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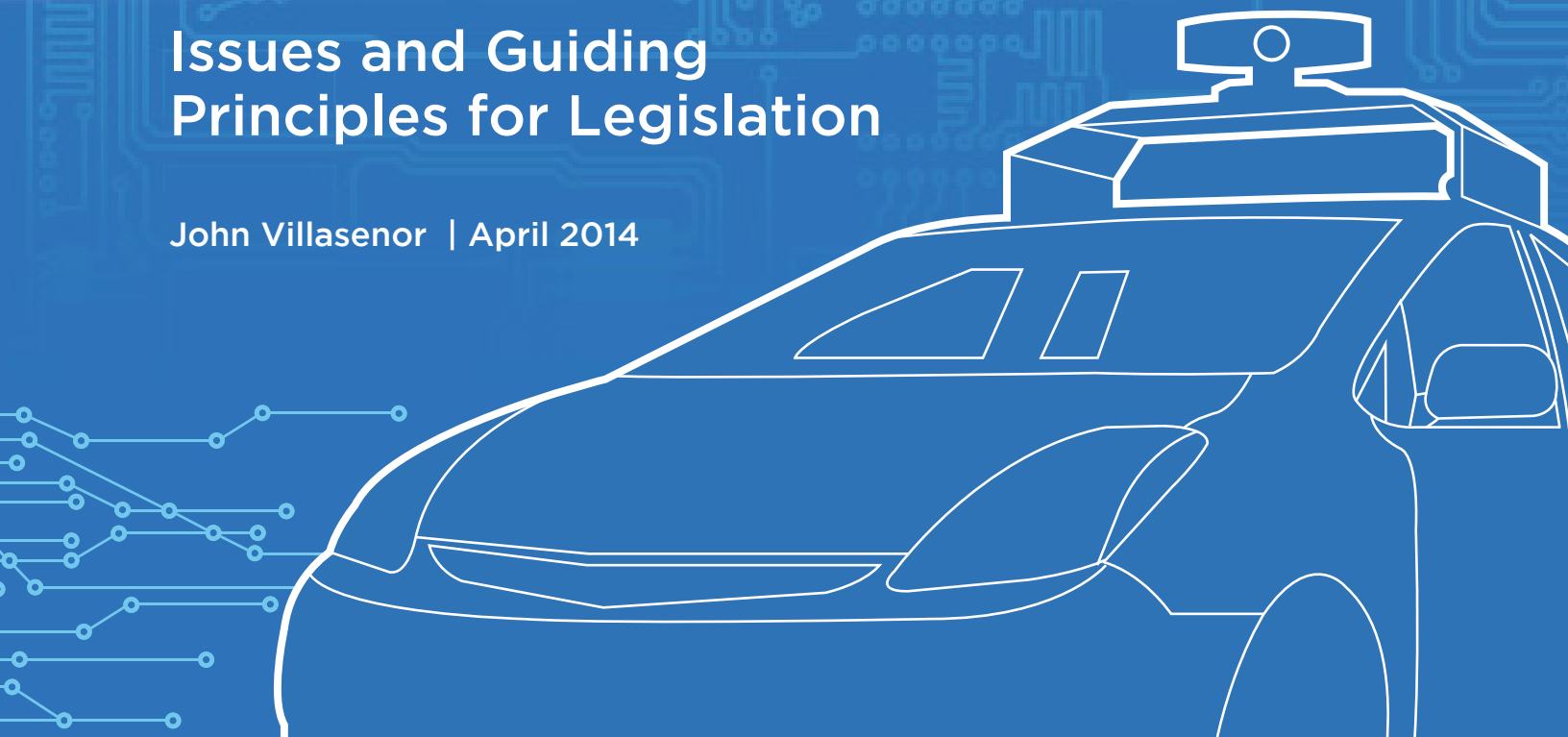
Products Liability and Driverless Cars:

Issues and Guiding Principles for Legislation

John Villasenor | April 2014



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Executive Summary

As driverless cars—or more formally, autonomous vehicles—continue to attract growing interest and investment, the associated liability issues are also getting increased attention. Often, this attention comes in the form of suggestions that liability concerns will slow or even completely prevent consumer access to advanced autonomous vehicle technology.

That would be a mistake. While liability will always be important with respect to motor vehicle operation, automation will dramatically increase safety on the highways by reducing both the number and severity of accidents. To some extent, it already has. For example, electronic stability control systems, which help drivers maintain control on turns and slippery surfaces by automatically selecting which wheels to use for braking, have saved thousands of lives.[1] And, they have done so without confronting the courts with insurmountable questions regarding liability.

Of course, emerging autonomous vehicle technologies are much more sophisticated than electronic stability control and can handle many more of the functions that today are performed by human drivers. Over the next decade, spurred by new state laws permitting the operation of autonomous vehicles and by continued investment in research and development, many more vehicle automation technologies will transition out of the laboratory and into widespread commercial use.

This paper provides a discussion of how products liability law will impact autonomous vehicles, and provides a set of guiding principles for legislation that should—and that should not—be enacted. In some very specific, narrow respects, state-level legislative clarity regarding autonomous vehicle liability can be beneficial. Vehicle manufacturers that sell non-autonomous vehicles, for example, should not be liable for defects in third-party vehicle automation systems installed in the aftermarket. But broad new liability statutes aimed at protecting the manufacturers of autonomous vehicle technology are unnecessary.

