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Appendix A: List of All Possible Attendees

San Antonio List of All Possible Attendees			
First Name	**Last Name**	**Position, if available**	**Organization; if available**
Leroy	Alloway	Planning and Public Involvement Program Manager	AAMPO
Jeff	Arndt	President / CEO	VIA Metropolitan Transit
John	Dugan	Director	Planning & Community Development
Joe	Ramos	Sr. Director of Regional Services	Alamo Area Council of Governments
Diane	Rath	Executive Director	Alamo Area Council of Governments
David	Kruse	Regional Data Center Director	Alamo Area Council of Governments
Steven	Ramsey	Director	Public Works
Jose	Ramos	City Engineer	Public Works
Michael	Mann.	Director	Public Works
Renee	Green	County Engineer	Public Works
Vic	Boyer	President / CEO	San Antonio Mobility Coalition
Bo	Gilbert	Assistant Vice President, Government & Industry Relations	USAA
Martha	Mangum	Executive Director	Real Estate Council of San Antonio
Nick	Wingerter	President	San Antonio Transportation Association
Stephen	Bonnette, P.E.	Senior Vice President	Pape-Dawson Engineers
Douglas	Melnick	Chief Sustainability Officer	Planning & Community Development
Erick	Portilla		San Antonio Transportation Alliance
Jon	Guinn		San Antonio Transportation Alliance
Anthony	Trevino	Interim Chief of Police	San Antonio Police Department
Tom	Wilbert	Chief of Police	New Braunfels Police Department
Kevin	Kelso	Chief of Police	Seguin Police Department
Jim	Kohler	Chief of Police	Boerne Police Department
Susan	Pamerleau	Sheriff	Bexar County Sheriff's Office
Joe	Wilson	Chairman	San Antonio Manufactures Association
John	Dewey	Chairman, Workforce & Economic Development Committee	San Antonio Manufacturers Association
Jim	Campbell	Senior Director of Public Affairs	HOLT CAT
Jonathan	Gurwitz	Director of Public Affairs	KGBTexas. Communications

San Antonio List of All Possible Attendees			
First Name	**Last Name**	**Position, if available**	**Organization; if available**
Duane	Wilson	President / CEO	North San Antonio Chamber of Commerce
Richard	Perez	President / CEO	San Antonio Chamber of Commerce
Ramiro	Cavazos	President / CEO	San Antonio Hispanic Chamber of Commerce
Louis	Ramirez, Sr.	President	Seguin Hispanic Chamber of Commerce
Leo	Gomez	President / CEO	Brooks City Base
William	Moseley	Transportation Director	Alamo Regional Transit
Mike	Frisbie	Director	Transportation & Capital Improvements Department
Chris	Trevino, P.E.		Alamo Reg. Mobility Authority
Reggie	Fountain, P.E.		Alamo Reg. Mobility Authority
Robert	Hanley		Pedestrian Mobility Advisory Committee
Daniel	Ludwig		Pedestrian Mobility Advisory Committee
Nicholas	Wingerter		Truck Safety
Jonathan	Bean		TxDOT
Mark	Mosley,		TxDOT
Brian	Buchanan		VIA Metropolitan Transit
Jason	Rodriguez		VIA Metropolitan Transit
Charles	Hood	Fire Chief	San Antonio Fire Department
Kenneth	Jacks	Fire Chief	New Braunfels Fire Department
Dale	Skinner	Fire Chief	Seguin Fire Department
Doug	Meckel	Fire Chief	Boerne Fire Department
Al	Auxier	Sheriff	Kendall County Sheriff's Department
Bob	Holder	Sheriff	Comal County Sheriff's Office
Arnold	Zwicke	Sheriff	Guadalupe County Sheriff's Office
Mark	Green	County Road Administrator	Road and Bridge Department
Ricky	Pfeiffer	Road Superintendent	Road and Bridge Department
Tom	Hornesth, P.E.	County Engineer	Comal County Engineer's Office
David	Smith	County Manager	Bexar County

San Antonio List of All Possible Attendees			
First Name	**Last Name**	**Position, if available**	**Organization; if available**
Sheryl	Sculley	City Manager	City of San Antonio
Douglas	Faseler	City Manager	City of Seguin
Robert	Camareno	City Manager	City of New Braunfels
Ronald	Bowman	City Manager	City of Boerne
Dr. Bruce	Leslie	Chancellor	Alamo Colleges
Roland	Mower	President / CEO	Port San Antonio
Clay	Smith		Adv. Transportation District
Hannah	Santiago		Adv. Transportation District
Dave	Wegmann, P.E.		Bexar County
David	Harris		City of Balcones Heights
Manuel	Longoria		City of Leon Valley
Garry	Ford, P.E., PTOE		City of New Braunfels
Christina	De La Cruz		City of San Antonio
Trish	Wallace		City of San Antonio
Luis	Maltos, P.E.		City of San Antonio
Rebecca	Pacini		City of San Antonio
Bianca	Thorpe, P.E.		City of San Antonio
Robert	Williamson	Senior Vice President, Real Estate & Development	Security Service Federal Credit Union
Kevin	Conner	Central Texas Operations Manager	Jacobs Engineering
Gabe	Farias	President	West San Antonio Chamber of Commerce
Al	Arreola	President	South San Antonio Chamber of Commerce
Leonard	John	Chairman	Tri-County Chamber of Commerce
Kendy	Gravett	President	Seguin Chamber of Commerce
Michael	Meek	President / CEO	The Greater New Braunfels Chamber of Commerce
Crisanne	Zamponi	President / CEO	The Greater Boerne Chamber of Commerce
Terry	Bellamy		City of San Antonio

San Antonio List of All Possible Attendees			
First Name	**Last Name**	**Position, if available**	**Organization; if available**
Pamela	Centeno		City of Seguin
Joe	Ramos, P.E.		City of Seguin
Blake	Partridge		City of Universal City
Tom	Hornseth, P.E.		Comal County
Allen	Dunn		Guadalupe County
Ron	Emmons (FOR)		Kendall County Area
Marcus	Jahns (FOR)		Kendall County Area
John	Archer	Project Manager	Rogers-O'Brien Construction
Stacey	Sinclaire	Engineer III	HNTB Corporation
Isidro	Martinez	Director	
Jeanne	Geiger	Deputy Director	

Austin List of All Possible Attendees		
Name	**Position, if available**	**Organization; if available**
Phil Tindall	Assistant Director	CAMPO
Daniel Yang	Modeling Planning Officer	CAMPO
Todd Hemingson	Vice-President of Strategic Planning and Development	Capital Metro
Bob Daigh	Director of Infrastructure	Williamson County
Rachel Clampffer	Planning Director	Bastrop County
Jerry Borchering	Transportation Director	Hays County
Steve Manilla	County Executive, Transportation and Natural Resources	Travis County
Dave Marsh	General Manager	Capital Area Rural Transportation System
Ken May	Director of Regional Services	Capital Area Council of Governments
Wes Burford	Director of Engineering	Central Texas Regional Mobility Authority
Ross Milloy	Director	Lone Star Rail District
Jeremy Martin	Senior Vice President	Greater Austin Chamber of Commerce
Heidi Gerbracht	Vice President of Public Policy	Real Estate Council of Austin
Jennifer Duthie, PhD	Network Modeling Center, Director	Center for Transportation Research
Michael Aulick	Principal	Aulick and Associates, LLC
Morgan Cotten	Public Works Director	Travis County
Charlie Watts	Planning Project Manager	Travis County
Joe Clemens	Senior Planner	Capital Metro
Gordon Derr	Transportation Assistant Director	City of Austin
Cole Kitten	Transportation Planner III	City of Austin
Melissa McCollum	City of Bastrop, Planning Director	City of Bastrop
Brian LaBorde	Assistant City Manager	City of Buda
Darwin Marchell	Director of Engineering	City of Cedar Park
Amy Miller	Community Development Director	City of Elgin
Ed Polasek	Transportation Services Director	City of Georgetown
Matt Bushak	City Engineer	City of Hutto
Leon Barba	City Engineer	City of Kyle
Chessie Zimmerman	Assistant City Manager	City of Lakeway
Tom Yantis	Assistant City Manager	City of Leander
Dan Gibson	City Planner	City of Lockhart

Austin List of All Possible Attendees		
Name	**Position, if available**	**Organization; if available**
Trey Fletcher	Assistant City Manager	City of Pflugerville
Tom Word	Assistant City Manager	City of Pflugerville
Gary Hudder	Transportation Director	City of Round Rock
Sabas Avila	Assistant Director of Public Services - Transportation	City of San Marcos
Amanda Hernandez	Senior Planner	City of San Marcos
Bob van Til	Planning/Development Director	City of Taylor
Lyle Nelson	Chief of Staff	Capital Area Rural Transportation System
Justin Word	Director of Project Management	Central Texas Regional Mobility Authority
Barbara Rush	Chief of Staff to Commissioner Brigid Shea	Travis County
Pharr Andrews	Environmental Program Coordinator	City of Austin
Tom Gdala	Senior Engineering Associate	City of Cedar Park
Nathaniel Waggoner	Transportation Analyst	City of Georgetown
Terri Crauford	Assistant City Engineer	City of Leander
John Dean	Assistant Transportation Director	City of Round Rock
Joseph Carrizales	Planner	Austin District TxDOT
Mason Gremar	Researcher	Center for Transportation Research
Natalia Ruz Juri	Researcher	Center for Transportation Research
Ken Perrine	Researcher	Center for Transportation Research
Scheleen Walker	Long Range Planning Manager Travis County	Department of Transportation & Natural Resources

Appendix B: Emails to Obtain Focus Group Participants

Greetings, ASCE Members!

UT Professor Kara Kockelman* is conducting research in **connected and autonomous vehicles (CAVs)**, and is excited to invite ASCE members and their technical expertise to CAV **discussion groups.** The focus groups will be conducted to understand participant's perceptions around automated and connected vehicles, specifically **opportunities in infrastructure decisions, city and regional planning, transport and related policy, and economic benefits and barriers.**

Dr. Kockelman would like to tap into ASCE member's expertise and likely interest in such fields. AVs & CVs may bring significant differences in traffic patterns and travel times, roadway safety, traveler convenience, and, possibly, emissions and air quality. It is important to get civil engineering leaders talking now.

Dr. Kockelman has contracted focus group experts at Austin's Think Group to lead the discussions, and their staff can arrange to schedule interested citizens with some transportation or engineering expertise into the meetings. (**12 persons** in each time slot: **12:30 pm**) We will also have researchers, including a technical expert and urban planners, on hand to assist in the discussions, as detailed questions emerge. We will provide a meal, to keep everyone's energy up!

We are hoping to confirm focus group participants as soon as possible. We've **struggled** booking contacts provided by local MPOs. If you are particularly interested in the discussion topics and would like to reserve a spot, **please contact Roshni Patel**, at roshni@thinkgroupaustin.com & 512-637-6153 **by Friday** of this week.

Austin Area's Focus Group Meetings
When: 2-hour sessions, Tuesday, May 19, 12:30-2:30 pm
Where: 6633 E. Hwy. 290, Ste. 201, Austin, TX 78723

San Antonio Area Focus Group Meetings
When: 2-hour sessions, Thursday, May 21,12:30-2:30 pm
Where: AAMPO offices, 825 South St. Mary's, San Antonio, TX 78205
We really look forward to hearing your ideas on what opportunities and challenges lie ahead, for the Austin and San Antonio region – its communities, residents, businesses, and public agencies. Please do join us.

Thank you for your time. We look forward to seeing you next week!

Greetings, WTS HOT and San Antonio chapters!

Dr. Kara Kockelman* is conducting research in **automated and connected vehicles**. She is excited to invite WTS members and their technical expertise to **four focus groups.** The focus groups will be conducted to understand participant's perceptions around automated and connected vehicles, specifically **its opportunities in city and regional planning, transport and related policy, infrastructure decisions, and economic benefits and barriers.**

Dr. Kockelman would like to tap into WTS member's expertise and likely interest in such fields. AVs & CVs may bring significant differences in traffic patterns and travel times, roadway safety, traveler convenience, and, possibly, emissions and air quality. It is important to get leaders talking now.

Dr. Kockelman has contracted focus group experts at Austin's Think Group to lead the discussions, and their staff can arrange to schedule interested WTS members into the four meetings. (**12 persons** in each time slot: **1 pm, 3 pm, or 5:30 pm**) We will also have researchers, including a technical expert and urban planners, on hand to assist in the discussions, as detailed questions emerge. We will provide a meal, to keep everyone's energy up!

We are hoping to confirm focus group participants as soon as possible. If you are particularly interested in the discussion topics and would like to reserve a spot, **please contact Roshni Patel**, at roshni@thinkgroupaustin.com & 512-637-6153 **by Friday** of this week.

Austin Area's Focus Group Meetings
When: 2-hour sessions, Tuesday, May 19, 1:00 pm, 3:00 pm, OR 5:30 pm
Where: 6633 E. Hwy. 290, Ste. 201, Austin, TX 78723

San Antonio Area Focus Group Meetings
When: 2-hour sessions, Thursday, May 21,1:00 pm, 3:00 pm, OR 5:30 pm
Where: AAMPO offices, 825 South St. Mary's, San Antonio, TX 78205

We really look forward to hearing your ideas on what opportunities and challenges lie ahead, for the Austin and San Antonio region – its communities, residents, businesses, and public agencies. Please do join us.

Thank you for your time. We look forward to seeing you next week!

*UT Department of Civil, Architectural, and Environmental Engineering.
www.caee.utexas.edu/prof/kockelman
WTS HOT 2013 Honorary Member and previous Woman of the Year

Appendix C: Final List of Focus Group Attendees

First Austin Focus Group		
Name	**Title**	**Organization**
Jerry M. Keys	Corridor Council	Matheson, Keys & Kordzik PLLC
Gordon Derr	Transportation Assistant Director	City of Austin
John Dean	Assistant Transportation Director	City of Round Rock
Neil Frydrych	Senior Planner	Capital Council of Government
Barbara Rush	Chief of Staff	Office of Travis Co. Commissioner Brigid Shea, Pct 2
Meredith Johnson	Planner	City of Buda
Jason JonMichael	National Technology Leader	HNTB
Rob Belarmino	Project Manager	HNTB Austin's Technology Group
Second Austin Focus Group		
Phil Tindall	Assistant Director	CAMPO
Michael Aulick	Principal (+ Past CAMPO Director)	Aulick and Associates, LLC
Heidi Gerbracht	Vice President of Public Policy	Real Estate Council of Austin
Justin Word	Director of Project Management	Central Texas Regional Mobility Authority
Stephanie McDonald	Vice President	Greater Austin Chamber of Commerce
Todd Hemingson	Vice-President of Strategic Planning and Development	Capital Metro
Sabas Avila	Asst. Director of Public Services - Transportation	City of San Marcos
Ross Milloy	Director	Lone Star Rail District
Nathaniel Waggoner	Transportation Analyst	City of Georgetown
David Greear	Senior Engineer	Travis County
Trey Fletcher	Assistant City Manager	City of Pflugerville
Jennifer Williams	Aviation Department	City of Austin

First San Antonio Focus Group		
Gilmer Gaston	Vice President of Traffic Engineering	Pape Dawson
Brad Peel	Senior Project Manager	HNTB Corporation
David H. Brown	Member	Boerne Chamber Board of Directors
Thomas H. Hornseth.	Comal County Engineer	Comal County
Shelby Guiterrez	Associate	Bracewell and Guililiani LLP
Can (John) Saygin	Asst. Vice President for Sponsored Project Administration	Office of the Vice President for Research
Jim Koening	Chair of the Infrastructure Committee of the North San Antonio Chamber of Commerce	Jacobs Engineering
Justin Renteria	Council Aide to City Councilman Joe Krier	City Council
Craig Follins	President	Northeast Lakeview College
Garl Latham	Principal	Latham Railway Services
Jason Scheppers	Civil Engineer	Maestas & Associates
Bregger A. Garrison	Engineer III	Lockwood, Andrews & Newnam, Inc
Second San Antonio Focus Group		
Jeff Arndt	President / CEO	VIA Metropolitan Transit
David Kruse	Data Center Director	Alamo Area COG
Jason Rodriguez	Manager of Strategic Planning	VIA Metropolitan Transit
Daniel Ludwig	Member	Pedestrian Mobility Advisory Committee
Joe Guinn	Limo and Bus Compliance	San Antonio Transportation Alliance
Vic Boyer	President / CEO	San Antonio Mobility Coalition
Diane Rath	Executive Director	Alamo Area Council of Governments
Mark Mosley	Planning Engineer	TxDOT
Lori Dullnig-Warlen	Sr. Project Manager	Bain Medina Bain, Inc.
Trish Wallace	Transportation Planning Manager	Transportation & Capital Improvements
Andy Greene	Senior Advisor to Councilman Lopez	San Antonio City Council
Ray Lopez	City Council Member	San Antonio City Council

Professional Perceptions of Automatous Vehicle Focus Groups

Discussion Guide v3

May 11, 2015

Objectives

- Discover planning-related professionals' perceptions of smart, or connected vehicles (individual and shared)
  - Reactions to vehicle Information provided before the groups
  - General knowledge, questions and concerns regarding the technology option
- Identify feedback regarding planning, policy, infrastructure and economic benefits
- Explore barriers to implementation, including professional opinions on how to overcome barriers

A. INTRODUCTION (10 MIN) 0:00

- Thank you for taking time today. My name is ____ and I'm an independent market researcher
- Discussing several topics related to smart, or connected vehicles (both individual and shared)

Disclosure/Discussion Guidelines

- VIDEOTAPING/AUDIO RECORDING
- TALK ONE AT A TIME
- AVOID SIDE CONVERSATIONS
- PARTICIPATE EQUALLY
- NO RIGHT OR WRONG ANSWERS
- DISAGREE RESPECTFULLY
- SAY WHAT YOU BELIEVE, EVEN IF YOU'RE THE ONLY ONE
- SPEAK FOR SELF, NOT OTHERS—WANT TO HEAR YOUR OPINIONS
- KEEP OTHERS HONEST

Respondent Introductions

- Name
- Where you work and what your role is
- Based on your reading, please tell the group one thing you are hoping to discuss today

NOTE: MODERATOR WILL PROBE DEEPLY THROUGHOUT DISCUSSION TO UNDERSTAND WHY PARTICIPANTS RESPOND AS THEY DO TO QUESTIONS AS APPROPRIATE.

B. SMART VEHICLES: POSITIVES AND NEGATIVES (35 MIN) 10:00

I know you all received and have read materials about future plans for smart and connected vehicles. To begin our discussion, I'd like for you to read a brief paragraph on the topic. Please circle the words and phrases that seem positive to you, and cross through those that are confusing or negative. (EXAMPLE ATTACHED ON STYLE OF PARAGRAPH. PARTICIPANTS PUT THEIR NAME AND GROUP # ON THE PAPER. DO NOT WALK THROUGH THE ACTUAL PARAGRAPH, JUST LEAVE THEM ON THE TABLE SO GROUP CAN REFER TO THEM AND TAKE THEM UP AFTERWARD).

