Minnesota Journal of Law, Science & Technology

Volume 16 | Issue 2 Article 10

2015

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ABSTRACT

Self-driving vehicles (SDVs) are predicted to be the future of automotive transportation. The significant potential benefits of SDVs to safety, congestion reduction, land use, and productivity are hard to ignore. Although fully automated vehicles are still a ways away, the technology is rapidly advancing and becoming more legally accepted. For example, the National Highway Traffic Safety Administration (NHTSA) requires all newly manufactured cars to have at least a low-level of autonomous vehicle technology and suggests widespread adoption of more advanced technology by 2020. Four states and the District of Columbia have some form of legislation expressly allowing SDVs or the testing of such vehicles within state boundaries. In

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The authors would like to thank all those who participated in the Symposium: Autonomous Vehicles—The Legal and Policy Road Ahead; numerous colleagues from the Transportation Research Board; colleagues and mentors from the University of Minnesota; and the Transportation Policy and Economic Competitiveness Program at the University of Minnesota for making this Article possible.

fact, two states—California and Nevada—have even issued comprehensive regulations for both private use and testing of SDVs. Several companies, most notably Google, are aggressively pursuing the technology and advocating for legal changes in support of SDVs. But what does this all mean for Minnesota drivers, laws and lawmakers, and local economies?

This Article explores the development of SDVs and related technology and how states have responded to this development as context for more substantive discussion about why and how Minnesota might move to adopt and adapt to this transformative technology. Specifically, this Article will explore how current laws may already permit SDVs and how the law could be, or in some cases must be, modified to authorize testing and use of SDVs in the state. Finally, this Article will describe why SDVs and the related legal changes needed to support their development and adoption can greatly benefit Minnesota's citizens and economy.

I. INTRODUCTION

Self-driving vehicles (SDVs) are predicted to be the future of automotive transportation.[1] Also referred to as autonomous, automated, or driverless vehicles, SDVs are often discussed as a "disruptive technology" with the ability to transform transportation infrastructure, expand access, improve mobility, and deliver a range of benefits to a variety of users.[2] Some observers predict limited availability of driverless cars by 2020 with wide availability to the public by 2040.[3] Recent announcements by Google and other major automakers indicate huge potential for development in this area.[4] For example, an Audi RS7 recently self-piloted around the famous Hockheimring racetrack.[5] The fully autonomous car reached a new record of 150 miles per hour and recorded a lap that was

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1. *See* DANIEL J. FAGNANT & KARA M. KOCKELMAN, ENO CTR. FOR TRANSP., PREPARING A NATION FOR AUTONOMOUS VEHICLES: OPPORTUNITIES, BARRIERS AND POLICY RECOMMENDATIONS 17 (2013), *available at* http://www.enotrans.org/wp-content/uploads/wpsc/downloadables/AV-paper.pdf ("The idea of a driverless car may seem a distant possibility, but autonomous technology is improving quickly and some features are already offered on current vehicle models.").

2. *Id.* at 3–10; KPMG & THE CTR. FOR AUTO. RESEARCH, SELF-DRIVING CARS: THE NEXT REVOLUTION 10–15 (2012), *available at* http://www.kpmg.com/US/en/IssuesAndInsights/ArticlesPublications/Documents/self-driving-cars-next-revolution.pdf; Burkhard Bilger, *Auto Correct: Has the Self-Driving Car at Last Arrived?*, NEW YORKER, (Nov. 25, 2013), http://www.newyorker.com/reporting/2013/11/25/131125fa_fact_bilger.

3. *See* KPMG & THE CTR. FOR AUTO. RESEARCH, *supra* note 2, at 21–22 (projecting the release of SDVs by 2019); Doug Newcomb, *You Won't Need a Driver's License by 2040*, CNN (Sept. 18, 2012), http://www.cnn.com/2012/09/18/tech/innovation/ieee-2040-cars/index.html.

4. *E.g.*, Chris Urmson, *The Latest Chapter for the Self-Driving Car: Mastering City Street Driving*, GOOGLE (Apr. 28, 2014), http://googleblog.blogspot.co.uk/2014/04/the-latest-chapter-for-self-driving-car.html.

5. Leo Kelion, *Audi Claims Self-Drive Car Speed Record After German Test*, BBC NEWS (Oct. 21, 2014), http://www.bbc.com/news/technology-29706473.

five seconds faster than a human competitor.[6] The federal automotive safety regulator, the National Highway Traffic Safety Administration (NHTSA), issued a policy statement in mid-2013 about the potential of SDVs and NHTSA's anticipated regulatory activity.[7] Many industry experts cite 2020 as the likely date that the first driverless cars will be available, with full self-driving capabilities and wider adoption in 2040–2050.[8]

Although fully self-driving cars are still prototypical today, the technology is rapidly advancing and increasingly greater levels of automation are being widely adopted and legally accepted.[9] For example, NHTSA requires all newly manufactured cars to have at least electronic stability control[10] and is also proposing to require the technology on semi-trucks and large buses.[11] Four states and the District of Columbia have some form of legislation expressly allowing SDVs or the testing of such vehicles within state boundaries.[12] In fact, two states—California[13] and Nevada[14]—have issued comprehensive regulations for both private use and testing of SDVs. While some scholars suggest that, even in the absence of specific laws and regulations, SDVs are legal under existing legal frameworks,[15] several companies, most notably Google (which has driven over 700,000 fully autonomous miles),[16] are

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6. *Id.*

7. NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., U.S. DEP'T OF TRANSP., PRELIMINARY STATEMENT OF POLICY CONCERNING AUTOMATED VEHICLES (2013) [hereinafter PRELIMINARY STATEMENT], *available at* http://www.nhtsa.gov/staticfiles/rulemaking/pdf/Automated_Vehicles_Policy.pdf.

8. *How Autonomous Vehicles Will Shape the Future of Surface Transportation*, *Hearing Before Subcomm. on Highways & Transit of the H. Comm. on Transp. & Infrastructure*, 113th Cong. 47–57 (2013) (statement of the Hon. Kirk Steudle, Director, Mich. Dep't of Transp.).

9. *See id.*

10. 49 C.F.R. §§ 571.126, 585.81 (2011).

11. *Id.* § 571.83.

12. CAL. VEH. CODE § 38750 (West 2015); D.C. CODE § 50-2352 (2014); FLA. STAT. ANN. §§ 316.003–.090 (West 2014); MICH. COMP. LAWS § 257.2b (2014); NEV. REV. STAT. ANN. § 482A.030 (LexisNexis 2013).

13. *See* CAL. CODE REGS. tit. 13, §§ 227.04, 227.18 (2014).

14. NEV. ADMIN. CODE § 482A.010 (2014).

15. Bryant Walker Smith, *Autonomous Vehicles Are Probably Legal in the United States*, 1 TEX. A&M L. REV. 411, 412 (2014).

16. Urmson, *supra* note 4.

aggressively pursuing the technology and advocating for legal changes in support of SDVs.[17] Automotive manufacturers from Bosch to Mercedes to Tesla are all pursuing the technology and frequently provide updates on their SDV plans and projects.[18]

The significant potential benefits derived from SDVs are hard to ignore. By far the greatest predicted benefits are related to safety and convenience.[19] NHTSA's crash causation survey found that more than ninety percent of all automobile crash fatalities are attributable, at least in part, to driver inattention, driver decision error, or driver performance errors.[20] These errors, which include distractions, excessive speed, disobedience of traffic rules or norms, and misjudgment of road conditions—all factors within the control of the driver—would be mitigated or even eliminated with SDVs.[21] Furthermore, SDVs have the potential to improve roadway capacity by increasing throughput, the maximum number of cars per hour per lane on a roadway.[22] Other potential improvements to capacity can include fewer necessary lanes due to increased throughput, narrower lanes because of the accuracy and driving control of SDVs, and a reduction in infrastructure wear and tear resulting from fewer crashes.[23]

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17. *See* Allen Young, *Google Warns DMV Not to Over-Regulate Self-Driving Cars*, SACRAMENTO BUS. J. (Jan. 27, 2015), http://www.bizjournals.com/sacramento/news/2015/01/27/google-dmv-self-driving-cars-workshop.html.

18. *See, e.g.*, Matthew de Paula, *Autonomous Driving Tech Package Will Be An Option on Mercedes Vehicles by 2020*, FORBES (Sept. 20, 2013, 11:33 PM), http://www.forbes.com/sites/matthewdepaula/2013/09/30/autonomous-driving-will-become-an-option-on-regular-mercedes-models-by-2020/; *Dual Motor Model S and Autopilot*, TESLA MOTORS (Oct. 10, 2014), http://www.teslamotors.com/blog/dual-motor-model-s-and-autopilot; T*echnology for Greater Safety,* BOSCH GLOBAL, http://www.bosch.com/en/com/boschglobal/automated_driving/automated_driving.html (last visited Feb. 8, 2015); *see also* Chris Urmson, *Just Press Go: Designing a Self-Driving Vehicle*, GOOGLE (May 27, 2014), http://googleblog.blogspot.com/2014/05/just-press-go-designing-self-driving.html.

19. *See* FAGNANT & KOCKELMAN, *supra* note 1, at 3–4 (listing safety and traffic operations as potential benefits of SDVs).

20. NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., U.S. DEP'T OF TRANSP., NATIONAL MOTOR VEHICLE CRASH CAUSATION SURVEY: REPORT TO CONGRESS 30 (2008), *available at* http://www-nrd.nhtsa.dot.gov/Pubs/811059.PDF.