The legal precedents established over the last half a century[2] of products liability litigation will provide manufacturers of autonomous vehicle technology with a very strong set of incentives to make their products as safe as possible. In the overwhelming majority of cases, they will succeed. However, despite these efforts, there will inevitably be some accidents attributable in whole or in part to defects in future vehicle automation systems. While this will raise complex new liability questions, there is no reason to expect that the legal system will be unable to resolve them.

In short, the liability concerns raised by vehicle automation are legitimate and important. But they can be addressed without delaying consumer access to the many benefits that autonomous vehicles will provide.

Introduction

Motor vehicle accidents claimed over 33,000 lives in the United States in 2012—a number corresponding to an average of over 90 fatalities every day.[3] Many of these deaths are directly attributable to a simple unfortunate fact: While most drivers are careful and conscientious, some are not. Motor vehicle accidents due to mistakes, poor judgment, poor driving skills, or outright criminal negligence exact an enormous societal cost.[4]

We take it for granted that this is a necessary price for the flexibility conferred by individual motor vehicle ownership. In the long run, this tradeoff will be viewed as a historical aberration, present only during the century or so when technology enabled the mass production of cars, but not of highly automated systems to help drive them safely and reliably.

Of course, we should not forcibly strip drivers of the choice to do their own driving. But automation will provide an option to reduce or remove the burden of driving tasks that very few people enjoy, such as navigating crowded freeways and city streets during rush hour.

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To a limited extent, vehicle automation has already provided important safety benefits. Features such as anti-lock braking have long been standard, and have helped to save many lives. Thus, the concept of allowing a computer to control a motor vehicle's systems in the interest of safety is not new. What is new is the degree to which automated systems are becoming capable of taking over driving functions that, only a few years ago, were far too complex to entrust to a computer.

Getting to that point will take time. While the phrase "driverless car" evokes a science fiction-like image of entering a destination on a dashboard keypad and sitting back to read an electronic book while being whisked along the highway, vehicle automation technologies with that level of functionality are not yet mass-market ready. It will be many years before cars capable of what the National Highway Traffic Safety Administration (NHTSA) calls "full self-driving automation" are in widespread use.[5]

The issue of liability invariably gets raised in policy discussions regarding autonomous vehicles. This is eminently sensible. When autonomous vehicles become involved in accidents, resolving the question of fault will indeed

require considering novel and in some cases challenging questions.

This paper, and the set of legislative guiding principles it provides, reflect a view that, subject to a few narrow exceptions, existing tort and contract law frameworks are generally very well equipped to address these questions. Thus, there is not a need to encumber the legal system with a new set of overly broad federal or state liability statutes relating to autonomous vehicles. Products liability law offers a time-tested framework that has proven to be adaptive to technology-driven liability issues in many other contexts. There is good reason to be optimistic that it will be equally capable of doing so when applied to autonomous vehicles.

The Move Toward Automation

"Like it or not, the robots are slowly taking over a driver's chores."

— quote from a 1958 *Popular Science* article

In-car automation—and concern about what it will mean for the driving experience—has a far longer history than is commonly recognized. A brochure for 1958 Chryslers and Imperials touted a new feature called "Auto-Pilot," which was described as "an amazing new device that helps you maintain a constant speed and warns you of excessive speed."[6]

"Like it or not, the robots are slowly taking over a driver's chores," intoned an April 1958 article in *Popular Science* about Auto-Pilot. The article called the concept of cruise control "faintly ominous," but in the end concluded that for "intercity driving, turnpike travel, and long trips generally, the Auto-Pilot is a genuine help" that "certainly promotes safety by reducing fatigue."[7]

Anti-lock brakes have been commercially available since the 1970s,[8] and provide well-documented benefits in reducing stopping distances on slick pavements.[9] Electronic stability control (ESC) was introduced in the mid-1990s and became mandatory in the United States in 2011 for newly manufactured light vehicles.[10] When the driver presses the brake pedal, ESC combines data from multiple sources in the car to selectively apply the brakes on a subset of the wheels, leading to increased control on turns and slippery surfaces. The National Highway Traffic Safety Administration (NHTSA) estimates that ESC saved over 2200 lives among passenger vehicle occupants during the three-year period from 2008 to 2010.[11]

In recent years, more advanced technologies sometimes called "driver assists" have become more common. Some higher-end vehicles ship with automated braking systems aimed at reducing the likelihood of "forward" collisions, which occur when a vehicle fails to stop before impacting the vehicle in front of it. Volvo's City Safety system uses a windshield-mounted sensor to measure the distance to the vehicle driving in the same lane and in

front of the Volvo. If a forward collision risk appears imminent and the driver does not press the brake, City Safety can automatically apply the brake to avoid or reduce the severity of a collision.[12] A 2012 study by the Highway Loss Data Institute (HLDI)[13] analyzed insurance "claim frequency" for the Volvo XC60 and S60, measured in the number of claims per 100 insured vehicle years. For the XC60, City Safety reportedly provided a 15 percent reduction in property damage liability loss claim frequency and a 33 percent reduction in bodily injury liability claim frequency.[14] For the S60, the corresponding percentages were 16 percent and 18 percent respectively.[15]