After exercise, have participants make two lists, and write 3 positive aspects of the topic and 3 negative aspects (or concerns).

POSITIVES (MAKE A LIST AND THEN DISCUSS).

- Describe the benefits associated with smart vehicle use (make a list).

  EXPLORE FOR BENEFITS

  - Fewer crashes
  - Easier travel (lower effective time cost, especially for drivers)
  - Reduced traffic congestion
  - Lower vehicle emissions & better fuel economy (via eco-style driving)

- What tasks could be attended to while riding in a smart vehicle?

  EXPLORE FOR TASKS THAT COULD BE ACCOMPLISHED WHILE RIDING

  - Use electronics to talk, text, or play games (phone, laptop, etc.)
  - Sleep or relax
  - Work (laptop, tablet, etc.)
  - Read (paper book or e-reader)
  - Access the internet (phone, tablet, laptop, etc.)
  - Watch movies (vehicle-installed infotainment system, or handheld device)
  - Eat or drink

NEGATIVES (MAKE A LIST AND THEN DISCUSS).

- Describe some of your concerns with this technology. What are some potential "negatives"?

  NEGATIVES OR CONCERNS

  - Equipment or system failures in route
  - Abuse & excessive use of the vehicles (lots of empty-vehicle travel, vehicles with no occupants ending up in predicaments away from their owners, children being sent out unchaperoned)
  - Legal liability assignment (to owner or manufacturer) following a crash or other incident
  - Hacking of the vehicle's computer to stall or harm the vehicle (and its occupants)
  - Privacy
    - *For example, these vehicles will need to have sophisticated data recording schemes for health diagnostics and incident analysis (black boxes). So your vehicle will have a very detailed record of where you drive, at what time of day, how often, etc. This data would be a gold mine for companies that want to target advertisements to you*

via the infotainment system, to health insurers to profile your behavior (do you drive a lot to the gym or to the bar?), etc.

- Affordability

C. USAGE/TARGETING (20 MIN) 45:00

- Who the technology is right for? Whose interests does this technology serve? Who will smart vehicles benefit, and how? (FOR EXAMPLE, consumers, the automotive industry, insurance companies, or traffic laws and traffic management systems

WAYS CONNECTED-VEHICLE TECHNOLOGIES COULD BENEFIT INTERESTED PARTIES

- Real-time traffic information (e.g., shortest path guidance to pre-set destinations)
- Guidance to available parking spaces
- Automatic notification of crash or other issues to emergency personnel
- Insurance companies monitoring driving habits to assess rates
- Control/Monitor driving patterns of dependents (e.g., teenagers, family members with cognitive or physical limitations)
- Display road signs (e.g., speed limits and coming exit ramps or cross-street names)
- Remote service (warm/cool vehicle) before use
- Vehicle health report
- Vehicle life-cycle management

1. Do you see different uses of smart vehicles in different environments, such as downtown driving vs. suburban neighborhoods?
    a. Transportation needs, like commuting or running errands?
    - *Many seem to think AVs will be used more for long distance commuting. But then others discussed how the downtown AV use will most likely be shared AVs to avoid self-parking, but the users will need to be open to sharing the car with strangers*
2. How would smart vehicles benefit transportation systems at a regional scale, compared to a local scale?
3. What other uses or benefits have we not discussed?

D. IMPACT (20 MIN) 1:05:00

- Let's talk about how smart vehicles will impact a variety of sources, including the community and region, planning and policy, consumers, and you personally?

POINTS FOR DISCUSSION:

- Community/Regional Impact
    - How will it affect your community? (Positively and negatively)
        - Does the use of smart vehicles differ in different environments, such as the urban core and suburban neighborhoods? How?
    - How will it affect your job specifically? (Positively and negatively)
    - When do you think your community would start using smart vehicles for personal travel?

        - How do you see usage rolling out? What will happen? Who will be affected first? Most?
        - How can we get smart vehicles to benefit our region, rather than just serve at a local community or individual-household scale?
            - How about the whole state? Are there implications for the state of Texas?
            - How should the broad-based expansion play out?
            - Who would/could lead this effort?
- Planning and Policy Impact
    - How might AVs affect our planning and policy?
    - In order to ensure smooth and safe traffic operations, when should we start thinking about design and policy changes?
- Impact on Consumers
    - How will these vehicles impact minor drivers? Or how adults think of utilizing the technology with minor drivers?
    - What are potential guidelines and restrictions that could be put in place for unlicensed youths traveling unchaperoned in such vehicles?
        - What potential guidelines and restrictions will be necessary?
- Personal Impact
    - How will such high levels of automation affect your job and your agency's responsibilities?
        - Positive and negative impact

E. INFRASTRUCTURE AND FUTURE USES (15 MIN) 1:30:00

- How might future road design benefit smart vehicles?
    - How could high-level smart vehicles help alleviate traffic congestion?
        (a) How might future road design be different from today assuming a majority of vehicles on the road are smart?
        (b) Lanes may be narrowed as driverless vehicles see in all directions and track position very closely
        (c) Road signage may have embedded codes visible only to the vehicle's camera system (not human-readable)
        (d) What road design decisions will be possible assuming a majority of vehicles on the road are smart vehicles?
            - More efficient traffic flow could lead to lower infrastructure demand (fewer new road-miles needed)
            - If road design is built for humans, it will be good for AVs (e.g., clear lane divisions, clear shoulder edge, clear signage)
            - It's not the road design but rather the traffic communication that will need to be improved
- What are current infrastructure barriers to higher-level smart vehicles?
- Can you foresee smart vehicles used for commercial purposes? What types of industries or businesses? How do you foresee commercial AVs working?

    - Shippers & carriers will save a great deal on labor costs and be able to avoid driver regulations (on sleep, for example) by automating vehicles, and having self-driving platoons (where a couple workers are on hand, for unloading purposes, emergencies, etc.).

- Platoons are unlikely to be popular with the public during the daytime, but may be permitted on major roadways (e.g., interstate-style facilities) at nighttime (e.g., 9 pm to 6 am)

- What other ideas should we consider for the future?

F. PENETRATION RATES (10 MIN) 1:45:00

- At what point do you think residents in your region will be comfortable with the idea of using smart vehicles for their & their family members' own personal travel?

  (Note: These questions are designed to address consumer behavior: e.g., how comfortable do you need to be before you buy it)

  - As soon as these vehicles are available
  - By the time at least 10% of the people in our community are actually using AVs regularly
  - By the time at least 50% of people in our community are using AVs regularly
  - I'm not sure if our residents will embrace this technology

- In order to ensure smooth and safe traffic operations, when should we start thinking about making such design and policy changes?

G. WRAP UP (5 MIN) 1:55:00

- For you personally, and your particular area of interest, what is your understanding of the likely impacts of smart vehicles?

Professional Perceptions of Connected and Automated Vehicles

QUALITATIVE RESEARCH - CONCEPT TESTING

FINAL ANALYSES AND CONCLUSIONS

PRESENTED BY

THINK GROUP AUSTIN

CREATED FOR

DEPARTMENT OF CIVIL, ARCHITECTURAL AND ENVIRONMENTAL ENGINEERING

THE UNIVERSITY OF TEXAS AT AUSTIN

Initial Report Date: June 8, 2015

Report Modified by UT & finalized: July 1, 2015

Data Collection Dates: May 19-21, 2015

BACKGROUND

Think Group Austin has been engaged by the Department of Civil, Architectural and Environmental Engineering at the University of Texas at Austin to conduct qualitative research regarding the future of connected and automated vehicles in the state of Texas. The purpose of the research is to provide researchers from the university with support data and information regarding the attitudes, perceptions, motivations and intention of transportation professionals in the Austin and San Antonio areas regarding connected and automated vehicle development and delivery service needs.

METHODOLOGY

The qualitative research project included four focus groups held according to the following schedule.

	DATE	TIME	LOCATION	PARTICIPANTS
Group 1	Tuesday, May 19	12:30 PM	Austin	8 Austin-area transportation professionals
Group 2		3:00 PM		9 Austin-area transportation professionals
Group 3	Thursday, May 21	12:30 PM	San Antonio	9 San Antonio-area transportation professionals
Group 4		3:00 PM		9 San Antonio-area transportation professionals

Focus group participants were recruited based on the following qualifications:

- PARTICIPATION CRITERIA

The University researchers collaborated with the Capital Area Metropolitan Planning Organization and the Alamo Area Metropolitan Planning Organization for their initial 130 contacts. The university was also connected with various professional organizations to advertise the focus groups. The intent was to find interested individuals who are also professionally involved in their locality's growth and transportation efforts. In response, Think Group Austin engaged a mix of transportation specialties, departments, job functions, and tenure. The overall groups included 35 professionals; 29 males and 6 females.

It should be noted that this report is based on the results of 4 focus groups in 2 cities. Accordingly, the results from this research should be generalized to the overall state of Texas with caution. Terms are used in this analysis that reflects general proportions of respondents, but not individual groups, cities, counties, or states.

Verbatim comments are used in this report to reinforce the observations and conclusion and to provide a voice of the customer. For the most part, comments are pulled directly from the transcriptions. There are instances where slight modifications have been made to improve readability.

KEY PERCEPTIONS

This summary combines observations from all focus groups and compiles the information into key perceptions that are considered important to connected and automated vehicles in the state of Texas.

Perception #1

TRANSPORTATION PROFESSIONALS ARE NOT PLANNING FOR THE PROSPECT OF AUTOMATED VEHICLES – EVEN AT THE HIGHEST LEVEL OF MANAGEMENT. TRANSPORTATION PLANNING AND CITY PLANNING PROFESSIONALS AGREE THAT THE CONCEPT IS NOT INCLUDED IN THEIR 25-YEAR PLAN.

Discussion

1. The majority of participants express some interest in the idea of connected and automated vehicles because they envision that the technology, if implemented, will lead to a more efficient transportation system.
2. They know the current system is not sustainable, but admit there is little being done in their domain beyond discussing issues and exploring available information.
3. Several say they are not sure the topic lies within a local jurisdiction, and at the very least should be addressed on a state, or even national level.
4. The problem is, as they point out, the United States does not have a national transportation policy, and in the absence of an agreed-upon strategy, the political hurdles of implementation alone may take several decades to address.
5. As exhibited in the past, transportation tends to lag behind the technology curve, lacking enough dollars to get ahead. Without direction mandating the technology, the technology will be slow to get out of the research phase.
6. Several participants felt that the market would be the ultimate driver of implementation. Consumers would make the choice once the technology was readily available and proven to be safe.
7. Since most think the benefits may be greater for regional or distance travel than for local travel, the assumption was made that there would be reluctance for local entities to "get the ball rolling."
    a. Most do not think it is their professional responsibility. A few seem to be waiting for a superior or the government to tell them to start planning, or others are not sure which local department would be in charge of these efforts.
8. The issue of integration leaves participants with questions:
    a. how will non-communicative and communicative vehicles coexist?

b. What additional infrastructure will automated vehicles require?

c. Who will pay for the technology upgrades that will surely be needed for the transportation system to communicate with the automated vehicles?

9. Expectations are that there will be managed lanes to accommodate the automated vehicles, but professionals are unsure of where that starts or if it is currently in planning. Even if planning and policy are being considered, most think implementation is at least 20-25 years away.

Level four is farther away than people say.

If I was on a fixed-route system with a predictable route, I can see the benefit. Local trips to the grocery store or Home Depot, that's where it breaks down.

I'd be curious as to rollout. Would it be all or nothing, or a combination? When they rolled out the automated trains, people get used to that. I'd be curious – small cities with different issues. Having these issues, what will be the infrastructure?

I think the challenge for rural areas, it's huge. This will happen from urban out. There are a lot of roads on this state. How would we get this incorporated into all facilities in the state? That would take centuries.

Perception #2

TRANSPORTATION PROFESSIONALS AGREE THAT IN TIME, AUTOMATED VEHICLES WILL PRODUCE A SAFER, MORE RELIABLE, AND EFFICIENT TRANSPORTATION SYSTEM.

Discussion

- Participants feel that CV is for vehicle safety and AV is self-driving, but haven't thought much beyond CV technology. They admit the various entities for which they work are ill prepared for action.
- They consider the automated technology to be reliable and predictable, which leads to much greater control. They think the most positive outcome of this control is safety.
- Since distracted driving leads to the majority of accidents, professionals say that safety will be the number one bonus and a motivator for implementation.
    - Many think the desire for increased crash avoidance will motivate policymakers to get the program off the ground.

- In addition to safety, they think a more efficient system will aid in predictability and consequently increase capacity for existing highways.
    - One professional noted as an example: more precisely scheduled cars can drive more closely together which means fewer lanes are needed.
    - Another noted with better scheduling, cars may also be able to squeeze small trips in between distance travel, reducing or even eliminating the need for parking.
- However, they feel the benefits described earlier can also work to the negative in a different situation.
    - For example, if you enforce the car to never go over the speed limit, people will have to slow down. Drivers will have to accept the route chosen by the vehicle and not be able to take short cuts.
    - The professionals questioned what about the transitionary time when every car is not subject to these regulations and some are driving outside the regulated cars. Non-automated vehicles could still cause accidents by trying to dart in and out of the regulated traffic.
- Professionals look forward to having better data that leads to better analysis and future planning – accident data, traffic flow, driver preference for speed and risk, alternate routes around accidents.

If we can keep teenagers from driving 45 in a residential, that would make our job easier. We could control top end speeds on certain roads.

As simple as we try to make it, it is still complex. People will need to become oriented to the new technology and trained to drive those cars.

Perception #3

CONSUMERS ARE EXPECTED TO EXPERIENCE AN IMPROVED QUALITY OF LIFE WHEN AUTOMATED VEHICLE USE IS WIDESPREAD FROM REDUCED TRAVEL TIME, ABILITY TO USE COMMUTE TIME MORE PRODUCTIVELY, AND FREEDOM TO LIVE IN MORE REMOTE AREAS. THE SYSTEM MAY BETTER SERVE UNLICENSED POPULATIONS, ESPECIALLY THE ELDERLY, DISABLED, AND MINORS.

Discussion

- Many think consumers are expected to enjoy the flexibility of being productive during travel time – whether they choose to use that time for work or play, the choice will be theirs.

- They can also choose to live where they want. Professionals envision a phenomenon of urban sprawl, with a possible mass migration to residing in suburban and rural areas where home prices are cheaper and life is simpler.
- Benefits to the currently underserved populations is top-of-mind for professionals. They envision greater Medical help in rural areas, where patients can easily come to the best location for medical services.
- They also see benefits to improved education; for example, young people not limited to schools they are close to. They can pick a location best serving their educational needs.
- A great deal of emphasis was placed on discussing the positives for people not now driving. There aren't exact figures about how many people are dropped off, but this service could add them to the mix.

"I drive an hour every day in the car. If I can be on the phone during that time, I can reduce my work day by an hour."

***"How much pent up demand is there for people who want to drive, but don't? My mother-in-law could be. She loves to get out, but doesn't. If she had* AV she would. How many cars added to freeways?"**

"You can send it home and have it pick you up."

"I can see if you got family, dad that commutes, wife stays home, dad could have his car, have it go back. Instead of two car they're one car family."

"Doesn't remove the vehicle from traffic. Only have to buy one, but car drove to work, all it does it saves a car. Might increase, because car's going back and forth."

Perception #4

THE OVERALL ENVIRONMENT SHOULD BENEFIT FROM FUEL ECONOMY AND REDUCED EMISSIONS.

Discussion

- Most professionals expect fewer cars on the highway as a result of shared automated vehicles (but this is unlikely, since automated cars make private-vehicle and shared-vehicle travel easier, for long-distance trips too).

    - The think fewer cars on the highway will mean greater fuel economy and lower CO2 emissions (but this is unlikely, for reasons noted above).

- Reduced idle time due to stop and go traffic will also contribute to greater fuel efficiency.
    - However, many also recognized the consequence of "orbiting vehicles" or "zombie cars". As AVs are sent to drive around, waiting for their owners to call for them, there may be an increase of car density and an increase in CO2 emissions. Consumers may send their cars to park at home to avoid parking fees or safety risks. The participants point out this is room for regulations to manage the empty AVs.

"It is good for our environment – fewer cars on the road means reduced emissions."

"There would be a limit on the number of cars in one place – the benefits of less density."

Perception #5

TECHNOLOGY MAY BE THE GREATEST DETERRENT TO THE DEVELOPMENT OF AN AUTOMATED TRANSPORTATION SYSTEM. CONCERNS INCLUDE THAT TECHNOLOGY DESIGN AND IMPLEMENTATION NECESSARY FOR THE NEW INFRASTRUCTURE WILL BE SLOW AND CUMBERSOME, SUBJECT TO FRUSTRATING COMPUTER GLITCHES AND FAILURES, AND MET WITH RESISTANCE FROM INDUSTRY PROFESSIONALS AND CONSUMERS ALIKE.

Discussion

- Professionals think the state will lag in planning and studies.
    - The technology will outpace the laws and infrastructure by years.
    - Policy changes will be needed for implementation, and political factors may impede policy change.
- They expressed concern that legislation may be necessary to ensure compatibility.
    - Competing manufacturers may create vehicles that purposefully don't communicate with one another.
- They feel technology glitches may exist during development, which may turn away interested consumers.
- They think we have to see technology connected.
    - Presently, we're assuming it's out there, but many feel government does not typically respond until the program is in place.
    - One participant noted first, we must have vehicles; we have to build them and see a reaction. It is not ideal, but it is the reality.

"…It's software running on hardware. With Safe Stop, if something goes wrong the car will stop in the middle of the lane."

"We have to assume technology intelligent enough to identify traffic controllers. One can't imagine only to start by putting in this traffic signal and boxes, without them being all networked."

"You have all this technology, but you're also going to have to drive. You're going to drive, but realize it's not talking yet. Giving inputs distracts. Perhaps the first transition is freight only. Freight has 10 or 20 years to automate, while providing safety. "

Perception #6

PROFESSIONALS WANT TO KNOW WHO WILL "OWN" AN AUTOMATED SYSTEM. THEY ARE CONCERNED THAT, WITH NO ONE CLEARLY IN CHARGE, THERE WON'T BE A STRUCTURE IN PLACE FOR SYSTEM DEVELOPMENT, MAINTENANCE AND IMPROVEMENT. THEY WANT TO KNOW THAT PUBLIC POLICY WILL ENSURE ACCESSIBILITY AND PROTECT THE PRIVACY AND SECURITY OF THE SYSTEM AND THE CITIZENS.

Discussion

- Professionals say the market will drive the process if we remain interested and visionary.
- Some expect automobile manufacturers will drive the technology, but point out there may be detractors. For example, they think insurance companies may not want to insure the new smart-transport technology if they stand to lose money.
- Many had concerns regarding big brother and privacy issues. Examples used by the participants were that terrorists could hack or breech the systems, causing crashes similar to airlines hacks
- Others also mention the problem of data being sold to private companies rather than being used to further the advancement of the program overall.
- A concern exists there won't be consistency between devices and sensors, (some think there already is a problem with connected vehicles.)
- Participants asked:
    - Who will create the high definition maps required by a public map system?
    - Who's liable for car accidents?
- Many felt everyone will need to be more nimble than in the past. Once the technology takes off, changes may happen rather quickly.