21. PRELIMINARY STATEMENT , *supra* note 7, at 2–3.

22. KPMG & THE CTR. FOR AUTO. RESEARCH, *supra* note 2, at 26.

23. JAMES M. ANDERSON ET AL., RAND CORP., AUTONOMOUS VEHICLE TECHNOLOGY: A GUIDE FOR POLICYMAKERS 17–36 (2014), *available at*

Wide adoption of SDVs could also significantly reduce greenhouse gas emissions from the transportation sector.[24] Furthermore, while supplemental transportation programs and senior shuttles have improved mobility for the disabled and elderly in recent decades,[25] SDVs have the potential to allow those who otherwise would be unable to drive the freedom, flexibility, and spontaneity that comes with driving.[26]

The economic benefits of SDVs are also staggering. Even if just ten percent of existing vehicles were replaced with SDVs, the ENO Center for Transportation estimates the cost savings from avoided crashes would range from $5.5 billion to $17.7 billion per year.[27] When aggregated, the economic benefit of a ten percent adoption rate would surpass $35 billion per year.[28] This amount rapidly increases as the rate of adoption increases; ENO estimates comprehensive cost savings of as much as $447.1 billion per year if ninety percent of the population drove SDVs.[29]

Although the benefits described above make a strong case for the widespread adoption of SDVs, there are currently many obstacles to making this technology viable and widely available. These obstacles include, among others, developing technology that is affordable enough for the consumer market,[30] adapting roadways to SDV use if necessary,[31] and addressing issues of driver trust and willingness to accept the

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http://www.rand.org/content/dam/rand/pubs/research_reports/RR400/RR443-1/RAND_RR443-1.pdf.

24. *Id*.

25. *See, e.g.*, Ed Hutchinson, *Automated Vehicles for the Elderly in Florida*, FLA. AUTOMATED VEHICLES (Dec. 2, 2014), http://www.automatedfl.com/automated-vehicles-elderly-florida/ (detailing the benefits SDVs could bring to elderly populations with limited mobility).

26. FAGNANT & KOCKELMAN, *supra* note 1, at 1.

27. *See id.*

28. *Id.* at 8.

29. *Id.*

30. *See* KPMG & THE CTR. FOR AUTO. RESEARCH, *supra* note 2, at 20; *see also* Samantha Murphy Kelly, *8 Big Questions About Google's Self-Driving Car*, MASHABLE (May 28, 2014), http://mashable.com/2014/05/28/google-self-driving-car-prototype/.

31. *See* Terry Bennett, *Google's Plan for Autonomous Cars Doesn't Go Far Enough*, WIRED (Sept. 30, 2013, 9:30 AM), http://www.wired.com/2013/09/we-need-to-think-about-the-infrastructure-for-autonomous-cars-too/. However, the technology in most existing SDVs does not necessitate roadway changes.

new technology.[32] Beyond these challenges, significant legal and policy issues also loom, such as who should be considered the "driver" in the self-driving realm, how should liability be distributed, and how insurance coverage should apply.

This Article addresses the legal and regulatory obstacles to adopting SDVs in Minnesota by reviewing the state's law in depth. We focus on Minnesota for several reasons. First and foremost, this Article was developed pursuant to the recent symposium on "Autonomous Vehicles: The Legal and Policy Road Ahead" co-hosted by the State and Local Policy Program, University of Minnesota's Humphrey School of Public Affairs, and the Center for Transportation Studies.[33] Second, the University of Minnesota has significant experience in technological and policy research in integrating technology in transportation systems.[34] Finally, the Minnesota Legislature briefly considered a bill with language that permitted SDVs, and directed the state's Department of Transportation to develop regulations for SDVs.[35] The types of issues addressed in this Article, however, are likely to be similar to those raised in other states as well.

In this Article, we first provide an overview of the technological context in which SDVs are developing. Second, we provide a summary of Bryant Walker Smith's analysis on the legality of SDVs and an overview of SDV-specific laws from the jurisdictions that have enacted them. Third, we evaluate whether SDVs are legal under existing Minnesota laws, regulations, and state case law. Next, we identify those gaps in existing laws and regulations that have the potential to prohibit or slow the development and adoption of SDVs. Finally, we provide our recommendations for closing those

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32. *See* KPMG & THE CTR. FOR AUTO. RESEARCH, *supra* note 2, at 19; *see also* Kelly, *supra* note 30.

33. *See Autonomous Vehicles: The Legal and Policy Road Ahead*, U. MINN., https://sites.google.com/a/umn.edu/autonomous-vehicles-the-legal-and-policy-road-ahead/ (last visited Feb. 8, 2015).

34. *See Research*, HUMANFIRST, http://www.humanfirst.umn.edu/research/ (last modified Aug. 21, 2014); *Research by Researcher: Max Donath*, INTELLIGENT TRANSP. SYS. INST., http://www.its.umn.edu/Research/Researcher.html?id=1852 (last modified Nov. 12, 2013); *Research: Intelligent Vehicles*, CENTER TRANSP. STUD., http://www.cts.umn.edu/Research/Topic.html?id=68 (last modified Aug. 25, 2014).

35. H.F. 1580, 88th Leg., Reg. Sess. (Minn. 2013), *available at* http://wdoc.house.leg.state.mn.us/leg/LS88/HF1580.0.pdf.

gaps. Ultimately, we argue that Minnesota should act to prepare for SDVs. Minnesota has much to gain from such efforts, including, but not limited to, attracting automotive manufacturers and technology companies involved in SDV research and development; opportunities for innovators and entrepreneurs; opportunities for educational institutions to engage in development of advanced technology; and most importantly, the significant chance to improve the health, safety, and well-being of Minnesota residents.

II. TECHNOLOGICAL CONTEXT

Computing technology has transformed tools that affect nearly every aspect of modern life, from washing machines, to telephones, to personal fitness.[36] Automobiles, however, are arguably still relatively rudimentary. In fact, Bill Gates once contrasted the economic benefits of the constant innovation in computers to the relative ossification of automobile technology.[37] In 2004, the U.S. Department of Defense organized the DARPA Grand Challenge. This 300-mile, on- and off-road course was the first large scale test of the SDV concept.[38] DARPA envisioned the challenge as an opportunity "to leverage American ingenuity to accelerate the development of autonomous vehicle technologies that can be applied to military requirements."[39] Although none of the entrants were able to complete the course in 2004, the very next year, five vehicles finished a 132-mile desert course.[40] In 2007, the technology was further tested in a much more complex and chaotic urban environment, including obstacles such as obeying

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36. *See* ORG. FOR ECON. CO-OPERATION & DEV., 21ST CENTURY TECHNOLOGIES: PROMISES AND PERILS OF A DYNAMIC FUTURE 10 (1998), *available at* http://www.oecd.org/futures/35391210.pdf.

37. Katie Hafner, *Do Computers Have to Be Hard to Use?*, N.Y. TIMES (May 28, 1998), http://www.nytimes.com/1998/05/28/technology/do-computers-have-to-be-hard-to-use.html. Automakers reportedly responded by questioning the reliability of computers: "Yes, but would you want your car to crash twice a day?" *Id.*

38. *Overview*, DEF. ADVANCED RES. PROJECTS AGENCY, http://archive.darpa.mil/grandchallenge04/overview.htm (last visited Jan. 31, 2015).

39. *Id.*

40. Andrew R. Swanson, *"Somebody Grab the Wheel!": State Autonomous Vehicle Legislation and the Road to a National Regime*, 97 MARQ. L. REV. 1085, 1095 (2014).

traffic laws, merging into traffic, U-turns, and intersection navigation.[41] Since the 2007 Urban Challenge, at least thirteen major automotive manufacturers and technology companies—Audi,[42] Ford,[43] GM,[44] Tesla,[45] and Volvo[46]—have joined the race to fully deploy SDVs.[47] Each project uses different terminology and each relies on different technology.[48] Many of these SDV

41. *Urban Challenge 2007,* DEF. ADVANCED RES. PROJECTS AGENCY, http://archive.darpa.mil/grandchallenge/index.html (last visited Jan. 27, 2015).

42. Jason H. Harper, *Audi's Self-Driving Car: Hands Off the Steering Wheel!*, FORTUNE (Jan. 28, 2015), http://fortune.com/2015/01/28/audis-self-driving-car/.

43. Edward Moyer, *Ford's Self-Driving Car Unveils* Itself, CNET (Dec. 14, 2013, 1:06 PM), http://www.cnet.com/news/fords-self-driving-car-unveils-it self/.

44. Keith Naughton, *GM to Introduce Hands-Free Driving in Cadillac Model*, BLOOMBERG (Sept. 7, 2014), http://www.bloomberg.com/news/articles /2014-09-07/gm-to-introduce-hands-free-driving-in-cadillac-model.

45. Alexander C. Kaufman, *Tesla's Self-Driving Feature Leaves Insurers Idling as States Scramble*, HUFFINGTON POST (Mar. 28, 2015), http://www.huffingtonpost.com/2015/03/28/tesla-self-driving-cars_n_696192 2.html.

46. Diana T. Kurylko, *Volvo to Unleash Self-Driving Cars on Swedish Roads*, AUTONEWS (Mar. 1, 2015), http://www.autonews.com/article/20150 301/OEM06/303029948/volvo-to-unleash-self-driving-cars-on-swedish-roads.