Mercedes-Benz's Distronic Plus system uses radar sensors to scan traffic ahead for stopped or slowing traffic. If the system senses that a collision is imminent, its PRE-SAFE Brake feature automatically initiates up to 40 percent braking power, audibly alerts the driver, and engages the PRE-SAFE system. When the driver brakes, 100 percent braking pressure is instantly applied. If the driver fails to respond, the system can apply full braking on its own, serving as an "electronic crumple zone" to help reduce the intensity of a collision.[16] An April 2012 HLDI bulletin credited Distronic Plus with a 14 percent reduction in property damage liability claim frequency.[17]

Automated parallel parking is another area in which there has been significant growth in the number and capability of commercially available solutions. These often require cooperation between a driver, who maintains control over the brake and accelerator, and the parking system, which takes over steering control as the vehicle is maneuvered into a parking space. Automakers that have offered solutions include Audi, BMW, Ford, Land Rover, Mercedes-Benz, Nissan, and Toyota.[18]

Vehicle automation spans a broad spectrum, and the technologies that have made it into commercial production represent only a small fraction of those under development. The next several years are likely to see increasing commercial availability of more advanced systems, including improved solutions for automatically keeping cars from drifting across lane lines.

In 2013 the NHTSA released a classification system partitioning vehicle automation into five levels, ranging from level 0 ("no automation") to level 4 ("full self-driving automation").[19] (The full definition provided by the NHTSA for each of these levels is included in this paper as Appendix A). The systems that automatically apply the brakes when they sense an impending frontal collision are in many respects quite sophisticated, yet they only correspond to NHTSA automation level 1 ("function-specific automation").

The last 10 years have seen enormous strides in research to tackle the more difficult tasks requiring higher levels of automation, such as autonomous

navigation of complex routes. In March 2004, the Defense Advanced Research Projects Agency (DARPA) held its first Grand Challenge race, offering a prize of $1 million to the team that could build the autonomous vehicle capable of most quickly navigating an approximately 140-mile course though the Mojave Desert. Almost half of the fifteen vehicles that started the race failed to complete the first mile, and all dropped out before the 10 mile mark.[20] A *Popular Science* article describing the event called it "DARPA's debacle in..... the desert."[21] "The mass media coverage," observed another publication, "bordered on mockery."[22]

DARPA doubled the prize and ran the event again in 2005 on a 132-mile course. This time, five vehicles completed the course.[23] The winning entry, from Stanford, did it in under seven hours. What had in 2004 been considered by some to be indication of the immaturity of autonomous vehicle technology turned, 18 months later, into a spectacular demonstration of how quickly the technology can advance.

"Automation can be used not only within a vehicle, but also among multiple vehicles to share information that can help avoid accidents."

Today, research in vehicle automation is thriving, with major efforts at Google, most of the major auto manufacturers, government organizations, and many universities. In light of this level of attention and investment, vehicle automation is unsurprisingly experiencing unprecedented innovation. The most notable effort is Google's self-driving car project. Google's self-driving cars use a combination of lasers, radar, and cameras to gather information about other nearby objects, such as vehicles, cyclists, and pedestrians. This information is then combined with data from GPS, other on-board sensors (such as accelerometers), and digital map data to make navigation decisions. Google's self-driving cars have traveled more than 500,000 miles without causing an accident while in self-driving mode. A video[24] released by the company in 2012 shows a Google self-driving car ferrying its passengers around Silicon Valley, stopping at a drive-in window to allow the passengers to order food, and then taking them to the dry cleaners.

Automation can be used not only within a vehicle, but also among multiple vehicles to share information that can help avoid accidents. In February 2014, NHTSA announced that "it will begin taking steps to enable vehicle-to-vehicle (V2V) communication technology for light vehicles," including "working on a regulatory proposal that would require V2V devices in new vehicles in a future year . . ."[25]

The research advances over the past few years have proven that vehicle automation technologies can perform amazingly well. But they aren't perfect, and they never will be. Sometimes autonomous vehicles will become involved

in accidents due at least in part to a defect in the autonomous vehicle technology. In the inevitable lawsuits that follow, courts will look to products liability law to identify the appropriate remedies for any resulting injuries and property damage.

Products Liability Law and Autonomous Vehicles: An Overview

Products liability law[26] provides the framework for seeking remedies when a defective product (or misrepresentations about a product) causes harm to persons or property. It is a complex and evolving mixture of tort law and contract law. Tort law addresses civil, as opposed to criminal, wrongs (i.e., "torts") that cause injury or harm, and for which the victim can seek redress by filing a lawsuit seeking an award of damages. A common tort, both in products liability and more generally, is negligence.

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Contract law is implicated by the commercial nature of product marketing and sales, which can create explicit and implicit warranties with respect to the quality of a product. If a product fails to be of sufficient quality, and that failure is the cause of an injury to a purchaser who uses the product in a reasonable manner, the seller could be liable for breach of warranty.[27]

A plaintiff in a products liability lawsuit will typically cite multiple "theories" of liability in an attempt to maximize the odds of prevailing on at least one and thereby obtain a damages award (or a large settlement). The most commonly encountered theories of liability are negligence, strict liability, misrepresentation, and breach of warranty. Each of these is discussed below with examples showing how they might apply in the case of autonomous vehicles.