- Many believed liability policies will have to be drafted and implemented. If this is going to be a national program, policy will have to be at a national level.

"Google has a bad attitude about connectivity. Don't' want to talk to anybody. Want to do it themselves.

"Whose responsibility is authentication and certification in an autonomous situation? How it's serviced and working properly

"The industry is moving away from vehicle manufacturing and focusing on mobility."

"Someone will have to insure the reliability of the technology. The issue is who is liable? The manufacturer, the engineer, the driver, or the sales person?"

"The government is going to have to be responsible for this. The private sector will follow."

"Regulations will need to be redone. There are legal barriers. You're in a small car and a truck will have an accident. You'll need to decide to sacrifice a small car. We save eight people, but your daughter was killed. Sorry."

Perception #7

THE IDEA OF AUTOMATED COMMERCIAL TRANSPORTATION IS ATTRACTIVE FOR ITS POTENTIAL AFFORDABILITY AND RELIABILITY, BUT WHEN JOB LOSS IS MENTIONED CONCERNS ARE RAISED ABOUT NEGATIVE ECONOMIC EFFECTS. PROFESSIONALS ALSO WANT TO KNOW WHAT TYPE OF COMMERCIAL SECURITY WILL BE IN PLACE.

Discussion

- Professionals assume better planning will result in needing fewer trucks, and trucks will be able to travel in more extreme conditions, leading to fewer accidents.
- Truck drivers may still be needed for loading and unloading, but they would have an opportunity to rest on the road, making commercial shipping more efficient.
- One creative idea by a professional was that trips could be tied to inventories at particular locations, i.e., *'take me to the place that has this item.'*
- Taxi companies could operate without drivers, but in general, there would be less incentive for public transportation.

"It's interesting for freight, where the routes and delivery times are predictable. It might encourage transportation at nighttime through cities. Freight management would be easier to command. For large companies like Wal-Mart or HEB, it makes sense."

"It would greatly benefit the freight – more reliable delivery. Plus, it could come through between three and six in the morning."

Perception #8

PROFESSIONALS ANTICIPATE UNINTENDED EFFECTS, POINTING OUT THAT DEVELOPERS MAY EXPECT RESISTANCE FROM CONSUMERS WHO STILL LOVE DRIVING, AND THAT CITY PLANNERS SHOULD BE AWARE OF THE POSSIBILITY OF "URBAN SPRAWL."

Discussion

- Professionals point out that there are several unintended effects of automated vehicles:
  - There is great concern for more urban sprawl. They point out that current goal in most city planning departments is greater density, since it helps conserve resources.
  - They discussed the possible consequence that people may stop investing in the urban core, which is historically the landmark of the cities.
  - Migration to the suburbs could nullify those resource savings, as well as increase fuel usage.
  - On the other side, they see that America represents an automobile-centric society, and the general public may lack trust in this new technology.
  - The system may also lack adaptability for the spontaneity Americans have become used to (i.e., cannot pull over at Starbucks if the trip is already planned).
  - Another creative thought was that people might choose to ride rather than fly for long distant trips, which might affect the airline industry.
  - And in general if trips are more convenient, it may increase travel rather than decrease it.

"Americans have a love affair with automobiles. You don't buy a Corvette to take a nap. There's an enjoyment to driving."

"I can drive an hour to the office while I work, I won't be concerned about the distance. The vehicles will be hybrids or electrified. So no fuel worry. It'll lead to more sprawl."

Perception #9

COST IS PREDICTED TO BE THE PRIMARY BARRIER TO AUTOMATED VEHICLE ADOPTION. VEHICLE AFFORDABILITY MAY LIMIT PERSONAL USE TO A PRIVILEGED FEW INDIVIDUALS. PROFESSIONALS ANTICIPATE GREATER RECEPTION FOR A SHARED VEHICLE SYSTEM.

Discussion

- Professionals point out that this technology will be cost prohibitive for smaller cities who cannot afford things like Bluetooth already.
- They envision these cars to initially be a luxury item. Some quoted the expected price for these vehicles is at least $150,000.
  - Already Mercedes has an autopilot where the car can stay in its lane. It can also control its speed.
- They foresee acceptance being on a continuum similar to the transition from horse and buggy to car – it could take from 20 years to 50 years.
  - Most agree that early adopters will pay whatever it takes to be the first to own an automated vehicle.
  - Most say the process will go slowly.
  - They point out that people who use mass transit often do so because they cannot afford a car, so shared automated vehicles is all they will ever be interested in anyway.
  - A business model will determine how the future of automated vehicles unfolds, and most expect that model will be driven by big businesses like Google or automobile manufacturers.

"It must be cost effective. Anything to reduce crashes is cost effective."

I think you'll have safety features in some expensive vehicles until we are able to prove that their effectiveness, then we will require it for all vehicles. I'll happen in steps – the market will drive it."

"We're moving in that direction. It'll be implemented – if you have managed lanes, that'll be the first thing. Then you can't drive a normal vehicle. There will be segregation. It would move into the freeway. Then you'll be off the freeways without an autonomous vehicle."

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Appendix F: Surveys Used for Data Collection on Projects 0-6838, 0-6847, and 0-6849

Following are copies of both the Texas and the national surveys.

U.S. Survey

Adoption of Self-driving and Connected Vehicle Technologies

UT Austin Internal Review Board # 2014-09-0078

Dear Respondent,

The Center for Transportation Research at **The University of Texas at Austin** is conducting a research study to explore preferences for and adoption of emerging self-driving and connected vehicle technologies and related traffic management strategies.

Self-driving vehicles and connected vehicles are new technologies with strong potential to improve traffic safety and mobility, and reduce emissions. Policymakers and transportation system planners need to assess how quickly such technologies will be adopted in order to develop optimal policies and strategies for traffic operations and management.

- The survey will take approximately **20-25 minutes** to complete.
- The survey will ask questions about you, your household's current vehicle inventory (example, odometer reading and average miles traveled per year), your future vehicle preferences, and preference for various self-driving and connected vehicle technologies.
- Your individual responses are **CONFIDENTIAL**. No names or other identifying information will be used in preparing the data for analysis.
- There are no risks involved in participation in this study and no direct benefits.
- **Your input and opinions** are **VERY IMPORTANT**, since it is critical that a variety of perspectives be represented in this survey.

If you have any questions or comments about this study, please feel free to contact me personally at kkockelm@mail.utexas.edu or (512) 471-0210. If you have any questions about your rights as a research participant, please contact the Office of Research Support by phone at (512) 471-8871 or email at orsc@uts.cc.utexas.edu. Your completion of the survey indicates your willingness to participate in the study.

Thank you very much for your time and cooperation.

Dr. Kara Kockelman
Professor of Transportation Engineering & Faculty Sponsor
www.caee.utexas.edu/prof/kockelman

NEXT

Please TAKE YOUR TIME on this survey. There are many novel questions in this survey that require careful reading and thoughtful answers. Those completing the survey in less than 15 minutes are unlikely to have read many questions.

SECTION 1: CURRENT AND PAST VEHICLES

1. Does your household **currently own or lease** one or more vehicles?

Note: Household includes all persons who occupy a housing unit, such as a house, an apartment, a mobile home, a group of rooms or a single room. The occupants may be a single family, one person living alone, two or more families living together or any other group of related or unrelated persons who share living arrangements.

- ○ Yes
- ○ No

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2. In order to forecast future vehicle ownership patterns and use, we need to know your **household's current vehicle ownership**. Please indicate the following for each of the vehicles used by your **household.**

	Make	**Model**	**Fuel type**	**Year of manufacture**	**Year of acquisition**	**Current odometer reading** (in miles)	**Is this vehicle leased?**	**Bought new?**	**Odometer reading** (in miles) at the time of acquisition
		(Example: Camry)				(Example: 15000)			(Example: 100)
Vehicle 1	▼		▼	▼	▼		▼	▼	
Vehicle 2	▼		▼	▼	▼		▼	▼	
Vehicle 3	▼		▼	▼	▼		▼	▼	
Vehicle 4	▼		▼	▼	▼		▼	▼	
Vehicle 5	▼		▼	▼	▼		▼	▼	
Vehicle 6	▼		▼	▼	▼		▼	▼	

3. Did you or anyone in your household **sell, donate, scrap, lose** (to a crash or other accident) or otherwise let go of a vehicle in the past **5 years**?

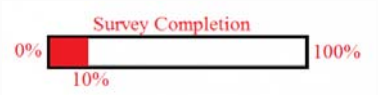
- ○ Yes
- ○ No

BACK NEXT

4. What vehicles have you or anyone in your household **sell, donate, scrap, lose** (to a crash or other accident) or otherwise let go of a vehicle in the past **5 years**?

	Make	**Model** (Example: Camry)	**Fuel type**	**Year of manufacture**	**Year of acquisition**	**Odometer reading** (in miles) at the time of acquisition (Example: 100)	**Last year of vehicle ownership**	**Odometer reading** (in miles) at the time you **sold, lost or given it away** (Example: 15000)
Vehicle 1								
Vehicle 2								
Vehicle 3								
Vehicle 4								
Vehicle 5								
Vehicle 6								

BACK NEXT



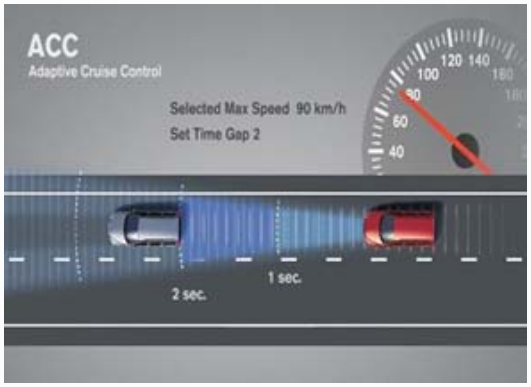
SECTION 2: PREFERENCE FOR VEHICLES AND SELF-DRIVING TECHNOLOGIES

Please read carefully before moving forward.
The National Highway Traffic Safety Administration (NHTSA) has defined five technology levels for vehicle automation technology. Levels 0 through 2 encompass technology that is commercially available today; Level 3 and Level 4 are emerging. These levels are defined as follows:

Currently Available Technologies for Consumers:

*No-Automation (**Level 0**):* The driver is completely responsible for the primary vehicle controls – braking, steering, throttle, and motive power – at all times.

*Function-specific Automation (**Level 1**):* Automation at this level involves one or more specific control functions. **Examples** include electronic stability control or pre-charged brakes, where the vehicle automatically assists with braking to enable the driver to regain control of the vehicle or stop faster than possible by acting alone. Other examples include adaptive cruise control (the ability of a vehicle to adjust its speed while in cruise control to maintain a safe following distance from a vehicle in front of it) and lane centering assistance (automatically adjusts the vehicle's steering angle away from a detected lane marker if a driver begins to wander out of his/her lane).



Adaptive Cruise Control

Lane Centering Assistance

*Combined Function Automation (**Level 2**):* This level involves automation of at least two primary control

functions designed to work in unison to relieve the driver's control of those functions. **Examples** include combination of adaptive cruise control and lane centering assistance.

Emerging Technologies:

*Limited Self-Driving Automation (**Level 3**):* Vehicles at this level of automation enable the driver to cede full control of all safety-critical functions under certain traffic and environmental conditions. This technology allows the driver to rely heavily on the vehicle to monitor for changes in those conditions, which may require transitioning back to driver control. The driver is expected to be available for occasional control, but with sufficiently comfortable transition time (example: 3 to 5 seconds). For example, the vehicle may be able to drive itself in low-speed environments or on freeways in good weather, but would need to transition to human control if inclement weather is encountered, or when turning onto higher-speed surface streets"

Level 3 Self-driving Vehicle

*Full Self-Driving Automation (**Level 4**):* The vehicle is designed to perform all driving functions for the entire trip. This design anticipates that the driver will provide destination or navigation input, but is not expected to be available for vehicle control at any time during the trip.

Level 4 Self-driving Vehicle

1. Which ONE of the following **decisions** are you and your household members considering at this time for the **next 12 months**?

- (●) We are planning on **selling one or more** vehicles.
- ( ) We are planning on **replacing (selling and buying) one or more** vehicles.
- ( ) We are planning on **buying one or more** vehicles.
- ( ) We are **not** planning on **buying another vehicle**, but after learning about **automation and connected vehicle technologies** from this survey, I am planning on **adding** these technologies to one or more of our current vehicle(s) (assuming that these technologies can be added to used/existing vehicles).
- ( ) We do not intend to take any above action.
- ( ) Other (please specify):

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2. Would you buy a **new or used vehicle**?

- I would buy a **new** vehicle.
- I would buy a **used** vehicle.
- I **do not know** whether the purchased vehicle would be new or used.

3. **How many vehicle(s)** do you plan to buy in next 12 months?

- 1
- 2
- 3
- 4
- 5 or more (please specify):

4. How much money do you plan to spend on the **next vehicle your household acquires**? If you plan to purchase **2 or more vehicles**, choose the maximum amount that you plan to spend on the **most expensive vehicle** and **answer the following questions for the same vehicle**.

Note: If you chose to "**buy and add automation technologies**", please **do not include** your budget **for adding** automation technologies.

- Less than $10,000
- $10,000 to $19,999
- $20,000 to $29,999
- $30,000 to $39,999
- $40,000 to $49,999
- $50,000 to $59,999
- More than $60,000

5. **How much ADDITIONAL money** would you be willing to pay for adding the following automation technologies (on top of your conventional [Level 1] car price) to your **next** vehicle?

	ADDITIONAL money you expect to pay
Combined Function Automation **(Level 2)**	▼
Limited Self-driving **(Level 3)**	▼
Full Automation **(Level 4)**	▼

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6. What is the **desirable fuel economy** (under city driving conditions) of your household's **next vehicle?** (Please keep in mind the price your household want to spend on the next vehicle purchase.)

- **Less than 10** miles per gallon
- **10** to **14** miles per gallon
- **15** to **19** miles per gallon
- **19** to **24** miles per gallon
- **25** to **29** miles per gallon
- **30** to **34** miles per gallon
- **35** to **39** miles per gallon
- **40** to **44** miles per gallon
- **45** to **49** miles per gallon
- **50 or more** miles per gallon

7. What **size of vehicle** are you planning to buy? (Please keep in mind the price you want to spend on the next vehicle purchase.)

- **Mini-compact car** (Example: Smart Fortwo)
- **Subcompact car** (Examples: Ford Fiesta and Kia Rio)
- **Compact car** (Examples: Hyundai Elantra, Honda Civic, Toyota Corolla, and Volkswagen Golf)
- **Mid-size car** (Examples: Chrysler 200, Ford Fusion, Audi A4, and BMW 3 Series)
- **Large cars** (Examples: Chevrolet Impala, Lincoln MKZ, Jaguar XF, and Toyota Avalon)
- **Minivan** (Examples: Ford C-Max, Toyota Sienna, and Fiat 500L)
- **Cargo van** (Examples: Chevrolet Express 1500 Cargo, Honda CR-V, and Ford Transit)
- **Passenger van** (Examples: Chevrolet Express 1500 Passenger and Ford E350 Wagon)
- **Small sport utility vehicle** (Examples: Jeep Compass, Jeep Wrangler, and Honda CR-V)

- ○ **Standard sport utility vehicle** (Examples: Audi Q5, Jeep Cherokee, and Ford Explorer)
- ○ **Small pickup truck** (Examples: Chevrolet Colorado and Toyota Tacoma)
- ○ **Standard pick-up truck** (Examples: Ford F-150, Chevrolet Silverado, and Nissan Titan)

8. Which of the following **vehicle brands** (make) do you **plan to buy or lease in the next 12 months**? (Please keep in mind the price you want to spend on the next vehicle purchase.)

Vehicle Brand	▼

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9. Please indicate the **make, model, year of acquisition, and year of manufacturer** for any vehicles you are presently considering selling.

	Make	Model (Example: Camry)	Year of acquisition	Year of manufacture
Vehicle 1	▼		▼	▼
Vehicle 2	▼		▼	▼
Vehicle 3	▼		▼	▼
Vehicle 4	▼		▼	▼
Vehicle 5	▼		▼	▼
Vehicle 6	▼		▼	▼

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10. **How much money** would you be willing to pay for adding the following automation technologies (on top of your conventional [Level 1] car price) for your **current** vehicle?

	Money you expect to pay
Combined Function Automation **(Level 2)**	▼
Limited Self-driving **(Level 3)**	▼
Full Automation **(Level 4)**	▼

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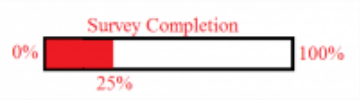
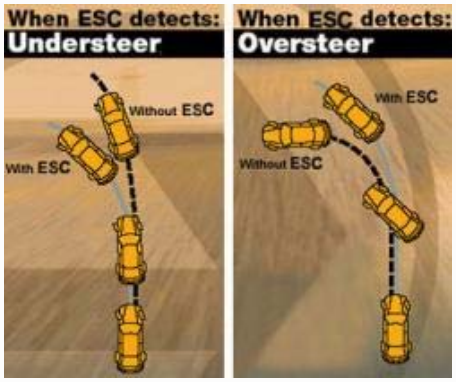


SECTION 3: WILLINGNESS TO PAY FOR SPECIFIC AUTOMATION TECHNOLOGIES

Note: This section will ask about your willingness to pay for various technologies. Current costs (and future estimated costs) for each technology are provided for illustration purposes.

1. **Electronic Stability Control:** When an extreme maneuver is attempted by the driver that nears or exceeds the traction limit of the vehicle, the vehicle will apply brakes to individual tires to maximize the driver's chances of keeping the vehicle under control.



Does one of your household's current vehicle presently have **Electronic Stability Control**?

- Yes
- No

Electronic Stability Control prices are likely to fall over time as shown below. **How much** are you **willing to pay** to add this feature to your household current vehicle or next vehicle purchase?

Current Price	$100
Price after 5 years	$70
Price after 10 years	$50

- Less than $60
- $60 to $79
- $80 to $119
- $120 to $149
- $150 to $200
- I **will not pay anything** to add **Electronic Stability Control**.

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2. **Lane Centering:** Automatically correct the vehicle's heading if a driver begins to wander out of his/her lane.

Does one of your household's current vehicle presently have **Lane Centering**?

- Yes
- No

Lane Centering prices are likely to fall over time as shown below. **How much** are you **willing to pay** to add this feature to your household current vehicle or next vehicle purchase?

Current Price	$950
Price after 5 years	$670
Price after 10 years	$480

- Less than $100
- $100 to $199
- $200 to $299
- $300 to $399
- $400 to $499

- $500 to $599
- $600 to $699
- $700 to $799
- $800 to $899
- $900 to $999
- $1,000 to $1,200
- I **will not pay anything** to add **Lane-Centering**.