47. Other companies include Google, BMW, Mercedes, Toyota, Nissan, Renault, and Jaguar. *E.g.*, Jesse Crosse, *Renault Developing Autonomous Driving Technology*, AUTOCAR (Dec. 15, 2013), http://www.autocar.co.uk/car-n ews/industry/renault-developing-autonomous-driving-technology; Stephen Elmer, *BMW Targets 2020 for Self-Driving Cars*, AUTOGUIDE (Feb. 26, 2013), http://www.autoguide.com/auto-news/2013/02/bmw-targets-2020-for-self-driv ing-cars.html; Jonathan Hawley, *Jaguar Joins the Race to Driverless Cars*, DRIVE (Oct. 3, 2014), http://www.drive.com.au/motor-news/jaguar-joins-the-ra ce-to-driverless-cars-20141003-10ply7.html; Alex Oagana, *Mercedes-Benz to Introduce Autobahn Pilot Assistant in Two Years*, AUTOEVOLUTION (Nov. 11, 2013, 12:32 PM), http://www.autoevolution.com/news/mercedes-benz-to-intro duce-autobahn-pilot-assistant-in-two-years-video-70731.html; Richard Read, *Nissan Reveals New Details About Autonomous Car Features & Arrival Dates*, CAR CONNECTION (July 21, 2014); Richard Read, *Toyota Will Roll Out Autonomous Cars by the 'Mid-2010s,'* CAR CONNECTION (Oct. 11, 2013), http://www.thecarconnection.com/news/1087636_toyota-will-roll-out-autonomo us-cars-by-the-mid-2010s; Rebecca J. Rosen, *Google's Self-Driving Cars: 300,000 Miles Logged, Not a Single Accident Under Computer Control*, ATLANTIC (Aug. 9, 2012, 12:29 PM), http://www.theatlantic.com/technology /archive/2012/08/googles-self-driving-cars-300-000-miles-logged-not-a-single-a ccident-under-computer-control/260926.

48. *See, e.g.*, Press Release, Audi USA, Audi A7 Piloted Driving Car Completes 550-mile Automated Test Drive (Jan. 4, 2015), *available at* http://www.audiusa.com/newsroom/news/press-releases/2015/01/550-mile-pilot ed-drive-from-silicon-valley-to-las-vegas; Press Release, Volvo Car Group,

projects are a partnership between a major auto company and a major research university.[49]

Before delving into the legal details and minutia, it is important to have a clear and consistent understanding of what an SDV is. First, there are numerous terms for the technology involved with SDVs: autonomous vehicles, automated vehicles, self-piloted, robot cars, driverless cars, etc. Unless otherwise noted, this Article will use SDV to mean any technology where the human driver cedes at least partial control over driving to the vehicle. There are several additional terms used to modify the base term—for instance, conditional automation, assisted automation, or full automation.[50] These terms refer to the relationship between the human driver and the technology used to operate the vehicle.[51] Finally, several individual technologies can be understood as intelligent, assist, or semi-automated technology.[52] Adaptive cruise control, parking assist, lane departure warnings, and blind spot detectors are included in this category.[53]

In May 2013, NHTSA published a comprehensive, although "preliminary," statement of policy regarding SDVs.[54]

Volvo Car Group's First Self-Driving Autopilot Cars Test on Public Roads Around Gothenburg (Apr. 29, 2014), *available at* https://www.media.volvocars.com/global/en-gb/media/pressreleases/145619/volvo-car-groups-first-self-driving-autopilot-cars-test-on-public-roads-around-gothenburg; *Dual Motor Model S and Autopilot*, TESLA (Oct. 10, 2014), http://www.teslamotors.com/blog/dual-motor-model-s-and-autopilot.

49. For instance, Volkswagen's Electronic Research Laboratory partners with Stanford University, GM partners with Carnegie Mellon University, and Ford partners with the University of Michigan. *Autonomous Driving*, VOLKSWAGEN ELECTRONICS RES. LABORATORY, http://www.vwerl.com/our-work/view/34 (last visited Jan. 31, 2015); *Ford Reveals Automated Fusion Hybrid Vehicle*, FORD (Dec. 12, 2013), https://media.ford.com/content/fordmedia/fna/us/en/news/2013/12/12/ford-reveals-automated-fusion-hybrid-research-vehicle—teams-up-.html; *GM Collaborative Research Lab*, CARNEGIE MELLON U., http://gm.web.cmu.edu/ (last visited Jan. 31, 2015).

50. *See* David Strickland, Nat'l Highway Traffic Safety Admin. Adm'r, Remarks at the Autonomous Vehicle Seminar (Oct. 23, 2012), *available at* http://www.nhtsa.gov/staticfiles/administration/pdf/presentations_speeches/2012/Strickalnd-Autonomous_Veh_10232012.pdf.

51. *See id.*

52. *See Research and Markets: Global Intelligent Driving Industry Report 2014-2017*, BUS. WIRE (Sept. 4, 2014, 12:01 PM), http://www.businesswire.com/news/home/20140904006004/en/Research-Markets-Global-Intelligent-Driving-Industry-Report#.VNfTY_7F-kk.

53. *See* ANDERSON ET AL., *supra* note 23, at 2.

54. PRELIMINARY STATEMENT, *supra* note 7.

This policy statement recognized the potentially disruptive effects—both positive and negative—of automated vehicles, but also noted that the changes were in many ways prompted by shifting attitudes and expectations of drivers.[55] Ultimately, the policy statement focuses on the "hundreds of billions of dollars" saved by SDVs because of the improvements in safety thanks to automation technology.[56] NHTSA believed the policy statement was necessary for realizing "the full benefits" of the technology, "charting [a] course" for progression, and preventing "confusion or disarray" in the development of automated technology.[57]

NHTSA outlined five levels of automation in its policy statement.[58] According to NHTSA, an automated vehicle is a vehicle "in which at least some aspects of a safety-critical control function (e.g., steering, throttle, or braking) occur without direct driver input."[59] These vehicles use "on-board sensors, cameras, GPS, and telecommunications to obtain information in order to make their own judgments regarding safety-critical situations and act appropriately by effectuating control at some level."[60] By providing a clear picture of the five levels of automation,[61] the policy statement facilitates discussion of SDV technology. More importantly, however, these levels will guide the development of the technology and systems, and, while not explicitly stated by NHTSA, will undoubtedly inform the regulatory schemes enacted in various states.

The policy statement details NHTSA's past SDV research and plans for future research on the topic. NHTSA has initiated or is planning to initiate research for automation Levels 2 through 4.[62] The agency also identified three key areas for future research on more advanced automated vehicle systems: (1) human factors research, (2) system performance

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55. *Id.* at 1.
56. *Id.*
57. *Id.*
58. *Id.* at 4–5; *see infra* Appendix 1.
59. PRELIMINARY STATEMENT, *supra* note 7, at 3.
60. *Id*. Interestingly, NHTSA excluded from its definition of automated technology both on-board sensors and vehicle-to-vehicle communication (V2V) of safety warnings. *See id.* at 3.
61. *See infra* Appendix 1.
62. PRELIMINARY STATEMENT, *supra* note 7, at 6.

requirements, and (3) electronic control system safety.[63] This research will "inform agency policy decisions, assist in developing an overall set of requirements and standards for automated vehicles, identify any additional areas that require examination, and build a comprehensive knowledge base for the agency as automated system technologies progress."[64] The NHTSA statement finishes with several recommendations for state legislators and policymakers.[65] These range from prohibiting use except for testing, proper driver licensing, limiting the locations and circumstances under which SDVs are used, and basic operating characteristics of test systems.[66] Ultimately, the agency discourages states from heavy regulation for fear that early and onerous regulation could slow or altogether halt the future development of the technology.[67]

III. LEGAL BACKGROUND

As the technology and discussion of NHTSA policies shows, SDVs are technically possible and theoretically acceptable to the federal government. But since state laws primarily govern both who can drive and the rules of the road,[68] are SDVs potentially legal and, if so, how can the law accommodate the nuances and complexities of cars driving with little to no human intervention? This section summarizes Bryant Walker Smith's argument on the legality of SDVs and compares and contrasts the five jurisdictions with existing laws or regulations governing SDVs.

A. SELF-DRIVING VEHICLES ARE PROBABLY LEGAL

Bryant Walker Smith's article, *Automated Vehicles Are Probably Legal in the United States*,[69] is arguably the seminal piece of scholarship on the legality of SDVs in the United

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63. *Id.* at 6–9.
64. *Id.* at 6.
65. *Id.* at 10.
66. *Id.* at 10–14.
67. *Id.* at 14.
68. *E.g.*, MINN. STAT. § 169.02 (2014) (stating that Minnesota's codified traffic regulations, governing every aspect of driving including towing, accidents, signs and pedestrians, vehicle equipment safety, and many more categories, apply "to any person who drives, operates, or is in physical control of a motor vehicle within this state").
69. Smith, *supra* note 15, at 1.

States. Smith covers the breadth of statutory and regulatory issues necessary for widespread sale and use of SDVs.[70] His ultimate conclusion is that SDVs are permitted because they are not expressly, or implicitly, prohibited.[71] As the article's title states, SDVs are "probably legal" because existing international law, federal safety regulations, and state statutes can be either broadly or narrowly construed to include the "computer direction of a motor vehicle's steering, braking, and accelerating without real-time human input."[72]

Automated Vehicles Are Probably Legal begins with a succinct analysis of the concept of driving—an idea core to his overall argument.[73] Driving does not necessarily require human input, nor does computer control of a vehicle "negate a human role" in driving.[74] The term "driving" is multifaceted, and should be defined so as to include all the components required to "drive" a vehicle.[75] Smith's conception of driving includes a hierarchy of tasks such as "selection of destinations and their order (trip), roads to those destinations (route), lanes as well as the turns and merges onto them (path), and speed and spacing within those lanes (position);" safety related tasks like adjustment of windshield wipers, lights, and turn signals; and adjustment of creature comforts like the climate control.[76] According to Smith, only an extremely constrained definition considers driving to be "the direct physical manipulation of a motor vehicle's steering wheel, throttle, brake, clutch, and related mechanisms."[77] Smith's understanding of what it means to drive is foundational to the arguments in his article, and should be seriously considered by any state contemplating legislation to legalize SDVs.