Negligence: Product manufacturers have a duty to exercise a reasonable degree of care in designing their products so that those products will be safe when used in used in reasonably foreseeable ways. As a (very unlikely!) thought experiment, consider a manufacturer of fully automated (e.g., specifically designed so no driver intervention is needed) braking systems that, against all common sense, conducts testing using only vehicles driven on dry road surfaces. If the braking systems then prove unable to reliably avoid frontal collisions on wet roads, a person injured in a frontal collision on a rainy day could file a negligence claim. He or she could argue that his or her injuries were directly attributable to the manufacturer's negligent failure to anticipate driving in wet conditions as a reasonably foreseeable use of a car equipped with the fully automated braking system.

Strict liability: Even when a manufacturer exercises all possible care in attempting to build safe products, sometimes a product will nonetheless be shipped containing an unsafe defect. If that defect then causes injury to a user of the product, the manufacturer could be "strictly" liable for the resulting damages. The term "strict" is used because it removes the issue of manufacturer negligence from consideration, and instead is based on consumer expectations that products should not be unreasonably dangerous. Historically, and to a significant extent today, strict liability has been invoked with respect to manufacturing defects, design defects, and "failure to warn."

State courts vary in their interpretations of the scope of strict liability. The doctrine was originally articulated in a 1963 California Supreme Court ruling[28] and then incorporated by the American Law Institute in the "Restatement (Second) of Torts"[29] in 1965 (often referred to as the "Restatement (Second)", or the "Second Restatement"). That in turn led to its near universal adoption in state courts in cases over the subsequent several decades.

Under the Second Restatement—and thus under an enormous body of products liability case law—a manufacturer can be liable for the sale of a product containing an "unreasonably dangerous" defect even if it has "exercised all possible care in the preparation and sale" of the product. In addition, the liability can apply even if the user of the product "has not bought the product from or entered into any contractual relation with the seller."[30] As a result, any entity in the product distribution chain upstream from the user can be held strictly liable,[31] and the user does not need to have purchased the product at all. If a manufacturing defect injures a passenger riding in a car owned by a friend, the injured passenger could file a strict liability claim against the manufacturer (or other entities in the distribution chain).

In 1998, the American Law Institute published the "Restatement (Third) of Torts: Product Liability."[32] The Third Restatement specifically addresses each of manufacturing defects, design defects, and failure to warn, but, notably, ties liability for design defects and failure to warn to "foreseeable risks." Under this framework, which will likely be used by an increasing number courts in the future, the failure of a manufacturer to identify and mitigate a dangerous "foreseeable" risk is more akin to negligence than to strict liability.

While the landscape is somewhat in flux with respect to the specific theories of liability that can be invoked to pursue claims regarding manufacturing defects, design defects, and failure to warn, all three remain central to products liability law.

Manufacturing defects: Consider a manufacturer of fully autonomous vehicles that usually ships its cars with well-tested, market-ready automatic braking software. However, suppose that in one instance it accidentally ships one vehicle with a prototype version of the software containing a flaw not present in the market-ready version. If the vehicle becomes involved in an accident attributable to the flaw, a person injured in the accident could file a claim for damages arising from this manufacturing defect. A manufacturer can be found strictly liable for dangerous manufacturing defects, even if it has exercised "all possible care" in preparing the product.[33]

Design defects: Sometimes a product contains a design defect that causes harm.[34] In the context of autonomous vehicles, liability complaints alleging design defects are likely to arise in connection with the shared responsibilities between the vehicle and the human driver. Consider NHTSA automation level 2, which "involves automation of at least two primary control functions designed to work in unison to relieve the driver of control of those functions." The NHTSA definition of automation level two also states that the "driver is still responsible for monitoring the roadway and safe operation and is expected to be available for control at all times and on short notice."[35]

Suppose that an autonomous vehicle manufacturer markets a vehicle that it claims has NHTSA level two automation. But what does "short notice" mean? Consider an accident that occurs because a human driver does not take over control of the autonomous vehicle quickly enough. In a products liability lawsuit, an injured party would likely argue that the autonomous vehicle had a design defect, because it should have been designed to provide the driver with more advanced warning. The manufacturer of the system might counter by arguing 1) that the system *did* provide sufficient advanced warning, and 2) that providing even more warning would necessitate adding very costly new sensors to the vehicle that would only increase the warning time so marginally as to make no practical difference in the time available to a driver to react.

Liability for an alleged design defect is often determined using a risk-utility test,[36] the standards of which vary in different states. Risk-utility tests generally examine whether the risks posed by an alleged design defect could have been avoided or reduced through the use of an alternative solution that would not have impaired the utility of the product or unnecessarily increased its cost.

Failure to warn: Manufacturers that fail to provide adequate information regarding the risks of using a product can be liable for failure to warn when an injury attributable to this lack of information occurs.[37] To minimize this

exposure, manufacturers tend to err on the side of being very conservative in issuing such warnings. For example, Mercedes-Benz's Distronic Plus, which uses automatic braking to help reduce the risk and severity of frontal collisions, is accompanied by a warning to "[a]lways pay attention to traffic conditions even when DISTRONIC PLUS is activated. Otherwise, you may fail to recognise dangers in time, cause an accident and injure yourself and others."[38] As manufacturers introduce new forms of vehicle automation, they will no doubt include copious warnings about the attendant risks.