BACK NEXT

3. **Left Turn Assist:** This feature will warn a driver attempting to turn left if there is an approaching vehicle traveling towards the driver's turn path.

Does one of your household's current vehicle presently have **Left Turn Assist**?

- Yes
- No

Left Turn Assist prices are likely to fall over time as shown below. **How much** are you **willing to pay** to add this feature to your household current vehicle or next vehicle purchase?

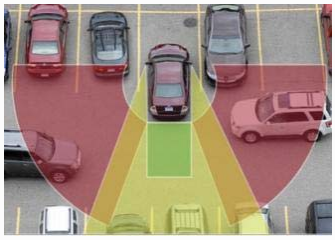
Current Price	$450
Price after 5 years	$320
Price after 10 years	$230

- Less than $100
- $100 to $199
- $200 to $299
- $300 to $399
- $400 to $499

- $500 to $699
- $700 to $1,000
- I **will not pay anything** to add **Left Turn Assist**.

BACK NEXT

4. **Cross-Traffic Sensor:** This feature monitors up to a 120 degree angle at the rear of the vehicle to detect if there is cross-traffic when a driver is attempting to back out of a parking space.



Does one of your household's current vehicle presently have **Cross-Traffic Sensor?**

- Yes
- No

Cross-Traffic Sensor prices are likely to fall over time as shown below. **How much** are you **willing to pay** to add this feature to your household current vehicle or next vehicle purchase?

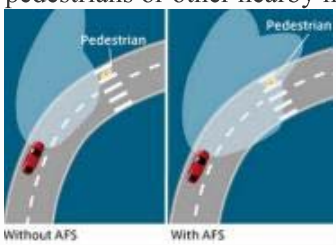
Current Price	$550
Price after 5 years	$380
Price after 10 years	$270

- Less than $100
- $100 to $199
- $200 to $299
- $300 to $399
- $400 to $499

- $500 to $599
- $600 to $699
- $700 to $1,000
- I **will not pay anything** to add **Cross-Traffic Sensor**.

BACK NEXT

5. **Adaptive Headlamps:** The vehicle can detect the level of lighting and will turn on the headlights when a threshold is breached. It can also detect pedestrians (and swivel its main beams around to shine light on the pedestrians or other nearby moving objects).



Does one of your household's current vehicle presently have **Adaptive Headlamps**?

- Yes
- No

Adaptive Headlamps prices are likely to fall over time as shown below. **How much** are you **willing to pay** to add this feature t,o your household current vehicle or next vehicle purchase?

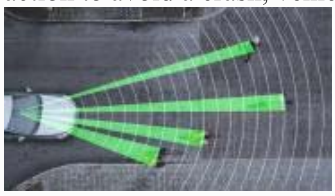
Current Price	$1,000
Price after 5 years	$700
Price after 10 years	$500

- Less than $150
- $150 to $249
- $250 to $349
- $350 to $449
- $450 to $549
- $550 to $649

- ○ $650 to $749
- ○ $750 to $849
- ○ $850 to $949
- ○ $950 to $1,049
- ○ $1,050 to $1,249
- ○ $1,250 to $1,500
- ○ I **will not pay anything** to add **Adaptive Headlamps**.

BACK NEXT

6. **Pedestrian Detection:** Detect and notify a driver about nearby pedestrians. If the driver does not take action to avoid a crash, vehicle will stop, using its automated braking feature.



Does one of your household's current vehicle presently have **Pedestrian Detection**?

- Yes
- No

Pedestrian Detection prices are likely to fall over time as shown below. **How much** are you **willing to pay** to add this feature to your household current vehicle or next vehicle purchase?

Current Price	$450
Price after 5 years	$320
Price after 10 years	$230

- Less than $100
- $100 to $199
- $200 to $299
- $300 to $399
- $400 to $499
- $500 to $699
- $700 to $1,000

I **will not pay anything** to add **Pedestrian Detection**.

BACK

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7. **Adaptive Cruise Control:** The ability of a vehicle to adjust its speed to ensure a safe (or minimum) distance from lead vehicles.

Does one of your household's current vehicle presently have **Adaptive Cruise Control**?

- Yes
- No

Adaptive Cruise Control prices are likely to fall over time as shown below. **How much** are you **willing to pay** to add this feature to your household current vehicle or next vehicle purchase?

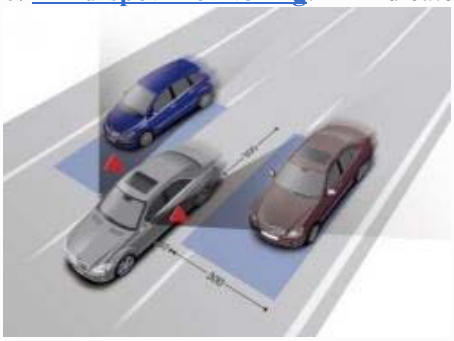
Current Price	$400
Price after 5 years	$280
Price after 10 years	$200

- Less than $50
- $50 to $149
- $150 to $249

- $250 to $349
- $350 to $449
- $450 to $699
- $700 to $1,000
- I **will not pay anything** to add **Adaptive Cruise Control**.

BACK NEXT

8. **Blind-spot Monitoring:** An indicator will warn the driver if a car is detected in its blind spot.



Does one of your household's current vehicle presently have **Blind Spot Monitoring**?

- Yes
- No

Blind Spot Monitoring prices are likely to fall over time as shown below. **How much** are you **willing to pay** to add this feature to your household current vehicle or next vehicle purchase?

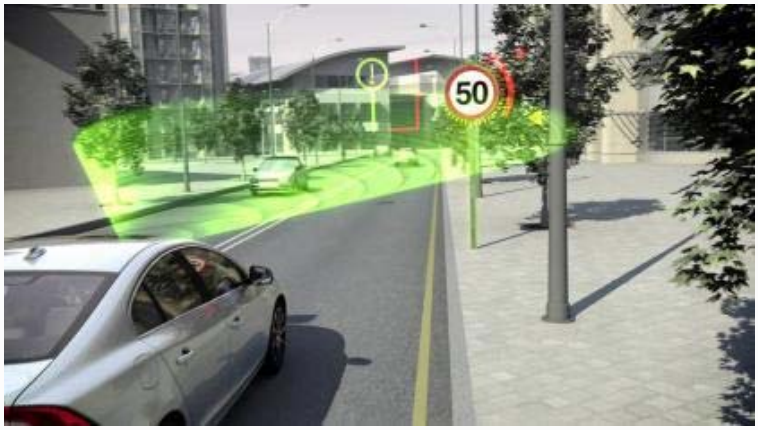
Current Price	$400
Price after 5 years	$280
Price after 10 years	$200

- Less than $50
- $50 to $149
- $150 to $249
- $250 to $349
- $350 to $449

- $450 to $699
- $700 to $1,000
- I **will not pay anything** to add **Blind Spot Monitoring**.

BACK NEXT

9. **Traffic Sign Recognition:** This technology will detect road signs and notify the driver about driving restrictions (examples: no overtaking, construction zone, speed limit zone, and stop signs) on the current stretch of road.



Does one of your household's current vehicle presently have **Traffic Sign Recognition?**

- Yes
- No

Traffic Sign Recognition prices are likely to fall over time as shown below. **How much** are you **willing to pay** to add this feature to your household current vehicle or next vehicle purchase?

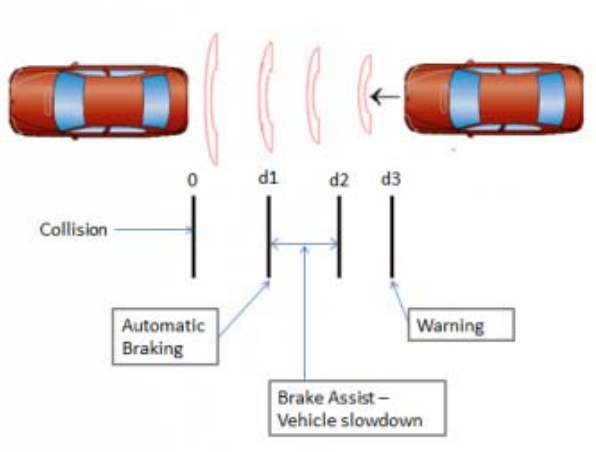
Current Price	$450
Price after 5 years	$320
Price after 10 years	$230

- Less than $100
- $100 to $199

- $200 to $299
- $300 to $399
- $400 to $499
- $500 to $699
- $700 to $1,000
- I **will not pay anything** to add **Traffic Sign Recognition**.

BACK NEXT

10. **Emergency Automatic Braking:** After detecting an obstacle on the road, if the driver does not react within a reasonable time frame, the vehicle will automatically apply the brakes.



Does one of your household's current vehicle presently have **Emergency Automatic Braking**?

- Yes
- No

Emergency Automatic Braking prices are likely to fall over time as shown below. **How much** are you **willing to pay** to add this feature to your household current vehicle or next vehicle purchase?

Current Price	$450
Price after 5 years	$320
Price after 10 years	$230

- Less than $100
- $100 to $199

- $200 to $299
- $300 to $399
- $400 to $499
- $500 to $699
- $700 to $1,000
- I **will not pay anything** to add **Emergency Automatic Braking**.

BACK NEXT

11. Please **indicate your interest** in the following technologies.

Note: If you forget the function of any technology, please click on it to see the associated image. If you would like to see a description of these technologies, please **click here.**

	Very Interested	Slightly Interested	Not Interested
Electronic Stability Control	○	○	○
Lane Centering	○	○	○
Left Turn Assist	○	○	○
Cross-Traffic Sensor	○	○	○
Adaptive Headlamps	○	○	○
Pedestrian Detection	○	○	○
Adaptive Cruise Control	○	○	○
Blind-spot Monitoring	○	○	○
Traffic Sign Recognition	○	○	○
Emergency Automatic Braking	○	○	○

BACK NEXT

12. **Limited Self-Driving (Level 3)**: This technology will enable the driver to give full control of all safety-critical functions to vehicle under certain traffic or environmental conditions, but still requires transitioning back to driver control in many situations.

Limited Self-Driving (Level 3) prices are likely to fall over time as shown below. **How much** are you **willing to pay** to add this feature to your household current vehicle or next vehicle purchase?

Current Price	$15,000
Price after 5 years	$10,500
Price after 10 years	$7,500

- Less than $2,000
- $2,000 to $3,999
- $4,000 to $5,999
- $6,000 to $7,999
- $8,000 to $9,999
- $10,000 to $11,999
- $12,000 to $13,999
- $14,000 to $15,999
- $16,000 to $17,999
- $18,000 to $21,000
- I **will not pay anything** to add **Limited Self-Driving (Level 3)**.

13. Self-Parking Valet System **(Level 3):** Enables park a vehicle itself within the immediately adjacent parking lot.

Self-Parking Valet System prices are likely to fall over time as shown below. **How much** are you **willing to pay** to add this feature to your household current vehicle or next vehicle purchase?

Current Price	$2,000
Price after 5 years	$1,400
Price after 10 years	$1,000

- Less than $250
- $250 to $749
- $750 to $1,249
- $1,250 to $1,749
- $1,750 to $2,249
- $2,250 to $2,749
- $2,750 to $3,000
- I **will not pay anything** to add **Self-Parking Valet System**.

BACK NEXT

14. **Full Automation (Level 4)**: The vehicle is designed to perform all safety-critical driving functions and monitor roadway conditions for an entire trip. Driver is not expected to be available for control at any time during the trip and thus can perform other activities (like working, reading, and sleeping).

Full Automation (Level 4) prices are likely to fall over time as shown below. **How much** are you **willing to pay** to add this feature to your household current vehicle or next vehicle purchase?

Current Price	$40,000
Price after 5 years	$28,000
Price after 10 years	$20,000

- Less than $2,000
- $2,000 to $5,999
- $6,000 to $9,999
- $10,000 to $13,999
- $14,000 to $17,999
- $18,000 to $21,999
- $22,000 to $25,999
- $26,000 to $29,999

- $30,000 to $33,999
- $34,000 to $37,999
- $38,000 to $41,999
- $42,000 to $45,999
- $46,000 to $50,000
- I **will not pay anything** to add **Full Automation (Level 4)**.

BACK NEXT

15. Connectivity may be added to an existing vehicle using one's smartphone plus additional equipment, such as dedicated short range communications [DSRC] technology and inertial sensors. Time-sensitive alerts to the driver could be audible sounds (like a message to "slow down" when congestion is forming up ahead or the roadway is deemed slippery), while more complex information may be relayed in text format (like real-time travel times to one's destination).

National Highway Traffic Safety Administration (NHTSA) recently announced an advanced notice for proposed rulemaking related to vehicle-to-vehicle communication technology for light-duty vehicles. Connected vehicles are equipped with technology enabling them to **"talk" to nearby vehicles and infrastructure** (traffic signal control boxes). This technology can be used for a variety of purposes, such as sharing information about nearby moving objects, roadway conditions, slowing vehicles, and better routes. Connected vehicles have the potential to increase roadway safety by reducing the number of crashes caused by human error.

Vehicle Connectivity prices are likely to fall over time as shown below. **How much** are you **willing to pay** to add this feature to your household current vehicle or next vehicle purchase?

Current Price	$200
Price after 5 years	$140
Price after 10 years	$100

- Less than $25
- $25 to $74
- $75 to $124

- ○ $125 to $174
- ○ $175 to $224
- ○ $225 to $274
- ○ $275 to $400
- ○ I **will not pay anything** to add **Vehicle Connectivity** .

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SECTION 4: OPINIONS

1. Do you **agree or disagree** with the following statements about car driving?

	Strongly Agree	Slightly Agree	Neutral	Slightly Disagree	Strongly Disagree
I believe that I am a **very good driver** myself.					
I think self-driving vehicles will drive **more safely** than my driving.					
Driving a car is something I **enjoy**.					
In the case of a new technology, I generally **tend to wait** if it proves itself (based on user reviews, for example) before purchasing.					

2. Do you agree or disagree about the following statements?

	Strongly Agree	Slightly Agree	Neutral	Slightly Disagree	Strongly Disagree
Self-driving vehicles are a **useful advance** in transportation.					
The idea of self-driving vehicles is **not realistic**. Conventional vehicles will be the standard for the next 40 years.					
Self-driving vehicles will be a **regular mode** of transport **in 15 years**.					
Self-driving vehicles **scare** me.					

	Strongly Agree	Slightly Agree	Neutral	Slightly Disagree	Strongly Disagree
I have **waited a long time** for self-driving vehicles.	○	○	○	○	○
I **do not think** that self-driving vehicles will function **reliably**.	○	○	○	○	○
I would be **comfortable sending** my self-driving car out on an errand knowing that I am liable if it gets into an accident.	○	○	○	○	○

3. Which **sources** would you **trust** to develop Level 4 self-driving vehicles? (Please check all that apply.)

- ☐ Technology companies (Examples: Google, Apple, Microsoft, and Samsung)
- ☐ Mass-market vehicle manufacturers (Examples: Toyota and Ford)
- ☐ Luxury vehicle manufacturers (Examples: BMW and Mercedes)
- ☐ Other (please specify) _____

4. How comfortable would you be in allowing your vehicle to **transmit information** (about its position and direction of travel, for example) to…?

	Very Comfortable	Slightly Comfortable	Neutral	Slightly Uncomfortable	Very Uncomfortable
Surrounding vehicles	○	○	○	○	○
Vehicle manufacturers	○	○	○	○	○
Insurance companies	○	○	○	○	○
Transportation planners	○	○	○	○	○
Toll operators	○	○	○	○	○

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SECTION 5: TRAVEL CHARACTERISTICS

1. Which of the following is your **primary means of travel** for the following activities? (Please select one means of travel for each activity.)

	Walk	Bicycle	Drive Alone	Drive with Others	Bus	Not applicable
Work Trips (either home to workplace or workplace to home)	○	○	○	○	○	○
School Trips (to & from your own school or your child's school)	○	○	○	○	○	○
Shopping Trips	○	○	○	○	○	○
Personal Business Trips (Examples: gym & doctors' appointments)	○	○	○	○	○	○
Social/Recreational Trips (Examples: dining out & visiting friends)	○	○	○	○	○	○
Other Trips (Examples: daycare & computer repair)	○	○	○	○	○	○

2. **How many ROUND trips** did you make for the following **purposes** in the **last 7 days?**

	0 trips	1-2 trips	3-4 trips	5-6 trips	7-8 trips	9 or more trips
Work Trips (either home to workplace or workplace to home)	○	○	○	○	○	○
School Trips (to & from your own school or your child's school)	○	○	○	○	○	○
Shopping Trips	○	○	○	○	○	○
Personal Business Trips (Examples: gym & doctors' appointments)	○	○	○	○	○	○
Social/Recreational Trips (Examples: dining out & visiting friends)	○	○	○	○	○	○
Other Trips (Examples: daycare & computer repair)	○	○	○	○	○	○

3. What is the **one-way** distance of the following locations **from your home**?

	Less than 1 mile	1-3 miles	3-5 miles	5-10 miles	10-15 miles	More than 15 miles
Grocery store (one you visit most)	○	○	○	○	○	○
Bus or Rail stop	○	○	○	○	○	○
Airport	○	○	○	○	○	○
City's downtown	○	○	○	○	○	○

4. If my vehicle could be set to self-driving or manual driving when making each trip, I think I would **set it to SELF-DRIVING when** I am making…. (Please check all that apply.)

- ☐ All types of trips
- ☐ A work trip
- ☐ A school trip
- ☐ A shopping trip
- ☐ A personal business trip (Examples: gym and doctors' appointments)
- ☐ A social or recreational trip
- ☐ I would not use self-driving vehicle.

BACK NEXT

5. Please answer the following questions about **your long-distance travel (**where the one-way trip distance is at least 50 miles**)** over the **past 3 months**. (**Please skip** this question if you **did not make** any such trip.)

	Origin	**Destination**	**Primary mode of travel**	**Trip type**	**Number of times you made this trip (in the past 3 months)**
	(Example: Austin)	(Example: New York City)			
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

6. Assuming I own a vehicle that can drive itself, I believe I will put it on **self-drive mode** when I am making trips…. (Please check all that apply).

- ☐ Between 50 and 100 miles
- ☐ Between 100 and 500 miles
- ☐ Over 500 miles.
- ☐ I will **not use** self-driving vehicles for any such long-distance travel.

7. How many MORE **long distance trips** (**one-way trips *over 50 miles***) do you think you will make each month (on average) if you have a fully self-driving vehicle?

▼

8. **How many miles** do you estimate you **traveled in a car or truck over the last year**? (This may be your own vehicle, plus miles in a rental car, and miles in anyone else's passenger vehicle over the past 365 days.)