Smith begins by noting that anachronistic, ossified legal systems often stymie innovation.[78] Failure of the law to evolve to meet innovation could result in major negative

70. *See id.*
71. *Id.* at 516.
72. *Id.* at 419.
73. *Id.*
74. *Id.*
75. *Id.* at 420.
76. *Id.*
77. *Id.* at 419.
78. *See id.* at 415–16 (describing how uncertainty in the law and bans on SDVs negatively impacts innovation).

consequences, including high death tolls from automobile accidents.[79] He then reviews an important international convention, the 1949 Geneva Convention on Road Traffic.[80] It sets "minimum regulations" for auto traffic so that "foreign motorists know roughly what standard of behavior to expect,"[81] including provisions focused on the "driver."[82] This Convention binds government action, at both federal and state levels, because the United States is both a signatory and party to the Convention, and is thereby required to enforce the Convention's obligations.[83] As binding international law, the federal government, state legislatures, agencies, and courts must apply their laws so as to comply with the Convention.[84] However, the Convention's history, the language used in relevant provisions, and international practice suggest that an SDV with a human occupant able to intervene and control the vehicle is sufficient to meet the standards of a "driver" under the Convention.[85]

Smith also delves significantly into regulation by the NHTSA and state vehicle codes.[86] NHTSA regulates vehicle safety and performance, including "defective vehicles."[87] Under federal rules, if SDVs are designed or operated within certain boundaries, the existing rules do not expressly prohibit their sale or use.[88]

State statutes imposing duties on "drivers" or "operators" are potential obstacles to full or partial computer control of an automobile. Smith concludes that SDVs are likely legal in most states because, as described above, the concept of a "driver" or "operator" is sufficiently broad to permit non-human operation

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79. *E.g.*, Nat'l Highway Traffic Safety Admin., *Fatality Analysis Reporting System Encyclopedia*, FATALITY ANALYSIS REPORTING SYS., http://www-fars.nhtsa.dot.gov/Main/index.aspx (last visited Feb. 6, 2015) (showing that the annual death toll from automobile accidents in the United States was 37,423 in 2008, 33,883 in 2009, 32,999 in 2010, 32,479 in 2011, and 33,561 in 2012).

80. *See* Geneva Convention on Road Traffic, Sept. 19, 1949, 3 U.S.T. 3008, 125 U.N.T.S. 3; Smith, *supra* note 15, at 424.

81. Smith, *supra* note 15, at 424.

82. *Id.* at 425.

83. *Id.* at 449–52.

84. *Id.*

85. *Id.* at 433–35.

86. *See id.* at 458–507.

87. *Id.* at 458–62.

88. *Id.*

of vehicles.[89] However, the significant variance in legislative definitions of these terms is further complicated by judicial interpretation, even contortion, at times.[90] Interestingly, these terms imply several individuals could be the "driver" or "operator": (1) a person who commands an SDV to complete an action or sets performance parameters of an SDV; (2) owners who permit others to drive their vehicles; (3) a person "physically positioned to provide real-time input"; and (4) a person who starts the automated operation of an SDV.[91] Some terms, such as "actual physical control," used to define the word "drive" may require at least human presence and ability to intervene.[92] Smith reviews several other categories of state vehicles codes that could influence, and possibly even constrain, the development and use of SDVs, including driver safety and prudence, license requirements, equipment requirements, unsafe vehicle prohibitions, and rules of the road.[93] Despite the potential confusion and complications posed by state laws, SDVs are probably not prohibited.

B. EXISTING STATE LAWS REGARDING SDVS

Currently, four states and the District of Columbia explicitly permit operation and testing of SDVs; however, each state has enacted a slightly different legal framework to manage SDVs. As the ENO Center for Transportation, the RAND Corporation, and others argue, multiple, inconsistent legislative and regulatory regimes could greatly hamper the development and deployment of autonomous vehicles and technologies.[94]

1. Nevada

Nevada first passed SDV legislation in 2011.[95] First proposed as a bill to reaffirm Nevada's leadership in development of new, "green" technology, and to ensure the state continues to leverage opportunities to grow and

89. *Id.* at 464–71.
90. *See id.* at 463–74.
91. *Id.* at 475–78.
92. *Id.* at 472–73.
93. *Id.* at 480–98.
94. FAGNANT & KOCKELMAN, *supra* note 1, at 11–12.
95. NEV. REV. STAT. ANN. § 482A.200 (LexisNexis 2013).

diversify,[96] Assembly Bill 511 permitted the Nevada Department of Motor Vehicles (DMV) to license drivers of automated vehicles, and also explicitly recognized "the fact that a person is not required to actively drive an autonomous vehicle."[97] This bill also directed the Nevada DMV to "adopt regulations authorizing the operation of autonomous vehicles on highways within the State of Nevada."[98] Subsequent amendments add a few interesting caveats. First, a 2013 act modified the definition of autonomous technology ("artificial intelligence" in the bill's terms) from a relatively simple statement,[99] to a more complicated definition.[100] Interestingly, the definition appears to exclude all technology below NHTSA's Level 2, such as electronic stability control, adaptive cruise control, and traffic jam and queuing assistance.[101] This definition sets the threshold of an automated vehicle at a high level, and enables the driver to cede active control of the vehicle and monitoring responsibility to technological systems.[102] Further amendments also required anyone testing a vehicle in the state to submit proof of insurance coverage or post a bond in the amount of $5 million.[103] Finally, the act exempts manufacturer from liability for damage caused by failure of

96. *Minutes Nev. S. Comm. on Finance*, 76th Sess. 34–35 (2011).

97. § 482A.200.

98. *Id.* § 482A.100.

99. *Id.* § 482A.020 (repealed 2013) ("'Artificial intelligence' means the use of computers and related equipment to enable a machine to duplicate or mimic the behavior of human beings.").

100. *Id.* § 482A.025 ("'Autonomous technology' means technology which is installed on a motor vehicle and which has the capability to drive the motor vehicle without the active control or monitoring of a human operator. The term does not include an active safety system or a system for driver assistance, including, without limitation, a system to provide electronic blind spot detection, crash avoidance, emergency braking, parking assistance, adaptive cruise control, lane keeping assistance, lane departure warning, or traffic jam and queuing assistance, unless any such system, alone or in combination with any other system, enables the vehicle on which the system is installed to be driven without the active control or monitoring of a human operator.").

101. *See id.*

102. *Id.*

103. *Id.* § 482A.060. This is an increase over the DMV's regulations requiring a $1 million bond. According to Senate testimony, it is designed to prevent "laypeople" or "knowledgeable hobbyists" from creating autonomous vehicles. *Minutes Nev. S. Comm. on Transportation*, 77th Sess. 6 (Mar. 27, 2013).

automated technology in vehicles that were converted into autonomous vehicles by third parties.[104] Other statutes exempt use of cellphones and other wireless communication devices by a driver or operator while the vehicle is operating autonomously.[105]

Regulations concerning SDVs from the Nevada DMV came into effect on March 1, 2012.[106] The regulations cover four general topics: (1) the general requirements to operate an autonomous vehicle, including who the operator is, certifications of autonomous vehicles, and license endorsements;[107] (2) testing licenses;[108] (3) selling SDVs;[109] and (4) licenses for autonomous technology certification facilities.[110] Most of these are standard licensing provisions, but a few are especially important examples.

First and most importantly, human intervention is not required to operate an autonomous vehicle in Nevada.[111] In order to operate an SDV in Nevada, the vehicle's automated technology must be certified as compliant by either the manufacturer or an autonomous technology certification facility.[112] The vehicle must include the ability to capture and store at least thirty seconds of read-only formatted sensor data in the event of a collision;[113] it must have a mechanism to engage and disengage autonomous operation in a variety of ways and a visual indication the vehicle is operating in autonomous mode;[114] the technology must be able to alert the driver of a failure of automated features;[115] and the vehicle

104. *Id.* § 482A.090.

105. *See, e.g.*, *id.* § 484B.165(7).

106. NEV. ADMIN. CODE § 482A (2014).

107. *Id.* § 482A.010–.050.

108. *Id.* § 482A.100–.110.

109. *Id.* § 482A.190.

110. *Id.* § 482A.200–290.

111. *See id.* § 482A.020.

112. *Id.* § 482A.030. An autonomous technology certification facility must prove that it has the "necessary knowledge and expertise to certify the safety of autonomous vehicles, including, without limitation, whether the autonomous vehicles meet the requirements for the issuance of a certificate." *Id.* § 482A.210.

113. *Id.* § 482A.100.