With respect to autonomous vehicles, the more interesting aspect of liability in relation to warnings concerns the legally distinct issue of a manufacturer's *post-sale* responsibilities to provide warnings regarding newly discovered risks. The issue is legally distinct because, among other reasons, a manufacturer's duty at the time of sale is well established in common law. By contrast, while manufacturers have a clearly recognized responsibility to provide warnings regarding newly discovered risks, the common law legal framework for addressing liability when manufacturers fail to do so is less well established. Notably, liability for post-sale failure to warn was included in the Third Restatement published in 1998, and as a result many states have now adopted stricter requirements regarding manufacturers' responsibilities to provide post-sale warnings regarding newly discovered risk.[39]

It is also important to note that while the common law for addressing post-sale notification regarding newly discovered risks is in flux, there has been plenty of government attention to this issue from the standpoint of consumer safety and protection. Product recalls are common for many different classes of products, including vehicles, and are often handled through legislatively established agencies. The NHTSA, for instance, "conducts defect investigations and administers safety recalls to support its mission to improve safety on our nation's highways."[40]

Post-sale safety with respect to autonomous vehicles will also involve software upgrades. Manufacturers that become aware of potentially risky software problems will need to act quickly to provide upgrades as soon as possible, but at the same time will need to ensure to appropriately test the upgraded software before releasing it. Properly finding that balance will in some cases be challenging, in part due to the associated liability considerations. There is also the question of how the upgrade installation will be managed. Configuring vehicles to accept automatic upgrades would be more efficient, but could also be viewed as problematic by owners who want to specifically approve any changes to their vehicle's software. And, upgrades will also need to be handled in a manner minimizing any cybersecurity risks.

Misrepresentation: Consider an autonomous vehicle manufacturer that advertises that a human driver will only "very rarely" need to take over control from the vehicle. If a purchaser of the vehicle in fact finds that he or she is being asked to take over control every three minutes, he or she might file a claim for damages based on misrepresentation. As this example illustrates, misrepresentation involves the communication of false or misleading information. Liability for misrepresentation can occur when a person who reasonably relies on that information suffers harm (i.e., the misrepresentation is "tortious").

There are several subcategories of tortious misrepresentation. Fraudulent (also called intentional) misrepresentation occurs when a party knowingly provides false or misleading information that causes harm. Negligent representation occurs when the party providing the information knew or should have known that it was false. Strict liability for misrepresentation can be asserted without the need to show whether the defendant knew that the information was false.

"Warranties are assurances, either explicit or implicit, that goods being sold (or leased) are of sufficient quality."

Misrepresentation does not always involve a product defect. In the example above, it is possible that the autonomous vehicle could have been intentionally designed to require human intervention every few minutes. The liability would then arise not from any manufacturing or design defect, but because misleading information about the vehicle's capabilities was conveyed to the buyer.

Breach of Warranty: Negligence, strict liability, and tortious misrepresentation are all features of tort law. In addition, products liability involves contract law due to the warranties created through the process of marketing and selling products. Warranties are assurances, either explicit or implicit, that goods being sold (or leased) are of sufficient quality. If that turns out not to be true, and if an injury to a purchaser of a product occurs as a result, then he or she may have grounds for a products liability claim based on breach of warranty.

Product warranties and many other aspects of commercial transactions are addressed in the Uniform Commercial Code (UCC),[41] which was originally published in 1952 by the National Conference of Commissioners on Uniform State Laws (now called the Uniform Law Commission)[42] and the American Law Institute (ALI). It has been revised multiple times in the decades since its original publication to adapt to changes in the legal and broader commercial environment. The UCC is intended to help provide uniformity of law with respect to commercial transactions across multiple jurisdictions, and has been adopted, in some cases with modifications, by all of the states and

the District of Columbia. With respect to product liability, the most relevant portions of the UCC are those addressing express and implied warranties.

An *express* warranty is created through promises made by a seller to a prospective buyer in association with the sale of goods.[43] In the context of vehicle automation, this could occur through the actual vehicle warranties provided to a buyer. It could also occur through advertising. If a provider of automated parallel parking systems advertises that its technology works just as well at night as during the day, but the system turns out to work well during the day but not at night, a purchaser could legitimately claim that the express warranty regarding the performance of the system has been breached.

An express warranty can also be created through a description of goods provided pursuant to a sale. If the automated parallel parking technology provider describes its system in online marketing brochures as able to "parallel park in spaces only three feet longer than the vehicle," but in fact sells a system that only works in spaces at least five feet longer than the vehicle, a buyer could claim breach of warranty.

Finally, an express warranty can be created through a sample employed during the sale process. Consider a buyer purchases a new vehicle in part based on a demonstration of a manufacturer-installed automated parking system on a vehicle different from the one he or she eventually purchases. If the buyer then finds that the system included with his or her own vehicle doesn't perform nearly as well as the demonstration model used in the sale, he or she would have a claim for breach of warranty.