- less than 3,000 miles
- 3,000 to 5,999 miles
- 6,000 to 8,999 miles
- 9,000 to 11,999 miles
- 12,000 to 14,999 miles
- 15,000 to 17,999 miles
- 18,000 to 20,999 miles
- 21,000 or more miles

9. Do you have, or have you ever had, **any disability** that prevents you from manually driving a vehicle? (Please check all that apply.)

- [ ] No disability
- [ ] Vision impairment
- [ ] Mobility issues
- [ ] Cognitive disorder
- [ ] Other (please specify):

BACK NEXT

SECTION 6: DEMOGRAPHICS

1. Including yourself, **how many people** live in your **household**? (Please do not include anyone who usually lives somewhere else or is just visiting, such as a college student away at school.)

- 1
- 2
- 3
- 4
- 5 or more (please specify):

2. Including yourself, **how many workers** usually live in your **household**? (Please include all the persons in your household who get paid for working full-time, part-time or are self-employed.)

- 0
- 1
- 2
- 3
- 4
- 5 or more (please specify):

3. What is your **age**?

- ○ Less than 18 years
- ○ 18 to 24 years
- ○ 25 to 34 years
- ○ 35 to 44 years
- ○ 45 to 54 years
- ○ 55 to 64 years
- ○ 65 or more years

4. Are you **male or female**?

- ○ Male
- ○ Female

5. Do you have a valid **U.S. driver's license**?

- ○ Yes
- ○ No

6. Which of the following best describes your **ethnicity**?

- ○ Hispanic
- ○ Asian
- ○ African American
- ○ Caucasian/White
- ○ Other (please specify):

7. **How many children** (those under the age of 16 years) usually live in your home?

- ○ 0
- ○ 1
- ○ 2
- ○ 3
- ○ 4 or more (please specify):

BACK NEXT

8. Which of the following best describes your **household's total annual income** from all sources, before taxes, for all members of your household in 2014? (Income data is very important for developing models that predict vehicle ownership behavior and thus changes in vehicle composition of households over time.)

- Less than $10,000
- $10,000 to $19,999
- $20,000 to $29,999
- $30,000 to $39,999
- $40,000 to $49,999
- $50,000 to $59,999
- $60,000 to $74,999
- $75,000 to $99,999
- $100,000 to $124,999
- $125,000 to $149,999
- $150,000 to $199,999
- $200,000 or more

9. What is the **highest level of education** you have completed?

- I **did not** complete **high school.**
- I completed **high school** (or equivalent).
- I completed **some college**, but **no degree**.
- I obtained an **associate's or technical degree** (or equivalent).
- I obtained a **Bachelor's degree.**
- **I obtained a Master's degree or higher.**

10. Which of the following best describes your **employment status**?

- ○ Employed, working 40 or more hours per week
- ○ Employed, working 20 hours per week
- ○ Student, working part time
- ○ Student, not work
- ○ Not employed, looking for work
- ○ Not employed, not looking for work
- ○ Retired
- ○ Disabled, not able to work

11. What is your **marital status**?

- ○ Single
- ○ Married
- ○ Divorced
- ○ Widowed

BACK NEXT

12. So that we can link respondent data to neighborhood features (like population density and access to transit services, and use those variables in our mathematical models), please let us know **your home street address**? (Example: “4500 Guadalupe Street”) And please feel free to round the number to the block level. (For example, 4553 becomes 4500).

13. What is your **home zip code?**

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NEXT

THANK YOU FOR COMPLETING OUR SURVEY!

We would like to **send you a copy of our report**, if that is of interest to you, and to contact you with any follow-up questions we may have. (This is especially helpful if we need to clarify an answer provided here.) Please allow us to do that by providing your **email address.**

Do you have any **comments or suggestions** for us?

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NEXT

Texas Survey

A Survey of New Travel Technologies

UT Austin Internal Review Board # 2014-09-0078

Dear Respondent,

The Center for Transportation Research at **The University of Texas at Austin** is conducting a research study to explore preferences for and adoption of emerging autonomous and connected vehicle technologies and related traffic management strategies.

Autonomous vehicles, connected vehicles, and various smartphone applications are new technologies with potential to improve traffic safety and mobility, and reduce emissions. Policymakers and transportation system planners need to assess how quickly such technologies will be adopted in order to develop optimal policies and strategies for traffic operations and management.

- The survey will take approximately **20 minutes** to complete.
- The survey will ask questions about you, your travel patterns, your opinion on speed limit restrictions, your vehicle crash history, and your preferences for various autonomous and connected vehicle technologies.
- Your individual responses are **CONFIDENTIAL**. No names or other identifying information will be used in preparing the data for analysis.
- There are no risks involved in participation in this study and no direct benefits.
- **Your input and opinions** are **VERY IMPORTANT**, since it is critical that a variety of perspectives be present in this survey.

If you have any questions or comments about this study, please feel free to contact me personally at **kkockelm@mail.utexas.edu** or (512) 471-0210. If you have any questions about your rights as a research participant, please contact UT Austin's Office of Research Support by phone at (512) 471-8871 or email at **orsc@uts.cc.utexas.edu**. Your completion of the survey indicates your willingness to participate in the study.

Thank you very much for your time and cooperation.

Sincerely,

Dr. Kara Kockelman
Professor of Transportation Engineering & Faculty Sponsor
www.caee.utexas.edu/prof/kockelman

Please TAKE YOUR TIME on this survey. There are many novel questions in this survey that require careful reading and thoughtful answers. Those completing the survey in less than 15 minutes are unlikely to have read many questions.

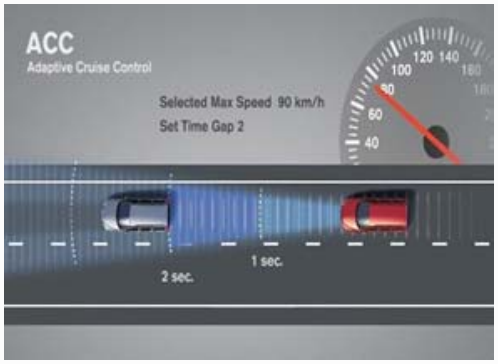
SECTION 1: AUTONOMOUS VEHICLES

Please read carefully before moving forward.
The National Highway Traffic Safety Administration (NHTSA) has defined five technology levels for vehicle automation technology. Levels 0 through 2 encompass technology that is commercially available today; Level 3 and Level 4 are emerging. These levels are defined as follows:

Technologies Currently Available for Consumers:

*No-Automation (**Level 0**).* The driver is completely responsible for the primary vehicle controls: braking, steering, throttle, and motive power.

*Function-specific Automation (**Level 1**).* One or more specific control functions are automated. **Examples** include electronic stability control or pre-charged brakes (the vehicle automatically assists with braking to enable the driver to regain control after skidding or stop faster than possible by acting alone). Other examples include adaptive cruise control (the ability of a vehicle to adjust its speed while in cruise control mode to maintain a safe following distance from a vehicle in front) and lane centering assistance (automatically adjusts the vehicle's steering angle if the driver begins to wander out of the lane).



Adaptive Cruise Control

Lane Centering Assistance

*Combined Function Automation (**Level 2**).* Automation of at least two primary control functions designed to work together to relieve the driver's control of those functions. **Examples** include a combination of adaptive cruise control and lane centering assistance.

Emerging Technologies:

*Limited Self-Driving Automation (**Level 3**).* Vehicles at this level of automation enable the driver to cede full control of all safety-critical functions under certain traffic and environmental conditions. This technology allows the driver to rely heavily on the vehicle to monitor for changes in those conditions, which may require

the driver to interfere from time to time. The driver is still expected to be available for occasional control, but after a warning and some comfortable transition time (3 to 5 seconds). For example, the vehicle may be able to drive itself at low speeds or on freeways during good weather, but would need to transition to human control when turning onto higher-speed streets or if inclement weather is encountered.

Level 3 Self-Driving Vehicle

*Full Self-Driving Automation (**Level 4**).* The vehicle is designed to perform all driving functions for the entire trip. This design anticipates that the driver will provide the destination or navigation input, but the driver is not expected to be available for vehicle control at any time during the trip.

Level 4 Self-Driving Vehicle

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1. Did you **understand** the description of **automation technology levels**?

- Yes
- No

2. Have you ever heard of **Google's Driverless Cars** prior to participating in this survey?

- Yes
- No

3. Select the most advanced level (if any) of **vehicle automation technology** present in the vehicle(s) that you (or your household members) own or lease?

- My household has **no vehicles** right now.
- I have **no automation (Level 0)** on vehicles in my household.
- I have at least one vehicle with **Level 1** automation technology in my household.
- I have at least one vehicle with **Level 2** automation technology in my household.
- I have at least one vehicle with **Level 3** automation technology in my household.
- I **do not know** if my vehicles have any of these technologies.

4. **How interested** are you in **owning or leasing a completely autonomous (Level 4) vehicle** (assuming it were affordable for your household)?

- Very interested
- Moderately interested
- Slightly interested
- Not interested

5. Does your household **plan to buy or lease** a vehicle in the **next 5 years**?

- Yes, we **plan to buy or lease** a vehicle in the next 5 years.
- No, we **do not plan to buy or lease a vehicle** in the next 5 years.

BACK NEXT

6. **How much additional money** would you be **willing to pay to** add the following automation technologies to your next vehicle (on top of your conventional Level 1 vehicle price)?

	Additional money you expect to pay
Level 2. Combined Function Automation	▼
Level 3. Limited Self-driving	▼
Level 4. Full Automation	▼

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Note: For the **remaining questions of this section**, the term "Autonomous Vehicle" will mean a fully automated (**Level 4**) vehicle.

7. In the following areas, what level of concern do you anticipate experiencing in regards to the following potential issues, after autonomous vehicle technology has been **tested and approved for sale** by the National Highway Transportation Safety Administration (NHTSA)?

	Very Worried	Slightly Worried	Not Worried
Equipment or system failure in adverse conditions (example: during heavy rainfall)	○	○	○
Legal liability for "drivers"/owners	○	○	○
Hacking of the vehicle's computer systems	○	○	○
Privacy, such as disclosure of travel destinations to third parties	○	○	○
Interactions with non-autonomous vehicles and vulnerable road users (such as pedestrians and bicyclists)	○	○	○
My learning to use autonomous vehicle technology	○	○	○
Affordability	○	○	○

8. Autonomous vehicles may bring certain benefits. Please indicate **how significant you think each of the following benefits** will be when autonomous vehicles are in extensive use.

	Very Significant	Moderately Significant	Slightly Significant	Insignificant
Fewer crashes	○	○	○	○
Reduced traffic congestion	○	○	○	○
Lower vehicle emissions	○	○	○	○
Better fuel economy	○	○	○	○

9. **How much money** are you **willing to pay to save 15 minutes** of travel time during a typical **30-minutes-long ONE-WAY journey** you make at least once a week (for example, home to work)?

▼

10. Which of the following activities do you do **at least once a week** while driving? (Please check all that apply.)

Note: Your responses are confidential.

- ☐ Listen to music
- ☐ Text or browse on my cell phone
- ☐ Hold a cell phone to talk on it
- ☐ Talk on cell phone with a hands-free device
- ☐ Eat or drink
- ☐ Smoke
- ☐ I do not drive a vehicle.

11. What **tasks do you think you will perform** while riding in an autonomous vehicle? (Please check all that apply.)

- ☐ Text or talk on cell phone
- ☐ Talk to others who are in the vehicle with me
- ☐ Sleep
- ☐ Watch movies or play games
- ☐ Work
- ☐ Read for pleasure
- ☐ Surf the Internet
- ☐ Look out the windows of the vehicle
- ☐ Exercise, stretch, yoga, or something similar
- ☐ Eat or drink
- ☐ Other maintenance activities (e.g., brushing teeth)
- ☐ Put on makeup
- ☐ I do not ever intend to ride in a completely autonomous vehicle.
- ☐ Other (please specify):

12. Assume that your vehicle can be converted into a self-driving vehicle by **your paying money at the beginning of the trip**. **How much money** would you be willing to pay to ride in this **self-driving vehicle** for simply **a one-way** journey? (Please note that you can use this travel time for new activities, such as reading and working, since you will be traveling in a Level 4 self-driving vehicle.)

Note: Please **assume that you were to be the driver**, so you essentially are paying to avoid driving or having anyone else drive.

	My typical **one-way distance**	**Traveling ALONE: Willingness to pay** to ride in self-driving mode for this **one-way trip**	**Traveling WITH FAMILY: Willingness to pay** to ride in self-driving mode for this **one-way trip**	**Traveling WITH FRIENDS: Willingness to pay** to ride in self-driving mode for this **one-way trip**
Work trip	▼	▼	▼	▼
Shopping Trip	▼	▼	▼	▼
Trip to the next closest big city (not the one you live in)	▼	▼	▼	▼

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13. Which vehicle type do you **currently use** for most of your automobile trips**?**

- **Minicompact car** (Example: Smart Fortwo)
- **Subcompact car** (Examples: Ford Fiesta and Kia Rio)
- **Compact car** (Examples: Hyundai Elantra, Honda Civic, Toyota Corolla, and Volkswagen Golf)
- **Mid-size car** (Examples: Toyota Camry, Ford Fusion, and Audi A4)
- **Large car** (Examples: Chevrolet Impala, Lincoln MKZ, Jaguar XF, and Toyota Avalon)
- **Minivan** (Examples: Ford C-Max, Toyota Sienna, and Fiat 500L)
- **Cargo van** (Examples: Chevrolet Express 1500 Cargo and Ford Transit)
- **Passenger van** (Examples: Chevrolet Express 1500 Passenger and Ford E350 Wagon)
- **Small sport utility vehicle** (Examples: Jeep Compass and Honda CR-V)
- **Standard sport utility vehicle** (Examples: Audi Q5, Jeep Cherokee, and Ford Explorer)
- **Small pickup truck** (Examples: Chevrolet Colorado and Toyota Tacoma)
- **Standard pickup truck** (Examples: Ford F-150, Chevrolet Silverado, and Nissan Titan)

14. Bigger vehicles (for example, cargo vans) may allow you to relax while riding in the self-driving mode. **Which one of the following decisions** are you likely to take **when self-driving vehicles become common**?

- I will **sell** my current vehicle and **buy a bigger** one.
- I will **not sell** my current vehicle, but will **rent a bigger** vehicle for **long-distance** trips (50 miles or longer).
- I will **not buy or rent** a **bigger vehicle**.
- Other (please, specify):

15. If I am in a Level 4 vehicle, I think I will **let my vehicle drive itself** when I am ____. (Please check all that apply.)

- ☐ traveling on any kind of roadway
- ☐ traveling on freeways
- ☐ traveling on less congested city streets
- ☐ traveling on highly congested city streets
- ☐ traveling in scenic areas
- ☐ parking my vehicle
- ☐ in other situations (please specify):

BACK NEXT

16. At **what stage** of autonomous vehicle design and adoption will you be willing to start using autonomous vehicles? (Assume autonomous vehicles will be affordable for you)?

- ○ As soon as autonomous vehicles are approved for **sale to the public** in the U.S.
- ○ When at least **10%** of the people in my community are using such vehicles regularly.
- ○ When at least **50%** of the people in my community are using such vehicles.
- ○ I am **not sure** I will ever be willing to start using such vehicles, regardless of how many autonomous vehicles are on the roads.
- ○ Other (please, specify):

17. Once autonomous vehicles are running safely and reliably on all roadways, **should a child between the age of 13 and 15**, without a driver's license, be **permitted to travel alone** in a driverless vehicle on trips up to 3 miles from his/her home (assuming that the child cannot change the destination, and that somebody you trust will meet the child there)?

- ○ Yes
- ◉ No
- ○ Other (please specify):

18. Assuming 50% of all new vehicles are self-driving vehicles, **will you support** a policy to **disallow conventional** (Level 1) vehicles in most downtowns and other areas with high pedestrian activity?

- ○ Yes
- ○ No
- ○ Other (please specify):

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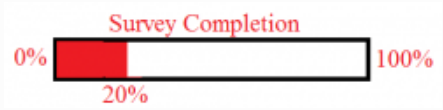

SECTION 2: CRASH HISTORY, SPEED LIMITS, AND OTHER OPINIONS

1. **How many years** have you been a licensed driver?

▼

2. How many **moving violations** (example: speeding tickets, but **NOT** parking tickets) have you received in the last 10 years?

0 ▼

3. **Red light cameras** (traffic enforcement cameras that capture images of vehicles entering intersections during red traffic lights) exist in 26 U.S. states. Most studies show that these cameras **reduce injury crashes** by 25% to 30%, though some people argue that red-light cameras are used to provide **revenue** for local authorities. **Do you support the use of red light cameras?**

- (●) Strongly support
- ( ) Somewhat support
- ( ) Neutral
- ( ) Somewhat oppose
- ( ) Strongly oppose

4. **Automated Speed Enforcement (ASE)** technologies, such as speed detection cameras, are used in 13 U.S. states to automatically issue tickets to speeding drivers. Studies have found that ASE **reduces the likelihood of injurious and fatal crashes** by an average of 17%. **Do you support the use of ASE?**

- (•) Strongly support
- ( ) Somewhat support
- ( ) Neutral
- ( ) Somewhat oppose
- ( ) Strongly oppose

5. If your local police department started using ASE technology on a roadway with a **speed limit of 30 miles per hour (mph)**, at **what speed** do you think it will be reasonable to **start automatically ticketing** a driver for speeding?

[▼]

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6. **Speed governors** are devices used to limit the maximum speed in vehicles. Studies indicate that higher speeds lead to more frequent and deadlier crashes. **Do you support installing speed governors in all new vehicles?**

- Strongly support
- Somewhat support
- Neutral
- Somewhat oppose
- Strongly oppose

7. The current **maximum speed limit** in any US state is **85 mph**. If manufacturers were required to install **speed governors** in all new vehicles, **what TOP speed do you think they should be limited to?**

▼

8. How do you percieve your **driving ability** in terms of **safety** relative to other drivers?

- I believe I drive **more safely** than most other drivers.
- I believe I am **about average** in driving safely.
- I believe I am **less safe** than most other drivers.

9. **Over the past 15 years, how many crashes** in which someone was **killed or sustained serious injury** have you been involved in as a **driver, passenger, bicyclist, or pedestrian**?

▼

10. **Over the past 15 years, how many crashes** in which someone experienced only monetary loss (of at least $200) and no injuries have you been involved in as a **driver, passenger, bicyclist, or pedestrian**?

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11. Please provide the **details of five (or less) most severe crashes** which you have been involved in as a driver, passenger, pedestrian, or bicyclist in which someone was **killed or sustained injury.**

Note: This survey is confidential.