114. Such as using the brake, the accelerator pedal, or the steering wheel. *Id.* § 482A.110, § 482A.190.

115. *Id.* § 482A.190.

must meet all other applicable federal safety and operation regulations.[116]

Second, the human who engages the SDV to operate is considered the actual operator of the vehicle, regardless of physical presence in the vehicle.[117] Similarly, the operator of the SDV is considered the driver for purposes of traffic laws.[118] Drivers who want to operate SDVs must obtain a special license endorsement which includes acknowledgment of the driver being "subject at all times to the traffic laws and other laws applicable to drivers and motor vehicles operated in [the] State,"[119] any other information the DMV requires to determine competency and eligibility of a driver to operate an autonomous vehicle,[120] as well as proof of insurance.[121] These regulations potentially resolve several of the liability issues inherent in SDV operation. It also encourages development of fully self-driven, humanless vehicles by permitting the operation of those vehicles.[122]

2. Florida

In contrast to Nevada's legislation, Florida expresses intent "to encourage the safe development, testing, and operation of motor vehicles with autonomous technology on the public roads of the state."[123] Nearly everything else about Florida's 2012 SDV legislation mirrors Nevada's statutes.[124] Definitions of autonomous vehicles and autonomous technology are exactly the same as Nevada's definition: it excludes Level 1 technologies such as blind spot assistance, crash avoidance, and lane departure warning.[125] In other words, no human operator is necessary, and a vehicle is autonomous when the operator cedes all monitoring and physical control of the

116. *Id.*
117. *Id.* § 482A.020.
118. *Id.* § 482A.030(2)
119. *Id.* § 482A.040.
120. *Id.*
121. *Id.* § 482A.050.
122. Nevada exempts texting while operating an SDV. *See* NEV. REV. STAT. ANN. § 484B.165(7) (LexisNexis 2013).
123. 2012 Fla. Sess. Law Serv. 1 (West).
124. *Compare id.* at 1–3, *with supra* Part III.B.1.
125. FLA. STAT. ANN. § 316.003(90) (West 2014).

vehicle to technology.[126] SDVs must meet the same standards as in Nevada in order to operate in Florida.[127] Standards include compliance with all state and federal safety regulations, a way to engage and disengage autonomous technology, a visual indication of autonomous operation, and a means of alerting the human operator that intervention is necessary.[128]

SDVs being tested in the state do require a human operator actively monitoring the vehicle's movement on the road and capable of intervening.[129] With traditional motor vehicles, the driver or operator is the person with "actual physical control" of the vehicle.[130] Like in Nevada, the operator of an autonomous vehicle is the person who engages the autonomous technology, regardless of her or his physical presence in the vehicle.[131] However, unlike Nevada, any person with a valid driver's license is permitted to operate an autonomous vehicle in autonomous mode.[132] Florida also exempts use of cellphones by a driver while the vehicle is operating autonomously from the statutory provision prohibiting such use while driving motor vehicles.[133] No regulations have been promulgated concerning SDVs in Florida.[134]

3. Michigan

Michigan SDV legislation is very similar to both Nevada and Florida.[135] First enacted in 2013, the legislation addresses SDVs with similar restrictions.[136] SDVs are defined as vehicles

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126. *Id.*
127. *See supra* Part III.B.1.
128. FLA. STAT. ANN. § 319.145 (West 2014).
129. *Id.* § 316.86.
130. *Id.* § 316.003(10)–(25).
131. *Id.* § 316.85(2).
132. *Id.* § 316.85(1).
133. *Id.* § 316.305(3)(b)(7).
134. *See* Gabriel Weiner & Bryant Walker Smith, *Automated Driving: Legislative and Regulatory Action*, CENTER FOR INTERNET & SOC'Y, http://cyberlaw.stanford.edu/wiki/index.php/Automated_Driving:_Legis lative_and_Regulatory_Action (last modified Feb. 3, 2015) (providing a list of states with regulations governing automated driving, which does not include Florida).
135. *See supra* Part III.B.1–2.
136. 2013 Mich. Legis. Serv. 100 (West).

that operate without any input from a human operator, but do not include "active safety systems" like the Florida and Nevada laws previously mentioned.[137] An operator is defined as the person who operates the SDV.[138] Operation means "actual physical control of a vehicle" regardless of whether the person is licensed, and includes "causing an automated . . . vehicle to move . . . in automatic mode . . . regardless of whether the person is physically present in that . . . vehicle at that time."[139] However, only "manufacturer[s] of automated technology" are allowed to operate SDVs, and only for testing.[140]

Prior to testing, manufacturers must submit proof of insurance, ensure that the operator is an employee or contractor of the company, and ensure that a properly licensed human operator is physically present in the vehicle monitoring the vehicle's performance and able to intervene in the vehicle's operation.[141] Like Florida and Nevada, manufacturers are not liable for damages caused by SDVs that have been modified by a third-party, unless the damage is caused by faults in the vehicle's original manufactured state.[142] Finally, cellphone use is exempted from statutory prohibitions while operating or programming the operation of an automated vehicle.[143]

4. District of Columbia

The Autonomous Vehicle Act of 2012 is relatively simple.[144] It permits operation of SDVs on public roads in the District of Columbia if the operator can override the autonomous technology at any time to take control of the vehicle, if a driver is located in the driver's seat and ready to take control of the vehicle, and if the vehicle complies with all other traffic and motor vehicles laws and traffic control devices applicable in the District.[145] Like other states, original manufacturers are excused from liability for damages caused by conversion of

137. MICH. COMP. LAWS ANN. § 257.2b(1) (West 2014).
138. *See id.* § 257.663.
139. *Id.* § 257.35a.
140. *Id.* § 257.665.
141. *Id.* § 257.665(1)–(2).
142. *Id.* § 257.817.
143. *Id.* § 257.602b(4)(e).
144. D.C. CODE §§ 50-2351–2354 (2014).
145. *Id.* § 50–2352.

regular vehicles to SDVs.[146] Unique to D.C., SDV legislation has a provision restricting conversion of vehicles to SDVs to model years 2009 or newer, or "vehicles built within 4 years of conversion, whichever vehicle is newer."[147]

As directed by statute,[148] the District's Department of Motor Vehicles published a notice of proposed rulemaking for autonomous vehicles on April 4, 2014.[149] Like other states, the operator of the vehicle is deemed to be the driver for purposes of enforcing traffic laws and other regulations.[150] The rules propose to require SDV operators to obtain a special license endorsement.[151] Drivers applying for the endorsement must acknowledge that they are subject at all times to applicable traffic and other laws,[152] certify completion of training in operation and abilities and limitations of an SDV,[153] and provide any other information the DMV requires to prove competency and eligibility to operate an SDV.[154] The vehicle itself must meet operating and performance standards similar to the states discussed above.[155] Autonomous vehicles must use special license plates.[156]

5. California

As with many other bodies of law,[157] California's regulation of SDVs is comprehensive and complex.[158] SDV legislation in California is unique in that it recognizes the potentially great

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146. *Id.* § 50-2353.

147. *Id.*

148. *Id.* § 50-2354.

149. 61 D.C. Reg. 3587 (Apr. 4, 2014) (to be codified at D.C. MUN. REGS. tit. 18, § 2003.1), *available at* http://www.dcregs.dc.gov/Gateway/NoticeHome.aspx?NoticeID=4830520.

150. *Id.* at 3587, 3590.

151. This endorsement is required even if the person does not intend to operate the vehicle in autonomous mode. *Id.* at 3587.

152. *Id.*

153. *Id.* at 3589.

154. *Id.* at 3587–88.

155. *Id.* at 3587–89.

156. *Id.* at 3580–90.

157. *See, e.g.*, Kevin L. Patrick & Kelly E. Archer, *A Comparison of State Groundwater Laws,* 30 TULSA L.J. 123, 125–27 (1994) ("[T]he California system is also the leading jurisdiction in implementation of the public trust doctrine," but "California has no statutory definition for empirically assessing whether groundwater is sufficiently connected to a surface stream").

158. *See* Weiner & Smith, *supra* note 134.

benefits SDVs offer, including increased safety and mobility, as well as the economic benefits of developing new technology.[159] Senate Bill 1289 also restates Bryant Walker Smith's hypothesis: SDVs are legal because the state neither permits nor prohibits their operation.[160] The preamble also states the legislature's desire to encourage "development, testing, and operation" of SDVs on California's roads.[161]

Substantively, the law is very similar to the laws reviewed above in terms of defining key terms,[162] vehicle and autonomous technology performance standards,[163] operator responsibilities,[164] storage of pre-collision sensor information,[165] insurance requirements,[166] and requiring SDVs to meet all other applicable federal and state safety and legal standards.[167] The law also provides that federal regulation will supersede any state law, if there is conflict.[168] Finally, the California DMV was directed to promulgate regulations on a number of topics no later than January 1, 2015.[169]

The DMV regulations were enacted on September 16, 2014.[170] The regulations allow testing of autonomous vehicles using autonomous technology by a person certified as competent and authorized by the manufacturer to operate the vehicle.[171] Before a vehicle can be tested on public roads, the manufacturer must prove the technologies in "controlled conditions that simulate . . . real world conditions."[172] Only individuals who meet specific requirements may test SDVs.

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159. Act of Sept. 25, 2012, ch. 570, § 1(a), 2012 Cal. Stat. 5004, 5005 (codified at CAL. VEH. CODE § 38750 (West 2013)); *see also* Damon Lavrinc, *Autonomous Vehicles Now Legal in California*, WIRED (Sept. 25, 2012), http://www.wired.com/2012/09/sb1298-signed-governor/ (discussing Senate Bill 1298).

160. Act of Sept. 25, 2012 § 1(c); *see supra* note 71 and accompanying text.

161. *Id.*

162. *See* CAL. CODE REGS. tit. 13, § 227.02 (2014); *see also* VEH. § 38750(a) (West).

163. VEH. § 38750(c) (West).

164. *Id.* § 38750(b).

165. *Id.* § 38750(c)(1)(C).

166. *Id.* § 38750(d).

167. *Id.* § 38750(c)(1)(F).

168. *Id.* § 38750(g).

169. *Id.* § 38750(d).