Warranties can also be *implied*. Unless there is an explicit exclusion or modification to the contrary (e.g., through a disclaimer that something is being sold "as is"), goods are sold under an implicit warranty that they are "merchantable."[44] The UCC provides a six-part test with respect to merchantability;[45] a less formal definition is "a product of a high enough quality to make it fit for sale."[46]

In addition, a seller of goods creates an implicit warranty that the goods will be fit for the purpose for which they are sold.[47] An automated parallel parking system should in fact be capable of using automation to help a driver park a vehicle. If, instead, the system automatically rotates the steering wheel in a manner that would make it impossible to use without causing a collision, a purchaser of the vehicle could assert that the implied warranty accompanying the sale of the product had been breached.

To state the obvious, the above description is not intended to be a complete treatment of products liability law in relation to autonomous vehicles. There is a growing body of legal scholarship that addresses this topic in much more depth, including law review articles from Ryan Calo,[48] Kyle Colonna,[49] Sophia H. Duffy and Jamie Patrick Hopkins,[50] Andrew Garza,[51] Kyle Graham,[52] Gary Marchant and Rachel Lindor,[53] Bryant Walker Smith,[54] and others. In addition, researchers at the RAND Corporation addressed autonomous vehicle liability in reports published in 2009[55] and 2014.[56]

Also, not all of the above theories of liability would be available to everyone injured due to a defect in an autonomous vehicle. The driver of a non-autonomous vehicle injured in a collision with an allegedly defective autonomous vehicle could make a manufacturing defect claim against the autonomous vehicle manufacturer, but would not generally have any basis for asserting liability claims based on misrepresentation, breach of warranty, or failure to warn.

"Autonomous vehicles will complicate the already complicated entanglements between insurance providers, plaintiffs, drivers/owners named as defendants, and manufacturers."

Liability insurance is an additional complicating factor. With respect to non-autonomous vehicles, the methods used by insurers to seek recovery from manufacturers vary in different states. Consider a driver (today, of a non-autonomous car) who gets in an accident attributable, he or she believes, to a manufacturing defect. If the driver is sued by someone injured in the accident, in some states the driver's insurer will then have the driver "implead" (bring in as a party to the lawsuit) the manufacturer. In other states, the insurer will wait until the case concludes, pay out any resulting claims, and then initiate a separate action against the manufacturer.

Autonomous vehicles will complicate the already complicated entanglements between insurance providers, plaintiffs, drivers/owners named as defendants, and manufacturers. One initial question is the extent to which insurance providers might incentivize the use of certain autonomous technologies, over and above those (such as vehicle-to-vehicle communications) that might be required through regulation. In addition, as a condition of providing insurance for drivers of autonomous vehicles, insurers may require greater access to data that could be used to reconstruct the actions that a driver of a vehicle—and/or the software partially controlling the vehicle—took in the moments preceding an accident.

Finally, it should be noted that *products* liability is not the only form of liability that will arise in association with autonomous vehicle use. All but the most fully automated vehicles will be controlled, at least some of the time, by human drivers. Untangling fault for accidents will sometimes involve complex questions of liability shared by both the human driver and autonomous

vehicle technology providers.

Technology As Enabler; Liability As Impediment?

While technology is usually described as an enabler of autonomous vehicles, liability is often described as an impediment. A 2013 article in the *San Diego Union-Tribune* put things bluntly: "Experts said the issue of liability, if not solved, could delay or even wipe out the vision of driverless cars gaining widespread consumer use."[57] Also in 2013, MSN published a story titled "Will lawsuits kill the autonomous car?,"[58] and the *Wall Street Journal* ran an article titled "Liability Issues Create Potholes on the Road to Driverless Cars."[59]

"While technology is usually described as an enabler of autonomous vehicles, liability is often described as an impediment."

Some of the legal scholarship cited above predicts a trend towards increased manufacturer liability with increased use of automation. Bryant Walker Smith writes that "commercial sellers' growing information about, access to, and control over their products, product users, and product uses could significantly expand their point-of-sale and post-sale obligations toward people endangered by these products."[60] Gary Marchant and Rachel Lindor believe that while autonomous vehicles "will increase the safety of vehicle travel by reducing vehicle collisions," they will nonetheless "*increase* the liability exposure of vehicle manufacturers. Autonomous vehicles will shift the responsibility for avoiding accidents from the driver to the vehicle manufacturer."[61]

Liability concerns have also figured prominently in state legislative initiatives related to autonomous vehicles. Autonomous vehicle legislation has been introduced in many states, and enacted in California,[62] Florida,[63] Michigan,[64] Nevada,[65] and the District of Columbia.[66] The California and Nevada statutes are silent on liability. By contrast, the D.C., Florida, and Michigan statutes contain language protecting original manufacturers from liability for defects introduced on the aftermarket by a third party who converts the a non-autonomous vehicle into an autonomous vehicle.