	Your role	**Number of people killed**	**Number of people injured, but not killed**	**Lighting conditions**	**Traffic conditions** at the time of the crash	**Crash location**	**Crash type**	**Primary reason** of crash
Crash 1	▾	▾	▾	▾	▾	▾	▾	▾

12. Please provide **details of five (or less) most severe crashes** which you have been involved in as a driver, passenger, pedestrian, or bicyclist in which someone experienced **only monetary loss of more than $200 (and no injuries).**

	Your role	**Total monetary loss of all parties**	**Lighting conditions**	**Traffic conditions** at the time of the crash	**Crash location**	**Crash type**	**Primary reason** of crash
Crash 1	▾	▾	▾	▾	▾	▾	▾

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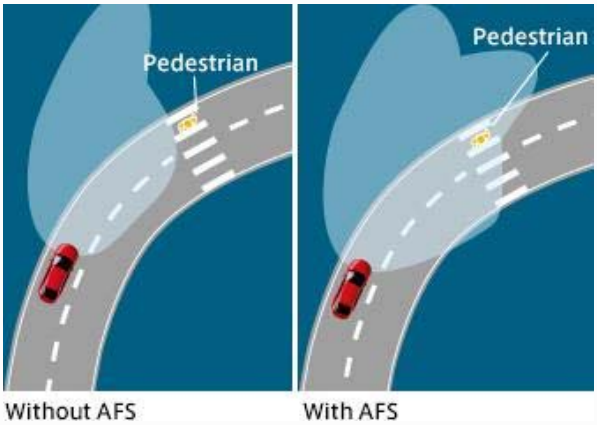
SECTION 3: WILLINGNESS TO PAY FOR SPECIFIC AUTOMATION TECHNOLOGIES

Note: *This section will ask you about your or your household's willingness to pay for various technologies. Current costs (and future estimated costs) for each technology are provided for illustration purposes.*

1. **Adaptive Headlights:** The vehicle turns the beams according to the driver's steering input so that the vehicle's actual path is always lit up. This system can also point beams up or down when the vehicle crests a hill, according to the position of the vehicle.



Please indicate **your interest** in **adaptive headlights technology?**

- **Very** interested
- **Slightly** interested
- **Not** interested

Do any of your household's current vehicles presently have **adaptive headlights?**

- Yes
- No

Adaptive headlight prices are likely to fall over time, as shown below. **How much** are you **willing to pay** to add this feature to one of your household's current vehicles or to your next vehicle purchase?

Current price	$1,000
Likely price after 5 years	$700
Likely price after 10 years	$500

- Less than $150
- $150 to $249
- $250 to $349
- $350 to $449
- $450 to $549
- $550 to $649
- $650 to $749
- $750 to $849
- $850 to $949
- $950 to $1,049
- $1,050 to $1,249
- $1,250 to $1,500
- I **will not pay anything** to add **adaptive headlights**.

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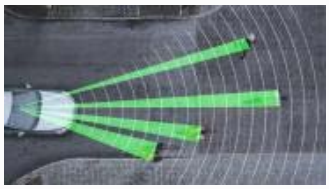
2. **Pedestrian Detection:** This technology detects pedestrians and cyclists on the road and issues a warning to the driver if the vehicle is dangerously close to them.



Please indicate **your interest** in **pedestrian detection technology?**

- ○ **Very** interested
- ○ **Slightly** interested
- ○ **Not** interested

Do any one of your household's current vehicles have **pedestrian detection**?

- ○ Yes
- ○ No

Pedestrian detection prices are likely to fall over time, as shown below. **How much** are you **willing to pay** to add this feature to one of your household current vehicles or to your next vehicle purchase?

Current price	$450
Likely price after 5 years	$320
Likely price after 10 years	$230

- Less than $100
- $100 to $199
- $200 to $299
- $300 to $399
- $400 to $499
- $500 to $699
- $700 to $1,000
- I **will not pay anything** to add **pedestrian detection**.

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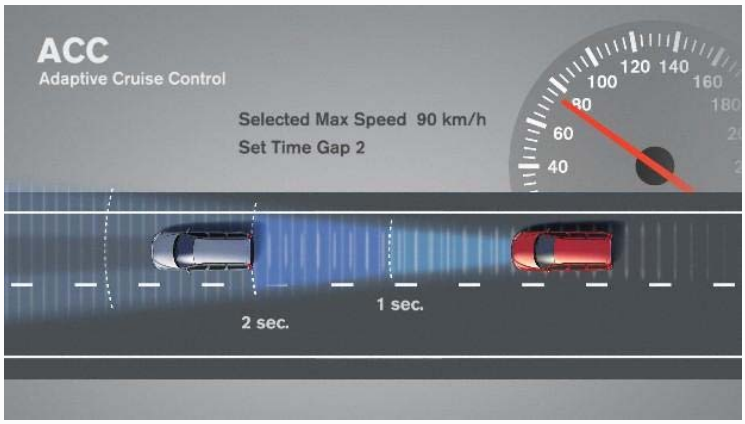
3. **Adaptive Cruise Control:** The ability of a vehicle to adjust its speed to ensure a minimum following distance, so that your vehicle does not hit the car in front of it while driving using cruise control.



Please indicate **your interest** in **adaptive cruise control?**

- **Very** interested
- **Slightly** interested
- **Not** interested

Do any of your household's current vehicles presently have **adaptive cruise control**?

- Yes
- No

Adaptive cruise control prices are likely to fall over time, as shown below. **How much** are you **willing to pay** to add this feature to one of your household's current vehicles or to your next vehicle purchase?

Current price	$400
Likely price after 5 years	$280
Likely price after 10 years	$200

- ○ Less than $50
- ○ $50 to $149
- ○ $150 to $249
- ○ $250 to $349
- ○ $350 to $449
- ○ $450 to $699
- ○ $700 to $1,000
- ○ I **will not pay anything** to add **adaptive cruise control**.

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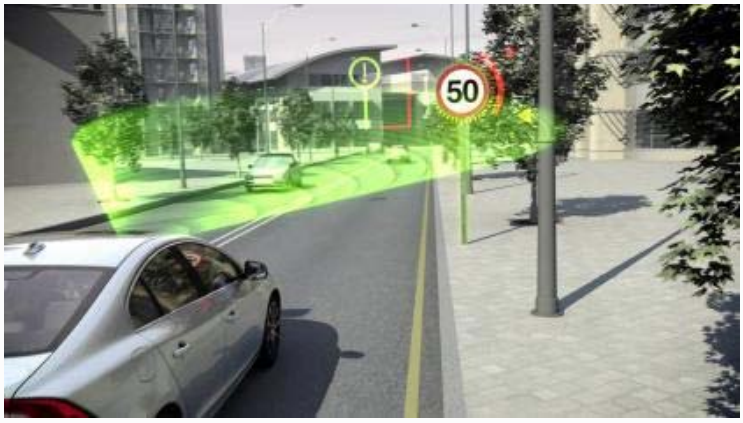
4. **Traffic Sign Recognition:** This technology will detect road signs and notify the driver about driving restrictions (examples: no passing zone, construction zone, speed limits, and stop signs) on the current stretch of road.



Please indicate **your interest** in **traffic sign recognition technology?**

- **Very** interested
- **Slightly** interested
- **Not** interested

Do any of your household's current vehicles presently have **traffic sign recognition**?

- Yes
- No

Traffic sign recognition prices are likely to fall over time, as shown below. **How much** are you **willing to pay** to add this feature to one of your household's current vehicles or to your next vehicle purchase?

Current price	$450
Likely price after 5 years	$320
Likely price after 10 years	$230

- Less than $100
- $100 to $199
- $200 to $299
- $300 to $399
- $400 to $499
- $500 to $699
- $700 to $1,000
- I **will not pay anything** to add **traffic sign recognition**.

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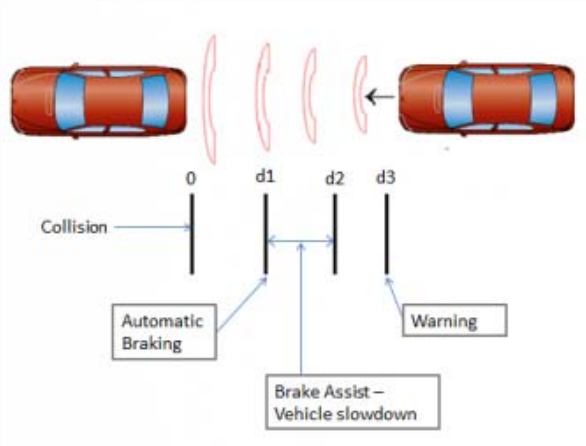
5. **Emergency Automatic Braking:** A vehicle monitors for obstacles on the road. If an obstacle is detected, the vehicle applies its brakes if the driver does not react within a reasonable time frame after the warning.



Please indicate **your interest** in **emergency automatic braking?**

- **Very** interested
- **Slightly** interested
- **Not** interested

Do any of one of your household's current vehicles presently have **emergency automatic braking**?

- Yes
- No

Emergency automatic braking prices are likely to fall over time, as shown below. **How much** are you **willing to pay** to add this feature to one of your household's current vehicles or to your next vehicle purchase?

Current price	$450
Likely price after 5 years	$320
Likely price after 10 years	$230

- ○ Less than $100
- ○ $100 to $199
- ○ $200 to $299
- ○ $300 to $399
- ○ $400 to $499
- ○ $500 to $699
- ○ $700 to $1,000
- ○ I **will not pay anything** to add **emergency automatic braking**.

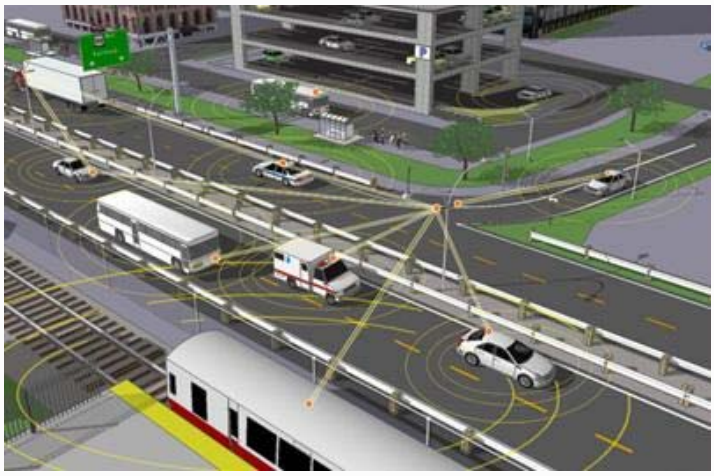
BACK NEXT

Survey Completion
0% 60% 100%

SECTION 4: CONNECTED VEHICLES

Please read carefully before moving forward.
A communications feature may be added to an existing vehicle using a smartphone and some additional equipment with dedicated short range communications (DSRC) technology and inertial sensors. This feature can be used to send alerts to the driver in form of audible sounds (like a message to “slow down” when congestion is forming up ahead or the roadway is deemed slippery) or in text format (like real-time travel times to one's destination). Connectivity is even more valuable when one’s vehicle is highly automated, because the vehicle can take corrective actions on its own, without its occupants having to register the alerts (about a coming conflict or speed violation, for example).

The National Highway Traffic Safety Administration (NHTSA) recently announced an advanced notice for proposed rulemaking related to vehicle-to-vehicle communication technology for light-duty vehicles. Connected vehicles are equipped with technology that enables them to **“talk” to nearby vehicles and roadside infrastructure** (like traffic lights' control boxes). This technology can be used for a variety of purposes, such as sharing information about nearby moving objects, roadway conditions, slow vehicles, and better routes. Connected vehicles have the potential to increase roadway safety by reducing the number of crashes caused by human error.



1. **Prior to participating** in this survey, had you ever **heard of connected vehicles**?

- Yes
- No

2. Would you **add connected vehicles technology** to any of your current or future vehicles (assuming it costs under $200 per vehicle)?

- I would **definitely add** connectivity to at least one of my household's current or future vehicles.
- I think I would **add** connectivity to at least one of my household's current or future vehicles.
- I really **do not know** whether I would add connectivity to any of my household's current or future vehicles.
- I **probably** would **not add** connectivity to any of my household's current or future vehicles.
- I **definitely** would **not add** connectivity to any of my household's current or future vehicles.

3. How much are you and/or your household **willing to pay** to **add connectivity to one** of your current vehicles or to one of your future **conventional** (**not self-driving**) vehicles?

- $0 to $99
- $100 to $199
- $200 to $299
- $300 to $399
- $400 to $499
- $500 to $599
- $600 to $799
- $800 to $999
- $1,000 or more
- I do not want to add it.

4. How much are you and/or your household **willing to pay** to **add connectivity to one** of your future **self-driving** (Level 4) vehicles?

Note: A self-driving vehicle that is "connected" can **anticipate and respond** to emerging conflicts, signal timing changes, and other **events it can not see** (with its cameras and LIDAR device). Such information is relayed to it by other connected vehicles and roadside devices that cities and states may invest in.

- ○ $0 to $99
- ○ $100 to $199
- ○ $200 to $299
- ○ $300 to $399
- ○ $400 to $499
- ○ $500 to $599
- ○ $600 to $799
- ○ $800 to $999
- ○ $1,000 or more
- ○ I do not want to add it.

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5. Please indicate your **interest** in having the following **connected vehicle technologies** in one of your current vehicles or in your future vehicle:

	I am **already using** this.	I am **interested in using** this.	I am **not interested in using** this.
Real-time traffic information (examples: travel time information based on congestion, traffic-jam-ahead warnings)	○	○	○
Alert about the presence of **speed cameras** on route	○	○	○
Information about **nearby available parking spaces**	○	○	○
Automatic notification to emergency personnel in the event of an accident	○	○	○
Automatic monitoring of driving habits by insurance companies to provide more appropriate (usage-based) rates	○	○	○
Personal restrictions (example: restrict the vehicle from exceeding certain speed limits when a teenager is driving)	○	○	○
Alcohol detection: Automatically prohibit the driver from starting the vehicle if he/she has a blood-alcohol level above a pre-determined threshold	○	○	○
Road sign information (examples: speed limit and stop signs) using a heads-up display	○	○	○
Cabin pre-conditioning (example: pre-warming or pre-cooling the vehicle)	○	○	○
Vehicle health report (examples: maintenance issues and software updates)	○	○	○
Vehicle life-cycle management (example: notification of vehicle service suggestions)	○	○	○

BACK NEXT

6. Please indicate your **interest** in using the following **technologies while driving your vehicle** (assuming that these activities are **safe and legal** to perform while driving):

	I am **already using** this.	I am **interested in using** this.	I am **not interested in using** this.
Surfing the Internet via a built-in car display	○	○	○
In-vehicle feature allowing one to **compose and read emails**	○	○	○
Operating a smartphone using controls on the steering wheel	○	○	○

7. Assuming that a high percentage (80%) of vehicles **are connected**, please indicate **your opinions** on the following **traffic management strategies.**

	I **support** this strategy.	I **do not support** this strategy.	I **do not have an opinion** about this yet.
Real-time modification of traffic signal timing to ease congestion (example: longer green time if vehicle lines are forming)	○	○	○
Real-time adjustment of parking prices (example: higher prices for busier blocks)	○	○	○
Variable toll rates on congested corridors to keep traffic moving at peak times of the day	○	○	○
Variable speed limits based on road and weather conditions	○	○	○

8. Automobile technologies have many different impacts on the environment and quality of life. Please **rank the important areas** (in decrease order of importance) for improvement in automobile technologies:

	Rank 1 **(most important)**	Rank 2	Rank 3	Rank 4 **(least important)**
Emissions (including air quality, but not greenhouse gas emissions)	○	○	○	○
Safety	○	○	○	○
Travel times (and congestion)	○	○	○	○
Energy use & climate change	○	○	○	○

9. Please provide any **other impacts** (not included in question 8) that you would like to rank, & note its ranking:

	Impact	**Rank**
	Not included in question 8	
Other impact #1		▼
Other impact #2		▼

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SECTION 5: CARSHARING, RIDESHARING, AND TOLLS

1. Do you carry/own a **smartphone**?

- Yes
- No

2. Are you **familiar** with **Zipcar, Car2Go,** or other **carsharing** programs?

Note: Uber, Lyft, and other on-demand taxi services are **not carsharing** programs.

- Yes
- No

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3. Have you **ever been a member** of **Zipcar** or any other **carsharing programs**?

- Yes
- No

BACK NEXT

4. Please select **your reason(s) for being a member** of a carsharing program. (Please check all that apply.)

- [ ] Carsharing **saves/saved money**.
- [ ] Carsharing **saves/saved time**.
- [ ] Carsharing is/was a more **environmentally friendly** practice than private vehicle ownership.
- [ ] Carsharing is/was a **necessity** for me because I do/did not own a vehicle.
- [ ] Carsharing is/was a **good back-up option** when my vehicle is/was in a garage for service.
- [ ] Sometimes, I need/needed a **different type** of a vehicle (e.g., a pickup truck) that I do/did not have.
- [ ] Other (please specify):

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5. What are the **reasons you have not joined** a carsharing program? (Please check all that apply.)

- [ ] Carsharing programs are **not available in my city**.
- [ ] Shared vehicle availability is **unreliable**.
- [ ] Shared vehicle locations **are not convenient**.
- [ ] I **own a vehicle**.
- [ ] I **rely on public transit, walking, and/or biking**.
- [ ] Carsharing is **expensive**.
- [ ] Shared vehicles **do not have enough capacity**.
- [ ] It is **too stressful** to be responsible to return a vehicle on time.
- [ ] I am not ready to share a vehicle with **people I do not know.**
- [ ] Other (please specify):

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6. Are you **familiar with on-demand taxi services like Uber or Lyft**?

- ○ Yes, I am **familiar** with at least one of these companies.
- ○ No, I am **not familiar** with any of these companies.

BACK NEXT

7. Have you **ever used Uber, or Lyft as a passenger**?

- ○ Yes
- ○ No

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8. Why did you use **Uber or Lyft?** (Please check all that apply.)

- ☐ To **save money** (rather than paying for a taxi or for parking)
- ☐ To **save time**
- ☐ To **try it out**
- ☐ To **avoid driving** (example: after drinking)
- ☐ No need to worry about parking
- ☐ When my **personal vehicle was unavailable** (e.g., in a repair shop)
- ☐ Promotion (e.g., a free ride)
- ☐ Other (please specify):

9. With whom would you feel **comfortable sharing a ride** on local trips during the daytime? Ride-sharing will reduce your travel cost. (Please check all that apply.)

- ☐ With a **stranger**
- ☐ With **a friend of one of my friends (whom I have not met before)**
- ☐ With my **regular friends and family members**
- ☐ Only with really **close friends and family members**
- ☐ Other (please specify):

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Information for question 10: Shared Autonomous Vehicles (SAVs) are an on-demand autonomous taxi systems that combine autonomous vehicles with carsharing membership features. Program members can call on these vehicles using smartphones or other mobile devices, rather than searching for and walking to an available carsharing vehicle.

10. Assuming **it has been several years**, so your household has had an opportunity **to consider releasing one of the vehicles** it may now own or lease, and assuming that a **large fleet of shared autonomous vehicles** is **available** to you and other Texans, **how often would you use them?** (Please, assume that these options are affordable for you and your household.)

- I think I would **rely entirely** on such a fleet, assuming it is readily available when needed.
- I think I would use them **quite regularly (at least once a week)**.
- I think I would use them **reasonably regularly (at least once a month)**.
- I think I would use them **less than once a month**.
- I think I would **not use them at all**.