170. CAL. CODE REGS. tit. 13, § 227.00 (2014).

171. *Id.* § 227.04.

172. *Id.* § 227.24(b).

The driver must (1) have knowledge of the technology's and the vehicle's limitations;[173] (2) have the physical ability and be seated in a position to exert immediate control of the vehicle;[174] (3) have been licensed to drive for at least three years;[175] (4) have a relatively clean driving record;[176] (5) comply with all other requirements of the state vehicle code;[177] and (6) have completed an autonomous vehicle training program certified by the manufacturer.[178] Interestingly, a person with a conviction for driving or operating a vehicle under the influence of drugs or alcohol is specifically prohibited from acting as an SDV test driver.[179]

The most complex and rigorous aspects of the regulations are the assurances as to the manufacturers' financial responsibility, instruments of insurance, and surety bonds.[180] All of these are considered a condition of the manufacturer's license to operate and test SDVs in California.[181] Manufacturers can also satisfy the financial responsibility requirements by submitting sufficient proof of self-insurance.[182]

C. INTRODUCED LEGISLATION

Several states have introduced legislation to officially legalize, or to evaluate the legal and policy requirements of SDVs. Currently Massachusetts, New Jersey, and New York

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173. *Id.* § 227.22(a)(1).

174. *Id.* § 227.18(a).

175. *Id.* § 227.20(b)(1).

176. *Id.* § 227.20(b)(1)(A)–(C).

177. *Id.* § 227.18(c).

178. *Id.* §§ 227.18, 227.20(b)(2), 227.22 (stating that manufacturers must communicate to the Department of Motor Vehicles information about the Test Driver Training Programs, including at least a course outline and description of the program, and that the actual program should include instruction on the automated driving technology, "behind the wheel training" with an "experienced" driver, defensive driving instruction, and generally training commensurate with the specific type and level of maturity of the particular SDV's technology).

179. *Id.* § 227.20(b)(1)(C).

180. *Id.* § 227.08 (outlining ways to fulfill the requirement to provide evidence of financial responsibility through instruments of insurance); *id.* § 227.10 (outlining ways to fulfill the requirement to provide evidence of financial responsibility through surety bonds); *id.* § 227.12 (discussing proof of financial responsibility).

181. CAL. VEH. CODE § 38750(b)(3) (West 2013).

182. CAL. CODE REGS. tit. 13, § 227.14.

have pending legislation.[183] Massachusetts Representative Peter J. Durant introduced House Bill 3369 in January 2013.[184] It is nearly identical to Florida's legislation and is currently in the committee process.[185] It authorizes any person with a valid driver's license to operate an SDV[186] and directs the Division of Highway Safety to report to the legislature on the need for further legislation or regulation.[187] New Jersey's proposed legislation, Senate Bill 2898, permits operation of SDVs by anyone with the proper license endorsement[188] and directs the state Motor Vehicle Commission to adopt pertinent regulations within one year of passage of the bill.[189] Pending legislation in New York recognizes the important safety-related benefits of SDVs and regulates these vehicles in a manner very similar to Nevada.[190] The last action on the bill was referring it to the Senate Committee on Transportation.[191]

Fourteen other states introduced legislation that is currently in the legislative process or did not pass.[192] The bills pending in the legislative process are almost all under legislative committee consideration or awaiting a report from a state agency about complications.[193] Many of these reports are due in early- to mid-2015,[194] while others have much longer deadlines.[195]

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183. Weiner & Smith, *supra* note 134.

184. H. 3369, 188th Gen. Ct., Reg. Sess. (Mass. 2013), *available at* https://malegislature.gov/Bills/188/House/H3369.

185. *Bill H. 3369 Bill History*, MASS. LEGISLATURE, https://malegislature.gov/Bills/188/House/H3369 (last visited Feb. 2, 2015).

186. H. 3369 § 1(a).

187. *Id.* § 1(c)(3).

188. S. 734, 216th Leg., Reg. Sess. § 2 (N.J. 2014), *available at* http://www.njleg.state.nj.us/2014/Bills/S1000/734_I1.PDF.

189. S. 734 § 3.

190. S. 4912, 236th Leg., Reg. Sess. (N.Y. 2013), *available at* http://open.nysenate.gov/legislation/bill/S4912-2013.

191. *Id.* § 3.

192. *See* Weiner & Smith, *supra* note 134 (mentioning Arizona, Colorado, Georgia, Hawaii, Louisiana, Maryland, Minnesota, New Hampshire, Oklahoma, Oregon, South Carolina, South Dakota, Texas, Washington, and Wisconsin).

193. *Id.*

194. *Cf.* H.R. 1265, 157th Leg., Reg. Sess. (Ga. 2014), *available at* http://www.legis.ga.gov/Legislation/en-US/display/2013_14/41187 (stating that a Georgia "House Study Committee on Autonomous Vehicle Technology" will report to the House by Dec. 31, 2014); H.R. 2167, 51st Leg., 1st Reg. Sess.

IV. MINNESOTA LAW

What exactly does Minnesota have to do to open the state to all the potential benefits of SDVs? This section will review SDV legislation introduced in the Minnesota House of Representatives in 2013 and examine the state's vehicle code and relevant case law in order to propose a way forward for the state to legalize SDVs.

A. PROPOSED LEGISLATION

Minnesota legislators have shown some interest in adopting legislation that clarifies the legal status of SDVs. Early in the 2013 regular session of the 88th Legislature, Representative Ron Erhardt introduced House File 1416, the Omnibus Transportation Bill.[196] The bill was referred to the Transportation Policy Committee, which recommended passage of an amended version.[197] The amendments proposed included section 54, which directed the Commissioner of Transportation to "evaluate policies and develop a proposal for legislation governing regulation of autonomous vehicles, which may include but is not limited to traffic and safety regulations, technical equipment requirements, surety bonds, and establishment of a pilot program."[198] The report would have been submitted to the legislature by January 31, 2014.[199] However, the Senate's companion bill did not include this

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(Ariz. 2013), *available at* http://www.azleg.gov/legtext/50leg/1r/bills/hb2167h.pdf.

195. *Cf*. H.D. 538, 434th Leg., Reg. Sess. (Md. 2014), *available at* http://mgaleg.maryland.gov/webmga/frmMain.aspx?id=hb0538&stab=01&pid=billpage&tab=subject3&ys=2014rs; S. 13-016, 69th Gen. Assemb., 1st Reg. Sess. (Colo. 2013), *available at* http://www.leg.state.co.us/clics/clics2013a/csl.nsf/fsbillcont2/F6C2E6A3EE6EF24887257A920050A144/$FILE/016_01.pdf.

196. Brian Johnson, *Minnesota Department of Transportation: $1.1 Billion in Projects*, FIN. & COM. (Mar. 27, 2013, 4:36 PM), http://finance-commerce.com/2013/03/minnesota-department-of-transportation-1-1-billion-in-projects/; *see also* H.F. 1416, 88th Leg., Reg. Sess. (Minn. 2013), *available at* http://wdoc.house.leg.state.mn.us/leg/LS88/HF1416.1.pdf (another bill, H.F. 1580, with the exact same language was introduced by Representative Tim Mahoney three days later on Mar. 14, 2013). *See generally Representative Ron Erhardt (DFL) District: 49A*, MINN. HOUSE REPRESENTATIVES http://www.house.leg.state.mn.us/members/members.asp?id=10167 (last visited Mar. 30, 2015).

197. *See* Minn. H.F. 1416.

198. *Id.* § 54.

199. *Id.*

language,[200] and the actual provision was deleted by a "delete everything" amendment proposed by Rep. Erhardt at the first meeting of the House Committee on Transportation Policy.[201]

B. CURRENT LAW PERMITS SDVS

As the proposed Minnesota laws are described above, and despite the lack of authorizing legislation, SDVs are arguably already legal in Minnesota. Because state law does not explicitly prohibit SDVs, manufacturers and individuals could potentially operate or test such vehicles here in Minnesota.[202] More importantly, existing statutory language and judicial interpretation may imply that SDVs are legal within the state.[203] This subsection discusses how SDVs may already be legal in Minnesota by looking at the impact of international law, vehicle safety requirements, and case law.

1. International Law

In *Automated Vehicles Are Probably Legal in the United States*, Bryant Walker Smith spends a considerable amount of time reviewing the 1949 Geneva Convention on Road Traffic.[204] Smith argues that the Convention may have an impact on whether autonomous vehicles are legal in any state in the Union.[205] This Convention will probably impact adoption of SDVs less than Smith suggests for three reasons: (1) most legislation is at least implicitly premised on the idea that SDVs will improve safety on domestic roads,[206] which is one of the main purposes of the Geneva Convention;[207] (2) federal policy on SDVs, an overt acknowledgment of state regulation of SDVs,

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200. *See* S. 88-1270, Reg. Sess., at 4775–77 (Minn. 2013), *available at* http://www.senate.leg.state.mn.us/journals/2013-2014/20130518060.pdf#page=583.

201. *Transp. Policy Comm.*, 88th Leg., Reg. Sess. (Minn. 2013) (statement of Rep. Ron Erhardt, Chair, Transp. Policy Comm. On Omnibus Transportation Bill), *available at* http://www.house.leg.state.mn.us/cmte/minutes/minutes.aspx?comm=88028&id=5068&ls_year=88.

202. *See* Smith, *supra* note 15, at 463–507.

203. *Id.*

204. *Id.* at 413–18, 424–29.

205. *Id.*

206. *See, e.g.*, *supra* note 159 and accompanying text.