Addressing Autonomous Vehicle Liability and Legislation: Some Guiding Principles

In the coming years, autonomous vehicle liability is certain to be a topic of continuing interest in state legislatures, in Congress, in the legal community, among the researchers and companies working to develop autonomous vehicle technology, and among the consumers who will eventually be purchasing and using that technology. Whether federal or state liability legislation is needed, and if so, what form it should take, will be a recurring question. Here are some guiding principles that can help frame those

discussions:

1. Preemptively resolving liability issues should not be a precondition to commercial rollout of autonomous vehicles. Given the certainty that new products liability questions will arise as more advanced autonomous vehicle technologies are commercially adopted, it is tempting to conclude that they need to be addressed in advance. Navigant Research, for instance, wrote in a late 2013 report on autonomous vehicles that "the factors that remain to be solved before rollout to the public are those of liability and legislation."[67]

However, while that statement is certainly true with respect to legislation clarifying the legality of operating autonomous vehicles on public roads, it does not follow that all of the associated liability questions need to be addressed *before* the public can get access to new autonomous vehicle technologies. Subject to a few narrow exceptions, there are good reasons (see principles two and three below) to let the courts address such questions, when and as they arise.

"Products liability law has proven to be remarkably adaptive to new technologies."

2. Products liability law has proven to be remarkably adaptive to new technologies. The same will hold true for autonomous vehicle technologies. Products liability has been one of the most dynamic fields of law since the middle of the 20th century. In part, this is because the new technologies that emerged over this period have led courts to consider a continuing series of initially novel products liability questions. On the whole, the courts have generally proven quite capable of addressing these questions, and in doing so have been the primary drivers of a positive feedback cycle involving case law, the American Law Institute's Second (in 1965) and Third (in 1998) Restatements, revisions to the Uniform Commercial Code, and changes to state statutory law. Through this process, products liability law has evolved to its current state. Given this strong record of adaptation to new technologies, there is no reason to expect that the legal system will be unable to address the products liability issues that arise with respect to autonomous vehicles.

3. Congress should not preempt state tort remedies with respect to autonomous vehicle liability. The authors of the 2009 RAND report wrote that:

> "Congress could consider creating a comprehensive regulatory regime to govern the use of these technologies. If it does so, it should also consider preempting inconsistent state-court tort remedies. This may minimize the number of inconsistent legal regimes that manufacturers face and simplify and speed the introduction of this technology. While federal preemption has important disadvantages, it might speed

the development and utilization of this technology and should be considered, if accompanied by a comprehensive federal regulatory regime."[68]

The authors of the 2014 RAND report also raised the possibility of (and recognized the drawbacks of) federal legislation that would "flatly limit liability"[69] for autonomous vehicle technology.

To put it mildly, congressional preemption of state tort remedies with respect to autonomous vehicle liability would be a mistake. Liability for vehicle manufacturing defects has always been the province of state courts applying state tort remedies. That should continue to be the case for autonomous vehicles. While it is certainly true that state court remedies are sometimes inconsistent, it does not follow that the solution is for the federal government to strip state courts of their authority. Among other problems, federal preemption would put the federal government in the impossible position of trying to formulate the "right" set of liability standards that would then be imposed, including the inevitable mistakes they would contain, on the states.

4. Manufacturers of non-autonomous vehicles should not be liable for alleged defects introduced through third party conversions into an autonomous vehicle.

Common sense would hold that, if an original manufacturer in no way participates in or promotes the post-sale installation of autonomous vehicle technology manufactured by a third party, the original manufacturer should not be liable for alleged defects in that technology. Unfortunately, some of the case law relating to liability for third-party conversions in other contexts doesn't necessarily support this common sense conclusion.

In 1996, for example, an Illinois court wrote that "[w]here an unreasonably dangerous condition is caused by a modification to the product after it leaves the manufacturer's control, the manufacturer is not liable unless the modification was reasonably foreseeable."[70] If applied in the context of autonomous vehicles, the logic of the "unless" clause could be problematic. After all, when autonomous vehicle technology becomes common, modifications to install it in non-autonomous vehicles will be "reasonably foreseeable." Yet it would be unfair on that basis alone to saddle original manufacturers of non-autonomous vehicles with liabilities for third party autonomous vehicle technologies they had no role in creating or installing.

Thus, this is an area in which state-level legislation to shield manufacturers from this unreasonable third-party liability is in fact beneficial. The District of Columbia, Florida, and Michigan autonomous vehicle statutes provide this projection, though the statutes in California and Nevada do not.

5. In the long term, federal attention to safety standards for autonomous vehicles will be needed, and those standards will have liability implications. As noted above, federal level legislation specifically preempting state authority regarding autonomous vehicle liability would be mistake, However, that does not mean there is no proper federal role related to autonomous vehicles more generally. In particular, just as the federal government has established "minimum safety performance requirements for motor vehicles" in the context of non-autonomous vehicles,[71] the federal government has a clear role in setting safety standards for autonomous vehicles.

In its May 2013 "Preliminary Statement of Policy Concerning Automated Vehicles," NHTSA stated that it "is conducting research on self-driving vehicles so that the agency has the tools to establish standards for these vehicles, should the vehicles become commercially available."[72] This will clearly be a long process, and the lack of specific minimum safety standards shouldn't be a reason to put the entire autonomous vehicle industry on hold. Even in the absence of such standards, the incentives for manufacturers to provide safe autonomous vehicle technologies are extremely high.

However, as the autonomous vehicle industry matures in the coming years, it will be important to establish a nationally consistent set of safety regulations. Those standards, once they are established, would indirectly impact liability: The process of setting standards at the federal level would provide a set of metrics that state courts would likely choose to adopt in liability cases.