BACK NEXT

Information on taxi costs for questions 11, 12, and 13: Taxis in Austin presently cost about $2.50 to $3.50 per mile. UberX and Lyft (companies providing real time on-demand taxi service) currently charge about $1.50 per mile. Car2Go (a company providing carsharing service) charges $0.80 to $1.25 per mile within its operating geographic area and $15 per hour of parking outside of this area.

11. Assuming it **has been several years**, so your household has had **an opportunity to consider releasing one of the vehicles it may now own or lease**, and assuming that **shared autonomous vehicles** then **cost $1 per mile**, how often would you use them?

- I think I would **rely entirely** on such a fleet, assuming it is readily available when needed.
- I think I would use them **quite regularly (at least once a week)**.
- I think I would use them **reasonably regularly (at least once a month)**.
- I think I would use them **less than once a month**.
- I **don't think** I would ever **use** these.

12. Assuming it **has been several years**, so your household has had **an opportunity to consider releasing one of the vehicles it may now own or lease**, and assuming that **shared autonomous vehicles** then **cost $2 per mile**, how often would you use them?

- I think I would **rely entirely** on such a fleet, assuming it is readily available when needed.
- I think I would use them **quite regularly (at least once a week)**.
- I think I would use them **reasonably regularly (at least once a month)**.
- I think I would use them **less than once a month**.
- I **don't think** I would ever **use** these.

13. Assuming it **has been several years**, so your household has had **an opportunity to consider releasing one of the vehicles it may now own or lease**, and assuming that **shared autonomous vehicles** then **cost $3 per mile**, how often would you use them?

- I think I would **rely entirely** on such a fleet, assuming it is readily available when needed.
- I think I would use them **quite regularly (at least once a week)**.
- I think I would use them **reasonably regularly (at least once a month)**.
- I think I would use them **less than once a month**.
- I **don't think** I would ever **use** these.

BACK NEXT

Information for questions 14 to 17: Autonomous vehicles may make travel easier for many people, and some travelers may decide to live further from the city center, their workplaces, and their children's schools. Alternatively, households living in urban locations will be able to access a low-cost (for example, $1.50 per mile) shared fleet of autonomous vehicles. This will allow them to let go of vehicles they presently own, and turn to other transportation options (like walking, biking, and utilizing autonomous buses for some trips).

14. Approximately **how far** do you **currently** live from the **center of the city/town** in which you spend most of your time?

▼

15. **Which one** of the following **decisions** are you likely to make once autonomous and shared autonomous vehicles become available?

- Move **closer** to the city-center
- Move **farther** from the city center
- **Stay** at my current home location

BACK NEXT

18. **Would you support** converting some of your city's currently congested non-toll **highway** sections into tolled lanes when congestion is normally present (in order to keep traffic moving at speeds above 50 mph) **if the toll revenues were used to lower local property taxes**?

- I **definitely** would **support** such a policy.
- I **probably** would **support** such a policy.
- I **do not know** whether I can support such a policy.
- I **probably** would **not support** such a policy.
- I **definitely** would **not support** such a policy.

19. **Would you support** converting some of your city's currently congested non-toll **highway** sections into tolled lanes when congestion is normally present (in order to keep traffic moving at speeds above 50 mph) if the **toll revenues were evenly distributed among residents' Toll Tag accounts**?

- I **definitely** would **support** such a policy.
- I **probably** would **support** such a policy.
- I **do not know** whether I can support such a policy.
- I **probably** would **not support** such a policy.
- (•) I **definitely** would **not support** such a policy.

20. The GPS and/or communications systems on board connected vehicles will enable **time-varying tolls** on **all roadways** that experience congestion. If application of such tolls is the **only reasonable way to curb congestion** on those roadways, **will you support such tolls?**

- I **definitely** would **support** such a policy.
- I **probably** would **support** such a policy.
- I **do not know** whether I can support such a policy.
- I **probably** would **not support** such a policy.
- I **definitely** would **not support** such a policy.

21. What if the **revenues** from such congestion-related tolls are **evenly distributed to all travelers' Toll Tag accounts**, to ensure a base level of travel for everyone, and such credits can also be used for transit, car-sharing, and other travel options, not just private car travel. **Will you support the use of such tolls**, in order to ensure that **excessive congestion is avoided** in your region?

- I **definitely** would **support** such a policy.
- I **probably** would **support** such a policy.
- I **do not know** whether I can support such a policy.
- I **probably** would **not support** such a policy.
- I **definitely** would **not support** such a policy.

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SECTION 6: TRAVEL CHARACTERISTICS

1. Which of the following is your **primary means of travel** for the following activities? (Please select one for each activity.)

	Walk	Bicycle	Drive Alone	Drive with Others	Public Transport (Including School Buses)	Not applicable
Work trips (either home to workplace or workplace to home)	○	○	○	○	○	○
School trips (to and from your own school or your child(ren)'s school **WHEN SCHOOL IS BACK IN SESSION**)	○	○	○	○	○	○
Shopping trips	○	○	○	○	○	○
Personal business trips (Examples: gym and doctor appointments)	○	○	○	○	○	○
Social/recreational trips (Examples: dining out and visiting friends)	○	○	○	○	○	○
Other trips (Examples: daycare and computer repair)	○	○	○	○	○	○

2. **How many ROUND trips** did you make for the following **purposes** in the **last 7 days?**

	0 trips	1-2 trips	3-4 trips	5-6 trips	7-8 trips	9 or more trips
Work trips (either home to workplace or workplace to home)	○	○	○	○	○	○
School trips (to and from your own school or your child(ren)'s school **WHEN SCHOOL IS BACK IN SESSION**)	○	○	○	○	○	○
Shopping trips	○	○	○	○	○	○
Personal business trips (Examples: gym and doctor appointments)	○	○	○	○	○	○
Social/recreational trips (Examples: dining out and visiting friends)	○	○	○	○	○	○
Other trips (Examples: daycare and computer repair)	○	○	○	○	○	○

3. What is the **one-way** distance **from your home** to the following locations?

	Less than 1 mile	1-3 miles	3-5 miles	5-10 miles	10-15 miles	More than 15 miles
Grocery store (one you visit the most)	○	○	○	○	○	○
Public transport stop/station	○	○	○	○	○	○
The airport	○	○	○	○	○	○
City's downtown	○	○	○	○	○	○

4. If my vehicle could be set to either self-driving or manual driving when making each trip, I think I would **set it to SELF-DRIVING when** I am making ___ (please check all that apply).

- ☐ all types of trips
- ☐ a work trip
- ☐ a school trip
- ☐ a shopping trip
- ☐ a personal business trip (Examples: gym and doctor appointments)
- ☐ a social or a recreational trip
- ☐ other type of a trip (please, specify): _____
- ☐ I would not use self-driving vehicle.

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5. **How many miles** do you estimate you **traveled in a car or truck over the last year**? (This may be your own vehicle, plus miles in a rental car, and miles in anyone else's passenger vehicle over the past 365 days.)

- ○ less than 3,000 miles
- ○ 3,000 to 5,999 miles
- ○ 6,000 to 8,999 miles
- ○ 9,000 to 11,999 miles
- ○ 12,000 to 14,999 miles
- ○ 15,000 to 17,999 miles
- ○ 18,000 to 20,999 miles
- ○ 21,000 or more miles

6. Do you have, or have you ever had, **any disability** that prevents you from manually driving a vehicle? (Please check all that apply.)

- ☐ No disability
- ☐ Vision impairment
- ☐ Mobility issues
- ☐ Cognitive disorder
- ☐ Other (please specify):

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SECTION 7: DEMOGRAPHICS

1. Including yourself, **how many people** live in your **household**? (Please do not include anyone who usually lives somewhere else or is just visiting, such as a college student away at school; do not include your roommates if you do not support each other financially.)

- (•) 1
- ( ) 2
- ( ) 3
- ( ) 4
- ( ) 5 or more (please specify):

2. Including yourself, **how many workers** usually live in your **household**? (Please include all the persons in your household who get paid for working full-time, part-time, or are self-employed.)

- ( ) 0
- ( ) 1
- ( ) 2
- ( ) 3
- ( ) 4
- ( ) 5 or more (please specify):

3. What is your **age**?

- ○ Less than 18 years
- ○ 18 to 24 years
- ○ 25 to 34 years
- ○ 35 to 44 years
- ○ 45 to 54 years
- ○ 55 to 64 years
- ○ 65 or more years

4. Are you **male or female**?

- ○ Male
- ○ Female

5. Do you have a valid **U.S. driver's license**?

- ○ Yes
- ○ No

6. Which of the following best describes your **ethnicity**?

- ○ Hispanic/Latino/Mexican American
- ○ Asian/Asian American
- ○ Black/African American
- ○ American Indian/Native American
- ○ White/European White/Caucasian
- ○ Mixed/Multiracial

- ○ Other (please specify):

7. **How many children** (those under the age of 16 years) usually live in your home?

- ○ 0
- ○ 1
- ○ 2
- ○ 3
- ○ 4 or more (please specify):

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8. Which of the following best describes your **household's total annual income** from all sources, before taxes, for all members of your household in 2014? (Income data is **very important** for developing models that predict vehicle ownership behavior and thus changes in vehicle composition of households over time.)

- Less than $10,000
- $10,000 to $19,999
- $20,000 to $29,999
- $30,000 to $39,999
- $40,000 to $49,999
- $50,000 to $59,999
- $60,000 to $74,999
- $75,000 to $99,999
- $100,000 to $124,999
- $125,000 to $149,999
- $150,000 to $199,999
- $200,000 or more

9. What is the **highest level of education** you have completed?

- I **did not** complete **high school.**
- I completed **high school** (or equivalent).
- I completed **some college**, but **no degree**.
- I obtained an **associate's or technical degree** (or equivalent).
- I obtained a **Bachelor's degree.**
- **I obtained a Master's degree or higher.**

10. Which of the following best describes your **employment status**?

- ○ Employed, working 40 or more hours per week (including self-employed)
- ○ Employed, working 1-39 hours per week
- ○ Student, working part time
- ○ Student, not work
- ○ Not employed, looking for work
- ○ Not employed, not looking for work
- ○ Retired
- ○ Disabled, not able to work

11. What is your **marital status**?

- ○ Single
- ○ Married
- ○ Divorced
- ○ Widowed

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12. So that we can link respondent data to neighborhood features (like population density and access to transit services, and use those variables in our mathematical models), please let us know **your home street address**? (Example: “4500 Guadalupe Street”) And please feel free to round the number to the block level. (For example, 4553 becomes 4500.)

13. What is your **home zip code?**

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THANK YOU FOR COMPLETING OUR SURVEY!

We would like to **send you a copy of our report**, if that is of interest to you, and to contact you with any follow-up questions we may have. (This is especially helpful if we need to clarify an answer provided here.) Please allow us to do that by providing your **email address.**

Do you have any **comments or suggestions** for us?

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Appendix G: Collection of "Guidelines or Model" State Laws (Not Necessarily Enacted)

This appendix includes the following "guidelines or model" state laws (not necessarily enacted):

1. NHTSA Recommendations for State Legislation from NHTSA Statement (2013)
2. Subcommittee from Uniform Law Commission (2014)
3. University of Washington School of Law Technology Law Clinic Comments on ULC (undated)
4. University of Washington School of Law Technology Clinic Model Bill
5. Suggestions for State Legislation governing CAVs by Bryant Walker Smith (2014)

NHTSA Recommendations for State Legislation from NHTSA Statement (2013)

D. Recommendations Concerning State Activities Related to Self-Driving Vehicles

Several states have enacted legislation expressly authorizing operation of "autonomous" vehicles within their borders under certain conditions. Generally, these laws seem to contemplate vehicle automation at Levels 3 and 4, as discussed above, i.e., some form of self-driving operation. Accordingly, these recommendations are tailored to Levels 3 and 4 automation.

Further research is needed to fully understand the technical and human factors issues implicated by self-driving vehicles. This guidance is therefore provisional and subject to reconsideration and revision as appropriate, especially before any potential regulatory action – which must appropriately balance the need to ensure motor vehicle safety with the flexibility to innovate.

We offer these recommendations to state drafters of legislation and regulations governing the licensing, testing, and operation of self-driving vehicles on public roads in order to encourage the safe development and implementation of automated vehicle technology, which holds the potential for significant long-term safety benefits. In general, we believe that states are well suited to address issues such as licensing, driver training, and conditions for operation related to specific types of vehicles. NHTSA has considerable concerns however about detailed state regulation on safety of self-driving vehicles, and does not recommend at this time that states permit operation of self-driving vehicles for purposes other than testing. Thus, the below recommendations all assume that the human driver of the vehicle will be employed by, or otherwise the agent of, a business or some other institution engaged in testing and will only be using the self-driving vehicle in that capacity.

The agency is not aware of any systems intended for wide scale deployment currently under development for use in motor vehicles that are capable of Level 4 automation. As we stated previously, very few Level 3 automated systems exist and the systems that do exist are still at the earlier stages of testing/development. Because Level 4 automated systems are not yet in existence and the technical specifications for Level 3 automated systems are still in flux, the agency believes that regulation of the technical performance of automated vehicles is premature at this time. While NHTSA's authority, expertise, and mandate is to establish uniform, national standards needed for vehicle safety, the agency recognizes that premature regulation can run the risk of putting the brakes on the evolution toward increasingly better vehicle safety technologies.

While the agency does not believe that self-driving vehicles are currently ready to be driven on public roads for purposes other than testing, the agency would like to emphasize that it is encouraged by innovations in automated driving and their potential to transform our roadways. The agency is confident that the development and testing of Level 3 automated systems will provide answers to many of the technical and human factors questions presented by the technology.

NHTSA has decades of experience in matters of highway safety and vehicle safety, including issues related to driver licensing and vehicle safety standards. NHTSA also has extensively studied and exercised its regulatory authority over various aspects of vehicle automation and has

closely observed recent developments in self-driving technologies, including in-depth discussions with developers of those technologies and direct experience with several of the vehicles under development. Based on all of this, and knowing that some states are anxious for guidance on how to proceed with regard to self-driving vehicles, NHTSA offers the recommendations below.

I—Recommendations for Licensing Drivers to Operate Self-Driving Vehicles for Testing

A--Ensure that the Driver Understands How to Operate a Self-Driving Vehicle Safely

- A driver licensing program should provide for driver's license endorsements (or separate driver's licenses) that authorize the operation of self-driving vehicles.
- The issuance of a driver's license endorsement (or separate driver's license) to a person should be conditioned upon certain prerequisites, such as that person's passage of a test concerning the safe operation of a self-driving vehicle and presentation of a certification by a manufacturer of self-driving vehicles (or the manufacturer's designated representative) that the person has successfully completed a training course provided by that manufacturer (or representative), or a certification by that manufacturer (or representative) that the person has operated a self-driving vehicle for a certain minimum number of hours. As used here, "manufacturer" includes a company that alters a vehicle manufactured originally by another company in order to give it self-driving capability.
- The training course should be submitted to the state agency that issues driving licenses for approval prior to the taking of that course by any person seeking a driver's license endorsement certification. The course should include providing an understanding of the basic operation and limits of self-driving vehicles, and knowledge of how to resume control of such a vehicle in the event that it cannot continue to operate automatically.

II—Recommendations for State Regulations Governing Testing of Self-Driving Vehicles

A--Ensure that On-road Testing of Self-driving Vehicles Minimizes Risks to Other Road Users

- Any state establishing regulations for self-driving vehicle testing should include provisions to ensure that businesses testing such vehicles conduct their testing in a way that minimizes risks to other road users, including provisions such as:
    - Requiring businesses to certify that the vehicle has already operated for a certain number of miles in self-driving mode without incident before businesses seeking the license can test the vehicle on public roads.
    - Requiring these businesses to submit data from previous testing involving the technology.
    - Requiring businesses to submit a plan to the state regulatory body describing how the business plans to minimize safety risks to other road users. The plan could include training for test drivers employed by the business seeking to conduct the

testing, fail safes in the design of the prototype automated vehicle, and/or aspects of the testing plan designed to ensure that risks to other road users are minimized.

- NHTSA strongly recommends that states require that a properly licensed driver be seated in the driver's seat and ready to take control of the vehicle while the vehicle is operating in self-driving mode on public roads.

B--Limit Testing Operations to Roadway, Traffic and Environmental Conditions Suitable for the Capabilities of the Tested Self-Driving Vehicles

- States should require that, as part of their testing plan, self-driving vehicle manufacturers inform the state of the operating conditions in which they wish to test. Manufacturers wishing to test self-driving vehicles should be required to supply states with test data or other information to demonstrate that their self-driving vehicles are capable of operating in these conditions with limited driver intervention.
- States are encouraged to consider appropriate limitations on the conditions in which a vehicle may be operated in self-driving mode. States are encouraged to tailor their regulations governing self-driving vehicle testing to limit the use of the self-driving mode to conditions conducive to safe operation in that mode.
- Regulations governing self-driving vehicle testing could limit testing to the operating conditions for which the self-driving system is specifically designed such as driving on a limited access highway. Likewise, depending on the self-driving vehicle, regulations could limit testing of the self-driving vehicle to roads in only certain geographical locations, e.g., those known for having light traffic or for having heavy traffic at low travel speeds.

C--Establish Reporting Requirements to Monitor the Performance of Self-Driving Technology during Testing

- To expand the body of data and support research concerning self-driving vehicles, states are encouraged to require businesses testing self-driving vehicles to submit to the state certain information, including:
    - instances in which a self-driving vehicle, while operating in or transitioning out of self-driving mode, is involved in a crash or near crash; and
    - incidents in which the driver of one of their self-driving vehicles is prompted by the vehicle to take control of the vehicle while it is operating in the self-driving mode because of a failure of the automated system or the inability of the automated system to function in certain conditions.

III—Recommended Basic Principles for Testing of Self-Driving Vehicles

NHTSA does not recommend that states attempt to establish safety standards for self-driving vehicle technologies, which are in the early stages of development. We believe there are a number of technological issues as well as human performance issues that must be addressed for self-driving vehicles. Particularly in light of the rapid evolution and wide variations in self-driving technologies, we do not believe that detailed regulation of these technologies is feasible

at this time at the federal or state level. However, until such time as NHTSA has developed vehicle safety standards pertinent to self-driving technologies, states may want to ensure that self-driving test vehicles in their states adhere to certain basic principles.

A--Ensure that the Process for Transitioning from Self-Driving Mode to Driver Control is Safe, Simple, and Timely

- During the testing phase of the development of self-driving vehicles, a driver familiar with the particular vehicle's automated systems is necessary to ensure that a failure of the automated system or the occurrence of conditions in which the automated system is not intended to operate does not put other road users at risk. The driver must be able to quickly and easily retake control of the vehicle from the automated system.
- A regulation may require that the driver be able to retake control of the test vehicle by an immediately over-riding, relatively simple, and non-distracting method such as pressing a button located within the driver's reach.
- Further, the automated functions of a test vehicle should defer to the driver's input by allowing the driver to retake control by using the brakes, the accelerator pedal, or the steering wheel.
- The self-driving vehicle should alert the driver when the driver must take control of the vehicle because the automated system cannot operate due to road conditions, environmental conditions, a malfunction, or any other condition or circumstance that would require manual driving for safe operation.