207. *See* Smith, *supra* note 15, at 424 ("The 1949 Geneva Convention on Road Traffic, to which the United States is a party, promotes road safety by establishing uniform rules.").

demonstrates tacit federal understanding that SDVs comply with the Geneva Convention; and (3) many foreign nations and foreign automakers are actively pursuing SDVs, which affirms U.S. federal understanding that SDVs comply with the Geneva Convention. Minnesota legislators could address this issue by including explicit references to the safety-related benefits of SDVs and how safety benefits align with the Geneva Convention on Road Traffic.

2. Safe Vehicles

Vehicle safety, in terms of collisions and operating capabilities, is exclusively a federal issue, regulated by NHTSA.[208] Although Minnesota has to comply with the minimum safety characteristics prescribed by NHTSA, section 3103(b), titled "preemption," allows states to set higher safety standards for vehicles, presumably including SDVs.[209] Indeed, NHTSA understands regulation of other aspects of SDVs to be a state-by-state issue, as its policy statement enumerates "licensing, driver training, and conditions for operation related to specific types of vehicles" as proper subjects for state legislation.[210]

3. Definition of "Driver"

Sadly, many of the definitions of the terms relevant to SDVs were developed in response to drivers fighting conviction under drunk driving laws.[211] However, consistent with Smith's analysis, SDVs are very likely legal under Minnesota's current definitions of "driver," "operator," "operating," or "physical control."[212] A "driver" is any "person who drives or is in actual physical control of a vehicle."[213] This definition may appear to preclude autonomous technology being considered the driver of a vehicle, because a "person" must "drive" or be in "actual physical control" of the vehicle. This statutory definition may require modification by eliminating the requirement of a human or physical control. However, other states require a

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208. *See* 49 U.S.C. § 30101 (2012).
209. § 30103(b) (discussing preemption of state law).
210. PRELIMINARY STATEMENT, *supra* note 7, at 10.
211. *See* Smith, *supra* note 15, at 468–73.
212. *See* MINN. STAT. § 169.011 subdiv. 24 (2014); Smith, *supra* note 15, at 468–73.
213. § 169.011 subdiv. 24.

human to closely monitor the operation of the autonomous technology and to be in a position to intervene.[214] Thus, "driving" and "physical control" could be easily satisfied by a human monitoring and ready to interrupt the autonomous technology. Florida has a very similar definition for both "driver" and "operator,"[215] but modified this term in SDV legislation by defining the operator of an autonomous vehicle as the person who "causes the vehicle's autonomous technology to engage, regardless of whether the person is physically present in the vehicle while the vehicle is operating in autonomous mode."[216]

Operation of a motor vehicle in Minnesota includes "any act that makes use of any mechanical or electrical agency which alone or in sequence will set in motion the motive power of the vehicle."[217] This more closely matches the role a human would play in an SDV. For example, starting an SDV's motor and engaging the autonomous technology is almost undoubtedly an act that makes use of mechanical *and* electrical agency that sets the vehicle in motion. Moreover, this definition is very similar to how existing state-level SDV legislation defines operator or driver, especially in Florida.[218]

4. Duty to Drive Safely and Prudently

Minnesota law also requires all drivers to drive safely and prudently.[219] Prudence is a combination of driving skill, awareness of conditions, and due care.[220] That Google's fleet of

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214. *See* Smith, *supra* note 15, at 506 (discussing specific requirements, including close monitoring, for testing autonomous vehicles in certain states).

215. FLA. STAT. ANN. § 316.003(10) (West 2014) ("Driver.—Any person who drives or is in actual physical control of a vehicle on a highway or who is exercising control of a vehicle or steering a vehicle being towed by a motor vehicle."); *id.* § 316.003(25) ("Operator.—Any person who is in actual physical control of a motor vehicle upon the highway, or who is exercising control over or steering a vehicle being towed by a motor vehicle.").

216. *Id.* § 316.85(2).

217. James O. Pearson, Jr., *What Constitutes Driving, Operating, or Being in Control of Motor Vehicle for Purposes of Driving While Intoxicated Statute or Ordinance*, 93 A.L.R.3d 7 (1979); *see In re* Welfare of R.A.D., 370 N.W.2d 469 (Minn. Ct. App. 1985).

218. FLA. STAT. ANN. § 316.003(10)–(25) (West 2014).

219. MINN. STAT. § 169.14 subdiv. 1 (2014).

220. *Id.* ("Duty to drive with due care. No person shall drive a vehicle on a highway at a speed greater than is reasonable and prudent under the conditions. Every driver is responsible for becoming and remaining aware of

autonomous vehicles have driven more than 700,000 accident-free miles since beginning testing[221] is compelling evidence that current SDV technology is capable of operating with prudence and safety, at least under typical conditions.[222] Existing regulation of SDVs both explicitly and implicitly mandates SDVs drive at speeds and in such a manner as not to create hazardous conditions or cause personal or property damage. For instance, Nevada prohibits operation of any SDV unless it is "[c]apable of being operated in compliance with the applicable motor vehicle laws and traffic laws of this State."[223] Interpretations of this mandate that do not assume that the legislature used "applicable" to mean *all* existing reasonable duties of safety and prudence is likely to cause some absurd legal results. Provisions mandating expensive financial assurance instruments[224] imply that manufacturers and testers of SDVs must be legitimate and well prepared before putting a hazardous vehicle onto the public roads.

Automobile drivers in Minnesota also owe passengers "the duty to operate the car with reasonable care so that the danger of riding in it is not increased or a new danger added to those assumed when" the passenger enters the vehicle.[225] Current self-driving prototypes have demonstrated the capability of operating so as to not cause danger to passengers under normal conditions.[226] Future improvements in autonomous technology will be geared to improve their operation in hazardous or emergency conditions and to recognize these conditions and safely bring the vehicle to a stop, further protecting those inside and outside the vehicle. In Minnesota, automobile

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the actual and potential hazards then existing on the highway and must use due care in operating a vehicle. In every event speed shall be so restricted as may be necessary to avoid colliding with any person, vehicle or other conveyance on or entering the highway in compliance with legal requirements and the duty of all persons to use due care.").

221. Urmson, *supra* note 4.

222. *Id.* These miles have largely been driven in California and other states without snow and ice. *Id.*

223. NEV. REV. STAT. ANN. § 482A.080(2)(d) (LexisNexis 2013).

224. *See* FLA. STAT. ANN. § 316.86 (West 2014) ("Before the start of testing in this state, the entity performing the testing must submit to the department an instrument of insurance, surety bond, or proof of self-insurance acceptable to the department in the amount of $5 million.").

225. Thompson v. Hill, 366 N.W.2d 628, 631 (Minn. Ct. App. 1985) (citing Olson v. Buskey, 19 N.W.2d 57, 58 (Minn. 1945)).

226. *See* Urmson, *supra* note 4.

owners do not have a duty to furnish an automobile entirely free of latent defects.[227] There is some potential that an injured passenger might not recognize or understand that the vehicle in which she or he rode was operating autonomously and may bring an action for the driver's or owner's failure to qualify the autonomous operation as "hazardous or unsafe for the guest."[228] Unless the driver failed to adequately satisfy her or his other driving duties, an injured passenger would not have such an action, unless the driver knew that the autonomous technology was actually defective. Current technology is designed to alert the driver when the system is not working properly and relinquish control of the vehicle.[229] Moreover, showing that the autonomous technology was a latent defect that the owner knew about would be extremely difficult. A plaintiff-passenger injured in a collision while riding in an SDV would have a significant burden to prove that she or he was unaware that a defendant-driver had ceded control of the vehicle to autonomous technology.

5. Additional Considerations

Minnesota lawmakers must consider the impact a unique set of laws and policies might have on the progression of self-driving technology more generally. If Minnesota and multiple other states enact a unique statutory or policy scheme, manufacturers of SDVs will likely encounter problems developing the technology. For instance, complying with numerous different policy schemes might result in a wide variety of driver interfaces, specialized software programs, and distinct hardware systems and components.[230] Taken to its logical limits, this might result in dozens of unique vehicles. In such situations, capital and research costs will exceed profits from almost any projected adoption rate.[231] In the same vein, simply understanding multiple unique regulatory systems will

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227. Lynghaug v. Payte, 76 N.W.2d 660, 663 (Minn. 1956).

228. *Id.* at 664.

229. *See* PRELIMINARY STATEMENT, *supra* note 7, at 5 ("The system can relinquish control with no advance warning and the driver must be ready to control the vehicle safely.").

230. *See* FAGNANT & KOCKELMAN, *supra* note 1, at 11.

231. *See* KPMG, SELF-DRIVING CARS: ARE WE READY? 13 (2013), *available at* http://www.kpmg.com/US/en/IssuesAndInsights/ArticlesPublications/Documents/self-driving-cars-are-we-ready.pdf.

certainly impact how much time the manufacturers require to develop market ready systems and vehicles.[232] Creating training programs for drivers, satisfying insurance, bonding, or financial assurances, and meeting various other manufacturing and testing license conditions will involve significant time for the manufacturers' engineers and attorneys.[233] Again, the difficulty of such achievements may be so costly as to offset profits from low and potentially moderate adoption rates.[234]

Less concretely, but no less important, a complex mix of statutory and regulatory systems across the states may raise the international law issues discussed by Smith.[235] Drivers unfamiliar with jurisdiction-specific laws are more likely to encounter problems. This would especially be true for foreign-born visitors and immigrants to the United States. Tourists and new Americans may be completely unaware of the porous, and often indiscernible, jurisdictional boundaries that are state borders.[236] Unawareness could result in major property damage, or loss of human life.[237] Damages are likely regardless of whether foreigners are traveling from a state that permits SDVs or vice versa.[238] Foreigners prosecuted for using a vehicle that is legal in one state, but not another, or those who suffer damages from a more advanced SDV than they knew existed could potentially sue the culpable party, the state, and the federal government for breach of the Geneva Convention on Road Traffic.[239]

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232. *See id.*

233. *See generally* FAGNANT & KOCKELMAN, *supra* note 1, at 10 (describing costs for "sensors, software, engineering, and added power and computing requirements" as some of the numerous barriers to the implementation of SDVs in the market).