6. Liability related to autonomous commercial motor vehicles should, at least in part, be addressed federally. Commercial motor vehicles are federally regulated. In particular, the Federal Motor Carrier Administration, which is within the Department of Transportation, has promulgated an extensive set of regulations aimed at reducing "crashes, injuries and fatalities involving large trucks and buses."[73] Those regulations include requirements regarding liability.[74]

Given this framework, it is sensible, and in fact advisable, for the Federal Motor Carrier Administration to proactively consider the best ways to regulate commercial motor vehicles in the different NHTSA automation levels, starting at levels two and 3. Not all of this regulation would directly involve liability. But the process of setting standards would also have clear ties to liability issues, as noted above in association with principle number 5.

Conclusions

In early 2014, IHS Automotive released "Emerging Technologies: Autonomous

Cars – Not If, But When,"[75] a study projecting a global total of "nearly 54 million"[76] self-driving cars by 2035, and predicting that "nearly all of the vehicles in use are likely to be self-driving cars or self-driving commercial vehicles sometime after 2050."[77]

While there can clearly be differing views on how fast autonomous vehicle technologies will be adopted, there is really no dispute that, as IHS Automotive states, it is a matter of if and not when. The result will be a driving environment that, on average, is far safer than what we are accustomed to today.

Accidents, however, will always be an aspect of motor vehicle travel, and the liability questions that autonomous vehicles will raise are thus important and worthy of attention. That should not, however, be a reason to prevent consumer access to autonomous vehicle technology. The United States has a robust products liability law framework that, while certainly not perfect, will be well equipped to address and adapt to the autonomous vehicle liability questions that arise in the coming years.

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Appendix

The National Highway Traffic Safety Administration's Vehicle Automation Levels

In May 2013, The National Highway Traffic Safety Administration (NHTSA) released a "Preliminary Statement of Policy Concerning Automated Vehicles"[78] that included a set of definitions regarding levels of vehicle automation as follows:

Level 0: No-Automation

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. Vehicles that have certain driver support/convenience systems but do not have control authority over steering, braking, or throttle would still be considered "level 0" vehicles. Examples include systems that provide only warnings (e.g., forward collision warning, lane departure warning, blind

spot monitoring) as well as systems providing automated secondary controls such as wipers, headlights, turn signals, hazard lights, etc. Although a vehicle with V2V warning technology alone would be at this level, that technology could significantly augment, and could be necessary to fully implement, many of the technologies described below, and is capable of providing warnings in several scenarios where sensors and cameras cannot (e.g., vehicles approaching each other at intersections).

Level 1: Function-specific Automation

Automation at this level involves one or more specific control functions; if multiple functions are automated, they operate independently from each other. The driver has overall control, and is solely responsible for safe operation, but can choose to cede limited authority over a primary control (as in adaptive cruise control), the vehicle can automatically assume limited authority over a primary control (as in electronic stability control), or the automated system can provide added control to aid the driver in certain normal driving or crash-imminent situations (e.g., dynamic brake support in emergencies). The vehicle may have multiple capabilities combining individual driver support and crash avoidance technologies, but does not replace driver vigilance and does not assume driving responsibility from the driver. The vehicle's automated system may assist or augment the driver in operating one of the primary controls – either steering or braking/throttle controls (but not both). As a result, there is no combination of vehicle control systems working in unison that enables the driver to be disengaged from physically operating the vehicle by having his or her hands off the steering wheel AND feet off the pedals at the same time. Examples of function-specific automation systems include: cruise control, automatic braking, and lane keeping.

Level 2: Combined Function Automation

This level involves automation of at least two primary control functions designed to work in unison to relieve the driver of control of those functions. Vehicles at this level of automation can utilize shared authority when the driver cedes active primary control in certain limited driving situations. The driver is still responsible for monitoring the roadway and safe operation and is expected to be available for control at all times and on short notice. The system can relinquish control with no advance warning and the driver must be ready to control the vehicle safely. An example of combined functions enabling a Level two system is adaptive cruise control in combination with lane centering. The major distinction between level oneand level two is that, at level two in the specific operating conditions for which the system is

designed, an automated operating mode is enabled such that the driver is disengaged from physically operating the vehicle by having his or her hands off the steering wheel AND foot off pedal at the same time.

Level 3: Limited Self-Driving Automation

Vehicles at this level of automation enable the driver to cede full control of all safety-critical functions under certain traffic or environmental conditions and in those conditions to rely heavily on the vehicle to monitor for changes in those conditions requiring transition back to driver control. The driver is expected to be available for occasional control, but with sufficiently comfortable transition time. The vehicle is designed to ensure safe operation during the automated driving mode. An example would be an automated or self-driving car that can determine when the system is no longer able to support automation, such as from an oncoming construction area, and then signals to the driver to reengage in the driving task, providing the driver with an appropriate amount of transition time to safely regain manual control. The major distinction between level two and level three is that at level 3, the vehicle is designed so that the driver is not expected to constantly monitor the roadway while driving.

Level 4: Full Self-Driving Automation

The vehicle is designed to perform all safety-critical driving functions and monitor roadway conditions for an entire trip. Such a design anticipates that the driver will provide destination or navigation input, but is not expected to be available for control at any time during the trip. This includes both occupied and unoccupied vehicles. By design, safe operation rests solely on the automated vehicle system.

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