [8] at 245. (Emphasis supplied.)

The conscious focus required goes beyond merely having "law at the back of [one's] mind" during design.

Relevance of Design Specifications to Advertising: To avoid allegations that a manufacture has engaged in false advertising and misled the public, any instructions for vehicle use should indicate whether the model is fit for the purpose of performing the role of "designated driver." Drafting disclosure after careful consideration of the design requirements and specifications, and comparison of those against applicable legal requirements would be part of ethical design of systems contemplated by IEEE 7000 because it treats users as stakeholders.

VII. WHY LAW REFORM IS NEEDED

The replacement of human agency by a cyber-physical system presents uncertainty for application of current laws because those laws were structured by legal categories developed prior to the arrival of advanced vehicle automation technology. Moreover, the regulatory environment for motor vehicles is further complicated in the US because of multiple regulatory regimes unlike aviation where national authorities regulate design, manufacturing and operations. The use case of transporting intoxicated persons illustrates the uneasy fit that results from divided regulatory responsibility—with the federal government regulating equipment and individual states licensing human drivers and sanctioning improper operation of vehicles. An ADS, as both equipment and operator, clouds the proper jurisdiction to identify the party responsible for improper AV operation. Today in the US, federal leadership to create uniform standards across jurisdictions has stalled.

With a change in administrations, there is some hope federal leadership will make it a priority to clarify owner/operator criminal and civil liability for operation of automated vehicles. With appropriate liability attribution rules, it may be possible to eliminate or reduce a plethora of technical regulation which could stifle innovation.

The concern in the United States is that, instead of pursuing serious law reform to address structural changes created by merging the driving function with equipment (rather than driving remaining a direct human activity), an expedient solution would simply allow automated vehicles to operate on highways throughout the U.S. Rather than a quick fix such as this, legislators and regulators should grapple with the complexities of technological change in which regulation of equipment merges with regulation of driving and licensing.

Failure to guide the deployment of automated vehicles and the related regulations risks creating consumer confusion and the deployment of vehicles not fit for many purposes which the public expects automated vehicles to perform. Such confusion can lead to a loss of public confidence in critically important automation technology. Acceptance of vehicle automation technology is crucial in winning a technology race with scientists in other countries, such as China.

The amendment process for the Vienna Convention on Road Traffic (1968) is one step at law reform to accommodate deployment of AVs in Europe but also requires further domestic legislation. Approaches such as found in German law which treat remote operators "as if" they were located in an automated vehicle is another expedient or quick fix which does not address fundamental technology advances—merely facilitating deployments instead.

Engineers have an important role to play by engaging with legal requirements as part of design specifications to better align legal requirements with vehicle features and the legal implications of those features.

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[17] J3016 is not a safety standard. It is a taxonomy and satisfaction of a definition does not imply any judgment in terms of system performance. See J3016 8.1.

[18] Discussions often equate Level 2 with "ADAS" but, just as J3016 does not sanction references to fractional levels such as Level 2+, treating ADAS as equivalent to Level 2 is not a J3016 supported usage. Philip Koopman, SAE J3016 User Guide, https://users.ece.cmu.edu/~koopman/j3016/index.html#myth20 (visited Feb. 4, 2025).

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