234. Marc Hachman, *Will Google Make Money Off the Self-Driving Car?*, PCMAG (Sept. 22, 2012, 11:00 AM), http://www.pcmag.com/article2/0,2817,2409960,00.asp.

235. *See* Smith, *supra* note 15, at 441.

236. *See id.* at 480.

237. For instance, tourists visiting the United States from a country that does not permit SDVs could begin their visit in a state that does not permit SDVs and continue into another state that does permit SDVs. Alternatively, tourists could rent a vehicle capable of autonomous operation, and because they do not know of or understand what an SDV is capable of, they could easily cause a major collision.

238. *See* Smith, *supra* note 15, at 480.

239. *Id.* at 444–47.

Liability and computer security may not be as important at this point in the technology's lifespan and capability.[240] Because the issues are not crucial, at least at this point, legislation and policy does not necessarily require special legislative consideration.[241] Even at this stage in the technology's development, computers are almost inarguably more precise, "rational," and capable—in other words, more responsible and accountable—than even some of the best human drivers.[242] However, the public does not yet believe this. Instead, the public perceives a great deal of risk in allowing computers to control automobiles.[243] Notwithstanding the difficulty of debunking this perception, holding SDVs to higher or different legal standards than humans may result in higher costs to individual drivers.[244] This strongly suggests that ultimate legal and financial liability for all SDVs must remain with the human legal owner. Existing standards of primary and secondary liability for damages from automobiles will suffice for the next several years. Moreover, technologies like smart mobile technology and the Internet have rapidly overtaken several industries, and this perception will certainly slowly evolve over the near future.[245] Generational changes will also have significant impacts on public opinion.[246]

Computer security, on the other hand, is not problematic for other prospective reasons.[247] According to Jason Hickey,

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240. *See generally* Jacob Siegal, *Here's Why You're Not Behind the Wheel of Google's Self-Driving Car*, BGR (Aug. 25, 2014, 9:15 PM), http://bgr.com/2014/08/25/google-self-driving-car-issues/ (outlining several barriers to widespread implementation of SDVs).

241. *But see id.* ("Who pays the bill if a self-driving car is involved in a wreck? California has tried to solve this problem as well by requiring companies involved in testing the vehicles to have $5 million in insurance.").

242. *See* FAGNANT & KOCKELMAN, *supra* note 1, at 3–7.

243. BRANDON SCHOETTLE & MICHAEL SIVAK, UNIV. MICH., A SURVEY OF PUBLIC OPINION ABOUT AUTONOMOUS AND SELF-DRIVING VEHICLES IN THE U.S., THE U.K., AND AUSTRALIA 1 (2014), *available at* http://deepblue.lib.umich.edu/bitstream/handle/2027.42/108384/103024.pdf.

244. *See* KPMG, *supra* note 231, at 13.

245. *Compare* SCHOETTLE & SIVAK, *supra* note 243, at 1 (reporting high levels of skepticism of SDVs), *with* Kristen V. Brown, *People Are Ready for Self-Driving Cars, Studies Say*, SFGATE (Feb. 2, 2015, 3:51 PM), http://www.sfgate.com/business/article/People-are-ready-for-self-driving-cars-studies-6057543.php.

246. *See generally* Brown, *supra* note 245.

247. *See* FAGNANT & KOCKELMAN, *supra* note 1, at 10–11.

Vice President of software security firm Vinsula, current cyber-attacks are more commonly acts of large-scale information gathering rather than acts of sabotage designed to cause system failure or to purposefully cause damage.[248] Disrupting a vehicle's communication or control systems requires a more complex and sophisticated attack than one designed to simply gather information.[249] More importantly, most security measures for personal computers and Internet communication were designed and disseminated retrospectively in response to unknown and unperceived weaknesses.[250] Security protocols for SDV technology, especially V2V and V2I systems, were developed more proactively, with strong security already existing in the initial development phases.[251]

One final item that will likely affect legislative discussion and design is climate—namely, winter. Minnesota's winters are notoriously long and harsh.[252] Harsh winters are both a boon and a burden. On the one hand, winter driving conditions are variable, difficult, and can be extremely dangerous.[253] Winter driving conditions will pose major software and hardware hurdles in designing and implementing SDVs.[254] On the other hand, with the right policy package, Minnesota stands at the gates of a potentially very profitable testing ground for SDV manufacturers as only one of the states that currently regulates SDVs, Michigan, has similar issues.[255] Minnesota could serve as the crucial test ground for the first winter-capable SDVs. Manufacturers could use the state's difficult winter driving conditions to test and perfect autonomous control packages crucial to the next steps of the technology's development—driving on congested roads in snow-covered, icy conditions. This ability is utterly crucial to producing vehicles ready for road conditions in nearly any state in the nation.

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248. *See id.* at 12.
249. *Id.* at 11.
250. *Id.* at 12.
251. *See id.*
252. *The Twin Cities Winter Misery Index*, MINN. DEPARTMENT NAT. RESOURCES, http://www.dnr.state.mn.us/climate/journal/winter_misery_index_13_14.html (last updated Dec. 23, 2014).
253. *See generally* Smith, *supra* note 15, at 503.
254. *See generally id.*
255. *See generally id.*

However, legislation and regulation needs very little tailoring in terms of climatic considerations. Michigan's legislation is instructive. For instance, the Upper Peninsula of Michigan consistently experiences long and harsh winters.[256] In fact, "lake effect" snow can dump many feet of snow in a very short period of time,[257] turning normal driving conditions into icy, cold, hazardous conditions in only a few hours' time.[258] However, Michigan's self-driving law is simple and does not mention snow, ice, or any other similar climatic conditions.[259] While this paucity by itself does not justify total disregard for the issue, it should give legislators pause. The ability of statutes or regulation to effectively address this issue is the key to the development of the technology. Significant restrictions on when or where SDVs are permitted to operate could entirely prevent winter driving technology from being tested or proven. Moreover, the ability of automated technology to rapidly and correctly react to winter driving conditions with precision and consistency is arguably greater than human drivers. Computer drivers are the perfect response to the hazards involved in winter driving.[260]

V. CONCLUSION AND RECOMMENDATIONS

Before legislators and policymakers begin the process of regulating SDVs, the following maxim must be considered. As with all technology, SDVs are likely open-feedback loops: technology drives what is possible and what regulators can regulate; but regulation also drives what technology is legal, making certain realties feasible or infeasible. Thus, the law will undoubtedly play a major role in shaping the autonomous driving technology and the public's experience with SDVs.

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256. *Upper Peninsula*, WILDERNET, http://areas.wildernet.com/pages/area.cfm?areaID=MITRUP&CU_ID=165 (last visited Feb. 14, 2015) (noting that significant amounts of snow can fall in a short amount of time in this region).

257. *Warm Water and Cold Air: The Science Behind Lake-Effect Snow*, NAT'L OCEANIC & ATMOSPHERIC ADMIN. (last visited Feb. 2, 2015), http://www.noaa.gov/features/02_monitoring/lakesnow.html (explaining the science behind the lake effect).

258. *See, e.g.*, Bob Collins, *The Beauty of the Lake-Effect Storm*, MINN. PUB. RADIO (Nov. 20, 2014), http://blogs.mprnews.org/newscut/2014/11/the-beauty-of-the-lake-effect-storm/.

259. *See supra* Part III.B.3.

260. KPMG, *supra* note 231, at 25.

Consequently, Minnesota legislators should consider legal changes to ensure the legality of SDV operation in the state. However, a comprehensive law, as has been passed in other states, may not be necessary. Although California likely represents the best practice for promulgating statutes and regulations that are sufficiently comprehensive without being overly restrictive or unnecessarily complex,[261] the above discussion shows that simple amendments to existing Minnesota laws may be enough to ensure legality. While California needed to issue the "rules of the game" to ensure fair competition between existing industries, Minnesota merely needs to demonstrate that the legal environment is sufficient to permit relatively unfettered research and development to occur.

With the above considerations in mind, Minnesota would benefit from carefully amending its laws to allow the operation of SDVs on its roadways. Widespread adoption of SDVs should bring significant safety and health benefits, as well as important and lasting impacts on the human and natural environment.[262] More specific to Minnesota and perhaps most importantly, the state is perfectly positioned to offer economically attractive testing and development opportunities to manufacturers of autonomous technology. State institutions, like the University of Minnesota and the Minnesota Department of Transportation, could collaborate with manufacturers in the development and testing of SDVs. Minnesota is at a major turning point in safe, efficient, personal transportation. The state should continue its role as a leader in innovative technology, research, and policy and formally legalize SDVs.

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261. *See supra* Part III.B.5.
262. KPMG, *supra* note 231, at 8.

Appendix 1. NHTSA Levels of Vehicle Automation[263]

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.
Level 1	**Function-Specific Automation** 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). 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.
Level 2	**Combined Function Automation** 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. At level 2, 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 the pedal at the same time.
Level 3	**Limited Self-Driving Automation** Enables 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 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. 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.

263. PRELIMINARY STATEMENT, *supra* note 7, at 4–5.