B—Self-Driving Test Vehicles Should Have the Capability of Detecting, Recording, and Informing the Driver that the System of Automated Technologies has Malfunctioned

- Self-driving test vehicles operating on the road should have the capability of detecting that their automated vehicle technologies have malfunctioned or are operating in a degraded state, and informing the driver in a way that enables the driver to regain proper control of the vehicle.
- Self-driving test vehicles should have the capability of recording the occurrence of such malfunctions, degradations, or failures in a way that can be used to establish the cause of any such malfunction, degradation and control failure.

C--Ensure that Installation and Operation of any Self-Driving Vehicle Technologies Does not Disable any Federally Required Safety Features or Systems

- Any regulation that allows for the operation of self-driving vehicles on public roads should ensure that entities installing automated technology in vehicles do not disable federally required safety systems.
- Federal law prohibits manufacturers of motor vehicles, dealers and motor vehicle repair businesses from making inoperative any federally required safety system.
- The installation of self-driving technologies should not degrade the performance of any of those federally required systems or the overall safety of the vehicle.

- States should consider requiring businesses offering self-driving vehicles for operation within their states to certify that they have not made any federally-required safety devices inoperative.

D--Ensure that Self-Driving Test Vehicles Record Information about the Status of the Automated Control Technologies in the Event of a Crash or Loss of Vehicle Control

- Self-driving test vehicles should record data from the vehicle's sensors, including sensors monitoring and diagnosing the performance of the automated vehicle technologies, in the event of a crash, or other significant loss of vehicle control. In addition to recording all the information from the sensors for the vehicle's automated technologies, the recording should note whether the automated technology system was in control of the vehicle at the time of the crash.
- Any regulation that allows for the operation of self-driving vehicles for testing purposes should also consider ensuring that the vehicle owner make available to the state all data recorded by the vehicle's event data recorder in the event of a crash.

IV--Regulations Governing the Operation of Self-Driving Vehicles for Purposes Other than Testing

NHTSA does not recommend that states authorize the operation of self-driving vehicles for purposes other than testing at this time. We believe there are a number of technological issues as well as human performance issues that must be addressed before self-driving vehicles can be made widely available. Self-driving vehicle technology is not yet at the stage of sophistication or demonstrated safety capability that it should be authorized for use by members of the public for general driving purposes. Should a state nevertheless decide to permit such non-testing operation of self-driving vehicles, at a minimum the state should require that a properly licensed driver (i.e., one licensed to drive self-driving vehicles) be seated in the driver's seat and be available at all times in order to operate the vehicle in situations in which the automated technology is not able to safely control the vehicle. As innovation in this area continues and the maturity of self-driving technology increases, we will reconsider our present position on this issue.

Subcommittee from Uniform Law Commission (2014)

Study Committee on State Regulation of Driverless Cars
Subcommittee on Issues

Revised Report of the Subcommittee on Issues

INTRODUCTION

This report is based on an earlier report by the subcommittee. It incorporates changes recommended by the full study group during a conference call held December 17, 2014.

The subcommittee consisted of William Covington, Mike Jacobs, Esson M. Miller, M.G. Taylor-Jones, H. Clayton Walker, V. David Zvenyach, and Robert M. Lloyd, chair. Pam Bertani, Chair of the Study Committee, participated in all of our deliberations and Lindsay Beaver was Staff Liaison. We received useful information from the students of the Technology Law and Public Policy Clinic at the University of Washington School of Law (Brooks Lindsay, Ashleigh Rhodes, Jasmine Hui, Eric Siebert, Don Wang, and Farah Ali). A copy of their report regarding risks of federal preemption of state laws concerning driverless cars is attached as Appendix A.

I. REASONS A UNIFORM ACT WOULD BE BENEFICIAL

A. Because Motor Vehicles Regularly Cross State Lines, a Uniform Law is Necessary So that Vehicles Operating in Multiple Jurisdictions Are Not Subject to Contradictory Requirements.

B. Manufacturers of Vehicles Need Uniform Laws So That They May Build "50-State Vehicles."

C. A Uniform Act Would Foster Innovation in AV Technology By Assuring Developers That If Their Products Met a Single Set of Requirements, the Commercialization of These Products Would Not Be Impeded by Inconsistent State Requirements.

II. THE SUBCOMMITTEE RECOMMENDS THE ADOPTION OF THE FOLLOWING GENERAL PRINCIPLES:

A. To the Extent Feasible, the Uniform Act Should Avoid Including Provisions that Would Require Additional State Spending

Unlike the federal government, 49 of the 50 states require an annual balanced budget, either through constitutional or statutory mandate. With slow economic growth patterns facing most states, a political adversity toward government spending, and federal sequestration mandates impacting those states that have traditionally relied on federal spending, states are facing extreme economic pressures.

A very good example of this dilemma is the Commonwealth of Virginia. Virginia has traditionally been a state that was among the last to slide into an economic downturn and among the first to recover. Even though the national economy is still recognizing positive economic growth, Virginia faces a revenue shortfall of approximately $2.4 billion. Most of the blame has centered on sharp reductions in federal spending, upon which Virginia has previously relied. Immediate actions were taken by Virginia's Governor to reduce spending, including across-the-board cuts in state agency spending. Agencies will not, therefore, assume additional responsibilities that are not fully funded.

Even states that have traditionally relied on their petroleum and gas resources to pull their state budgets through difficult times are facing economic pressures because of budget actions taken by previous legislatures. Some of those actions involve fund transfers from state retirement programs and tobacco settlement funds to plug revenue gaps.

The uniform act concerning autonomous vehicles will be very difficult to enact if funds will need to be appropriated to support it. States simply do not have the revenues to support a new initiative. Therefore, any provision prompting a negative state legislative fiscal impact statement should be avoided, if at all possible.

B. The Uniform Act Should, to the Extent Possible, Do Nothing that Would Dampen or Impede Innovation or Substantially Increase Costs to Industry and Small Entrepreneurs as They Advance Autonomous Vehicle Technology.

The Uniform Law Commission has enjoyed a long history of promoting the free flow of goods, credit, services, and persons among the states in an effort to encourage full economic and social development. Also, persons, corporations, and business directly involved in and impacted by proposals developed by the ULC have always been invited to fully participate in all areas of discussions as various committees study, develop, and draft statutory recommendations. We become partners as we advance those final decisions and recommendations through the various state legislatures.

This subcommittee, therefore, has adopted a basic principle of "do no harm." The automotive technology currently being discussed and planned may revolutionize the transportation industry. The ULC and this study committee should always be wary of any proposal that could delay or potentially destroy this emerging and significant economic and social advancement.

C. The Uniform Act Should Address Issues Relating to Deployment as Well As Testing

The subcommittee recognizes that a uniform act relating only to the testing of autonomous vehicles and not to their deployment for use by individuals and businesses would be a much more manageable task for the drafting committee. We also realize that an act limited to testing would be much easier to enact. We nevertheless believe that the uniform act should address issues of deployment as well as those of testing.

A statute limited to testing might be obsolete before it is approved by the Conference. Five jurisdictions already have legislation concerning autonomous vehicles in place and bills have been introduced in thirteen more[1]. The study committee report will not be completed until 2015. If the normal two-year drafting cycle is used, the uniform act will not be ready for adoption until late 2017. By that time, many states will have statutes covering testing in place and testing programs will be well established in accordance with those statutes. The stakeholders are likely to be reluctant to make changes, even if the Conference's product is better than the existing statutes.

California, Nevada, and the District of Columbia already have in effect statutes and regulations contemplating deployment of autonomous vehicles for purposes other than testing. A uniform act limited to testing would therefore be a step backward in those jurisdictions and in any others that enacted similar legislation before the uniform act becomes available for adoption.

We note that the NHTSA Preliminary Statement of Policy Concerning Automated Vehicles (hereinafter "NHTSA Statement") recommends that state statutes regulating autonomous vehicles be limited to issues involving testing. However, the NHTSA Statement was issued more than a year ago and there has been considerable progress in AV technology (probably more than anticipated) since that time. The NHTSA has not responded to requests for clarification of their position.

D. The Subcommittee is Divided on the Question of Whether the Uniform Act Should Address Issues in Considerable Detail or Limit Itself to General Principles

Some members have expressed concerns that if the uniform act does not contain sufficient detail, states will be required to issue regulations to fill in the details. This might create inconsistencies that could hamper the development of autonomous vehicles. Other members of the subcommittee are concerned that because the drafting committee will not be able to anticipate all technological changes, having too many details in the uniform act may itself be an impediment to the development of autonomous vehicles.

A RAND Corporation study provides further support for the position that the uniform act should remain general. After noting that autonomous vehicles will create many externalities, most of which will probably (but not surely) be positive, the RAND Study concludes with the following paragraph:

[1] Arizona, Colorado, Hawaii, Massachusetts, New Hampshire, New Jersey, New York, Oklahoma, Oregon, South Carolina, Texas, Washington, and Wisconsin.

> At some point, policymaker intervention to align the private and public costs of [autonomous vehicle] technology may be justified. But at this point aggressive regulatory action is premature and can probably do more harm than good.

James M. Anderson, et. al. *Autonomous Vehicle Technology: A Guide for Policymakers* 149 (2014).

In an earlier chapter, the RAND Study states:

> Inconsistent state laws might increase costs and hinder the use of this technology in a way that harms social welfare for little apparent gain. We are unaware of any reported accidents or harm from autonomous vehicle technology testing at this point. We would suggest that state lawmakers proceed cautiously in this area and adopt legislative solutions only in response to clearly identified problems. Further efforts to develop a model statute to promote uniformity in requirements may be useful.

Id. at 53.

Our conclusion is that the drafting committee will need to decide on an issue-by-issue basis how much specificity the uniform act should contain. We urge the drafting committee to keep in mind the competing considerations discussed above.

E. The Subcommittee Recommends that the Drafting Committee Consider Separate Regulatory Schemes Based Upon the Vehicle's Use and the Degree of Automation.

For example, the California statute addresses separately three types of autonomous vehicle operations: (1) testing by the manufacturer of the autonomous vehicle technology, (2) operation by the public with a driver aboard, and (3) operation without a driver aboard. Cal. Vehicle Code § 38750. The *Autonomous Vehicle Report and Recommendations to the ULC* prepared by the University of Washington Technology Law and Policy Clinic (the "UW Recommendations") recommends that using four categories: (1) a private-test vehicle used only on private property and not subject to state regulation, (2) a limited public test vehicle that could be tested on public roads only under certain conditions, (3) an unlimited public-test vehicle that could be tested under all conditions, and (4) a fully-certified vehicle that could be sold to the public. UW Recommendations at 3.

III. THE SUBCOMMITTEE RECOMMENDS THAT THE UNIFORM ACT ADDRESS THE FOLLOWING ISSUES:

A. Coverage of the Act

The NHTSA has identified four levels of automation, ranging from items like cruise control (Level 1) to full self-driving (Level 4). NHTSA Statement, pages 4 and 5. The presently-enacted statutes apply only to vehicles that are capable of driving themselves "without the active physical control or monitoring by a

human operator."[2] Some members of the subcommittee believe this definition is adequate, but others have expressed concerns that manufacturers may attempt to avoid the coverage of the act by designating vehicles as requiring active monitoring even though they know (and perhaps intend) that consumers will be operating them without active monitoring.

B. Prohibition of Autonomous Vehicles Except as Expressly Permitted By the Statute

It has been noted that the law of most states contains no provision that would prohibit the use of autonomous vehicles on public roads by any person or organization. *See* Bryant Walker Smith, *Autonomous Vehicles are Probably Legal in the United States*, 1 Texas A&M L. Rev. 411 (2014). The subcommittee therefore believes that the uniform act should expressly prohibit any use (including testing) of autonomous vehicles on public roads except as expressly permitted by the uniform act.

C. Provision for Rulemaking

The subcommittee believes the uniform act should have a provision authorizing the applicable state agencies (e.g., department of transportation, department of motor vehicles, highway patrol) to make regulations necessary or appropriate to carry out the purposes of the act. For example, the California statute sets out a number of issues as to which the state's department of motor vehicles must make regulations and sets a deadline of January 1, 2015 for the adoption of these regulations. Cal. Vehicle Code § 38750(d)(1). The uniform act should make rulemaking permissive rather than mandatory so that it will not create additional fiscal burdens in states that choose not to supplement the act with regulations.

D. Limited Rules Governing Liability Arising from the Operation of Autonomous Vehicles

The subcommittee recommends that a uniform act not contain major changes to liability rules addressing the operation of autonomous vehicles. (*See* Paragraph IV.A., below). The drafting committee may, however, want to consider some specific rules with limited application. For example, existing statutes provide that manufacturers are not liable for injuries due to defects caused by a third party converting a vehicle to an autonomous vehicle. *See* Nev. Rev. Stat. § 482A.090; Fla. Stat. § 316.86(2); D.C. Code § 50-2353; Mich. Comp. Laws § 257.817. The drafting committee, with added input from stakeholders, will be in a position to evaluate the costs and benefits of including this type of specific provision.

E. State-Issued Permits for the Testing of Autonomous Vehicles

The subcommittee recommends that the drafting committee consider whether the uniform act should require a state-issued permit for the testing of autonomous vehicles. We further recommend that the

[2] The language is from the California statute. Cal Vehicle Code § 38750(a)(1). Statutes in three other states have nearly identical language. Fla. Stat. § 316.003(90); Mich. Comp. Laws § 257.2b; Nev. Rev. Stat. § 482A.025. The District of Columbia has a slightly different definition: "a vehicle capable of navigating District roadways and interpreting traffic control devices without a driver actively operating any of the vehicle's control systems." D.C. Code § 500.2351(1).

drafting committee consider whether a person (an individual or entity) would be issued a blanket permit for all autonomous vehicle testing to be done by that person or whether they would be required to obtain individual permits for each individual autonomous vehicle or each model of autonomous vehicle to be tested. We note, however, that such a permitting process might require significant state expenditures, which might make enactment less feasible. This problem might be avoided by placing the requirement in an optional (bracketed) provision so that states that do not anticipate AV testing within their borders could omit the provision and avoid the fiscal impact.

Summary of Reports and Existing Legislation

The five statutes enacted to date appear to give any manufacturer meeting the requirements of the statute the right to test autonomous vehicles on public roads, but the California regulations require the issuance of a permit (Cal. Regs. § 227.04(d)) and Nevada regulations require a license (Nev. Regs. § 8.3).

The California regulations require that the manufacturer provide the DMV with identifying information on each vehicle to be tested. Cal. Regs. § 227.16.

To obtain the Nevada license, the applicant must (1) have the necessary insurance, (2) submit proof that "one or more of the autonomous vehicles of the applicant has been driven by the applicant for a combined minimum of not less than 10,000 miles in the autonomous mode" in various conditions, including day, night, various weather conditions and various types of roads, (3) demonstrate its technology to the DMV, (4) demonstrate that its vehicles are capable of being driven in the conditions of the geographic locations where the applicant proposes to test. Nev. Regs. § 8.3.

NHTSA recommends that states adopt regulations placing a number of requirements on persons seeking to test autonomous vehicles on public roads. These include: (1) a certification that the vehicle has already operated for a certain number of miles in self-driving mode "without incident," (2) submission of data from previous testing involving the technology, and (3) submission of a plan for minimizing safety risks to other road users." NHTSA Statement at 11.

F. Persons Allowed to Test Autonomous Vehicles

The subcommittee believes that the uniform act should be written so that it does not preclude individuals, small businesses, educational institutions and the like from testing autonomous vehicles as long as they meet the safety requirements. We also believe that the drafting committee should consider a provision allowing some or all state and federal agencies to test (and perhaps operate) autonomous vehicles without complying with all the requirements applicable to individuals and private businesses.

G. Testing Without a Driver On Board

The subcommittee recommends that the uniform act address the issue of when a driver must be on board the vehicle during testing operations. All the presently-enacted legislation requires a driver on board during all testing operations, but at some point testing without a driver on board will be required as a prelude to a deployment of fully driverless vehicles. To avoid obsolescence the uniform act should make provision for this.

Summary of Reports and Existing Legislation

"NHTSA strongly recommends that states require that a properly licensed driver be seated in the driver's seat and ready to take control of the vehicle while the vehicle is operating in self-driving mode on public roads." NHTSA Statement at 12.

The California statute mirrors the NHSTA recommendation. Cal. Vehicle Code § 38750(b)(1).

The Nevada regulations require two licensed drivers in the vehicle, one of them being capable of taking immediate control of the vehicle. Nev. Regs. § 10.2.

The Michigan statute requires a licensed driver "designated or otherwise authorized by the manufacturer of the automated technology," and a second licensed driver aboard the vehicle monitoring vehicle performance and capable of taking immediate control of the vehicle. Mich. Comp. Laws §257.665.

D.C. does not appear to distinguish between testing and deployment, but requires "a driver seated in the control seat of the vehicle while in operation who is prepared to take control of the autonomous vehicle at any moment." D.C. Code § 2352.

H. Test Driver Qualifications and Co-Driver Requirements

The subcommittee is divided as to whether the uniform act should go beyond merely requiring a driver for all testing operations. The uniform act might specify the qualifications required of the driver and specify whether a second person needs to be on board an autonomous vehicle during testing operations on public roads. Some members note that the presently-enacted legislation addresses this issue and that a statute that fails to address this issue would be incomplete. Others believe that the uniform act should not go into this much detail. These members note that this is an issue on which uniformity is not required and that it is one that states can address via regulations.

Summary of Presently-Enacted Legislation

California requires that the driver have completed the manufacturer's test-driver training program, that they have been "certified by the manufacturer to the [Department of Motor Vehicles] as competent to operate the vehicle" and that they have a relatively clean driving record. Cal. Regs. §§ 227.18, 227.20. The regulations also specify the requirements for the manufacturer's training program.

The Nevada regulations require two licensed drivers on board for testing. Both "[m]ust be trained in the operation of the autonomous vehicle and have received instruction in the capabilities and limitations of the autonomous vehicle." Nev. Regs. § 11.3.

I. Limitation of Testing to Specific Conditions or Specific Geographic Areas

Presently-enacted legislation in Nevada requires that the Department of Transportation adopt regulations to '"[r]estrict the testing of autonomous vehicles to specified geographic areas." Nev. Rev. Stat. § 482A.100. The uniform act might provide, for instance, that the applicable state agency could limit testing to specific geographic areas or that they could allow testing of unmanned vehicles in certain areas which they would designate. Some members of the subcommittee believe such provisions would be useful; others believe this is too much detail for a uniform act. All agree, however, that this is an issue that the drafting committee should at least consider.

J. Reporting of Accidents and Incidents During Testing

The subcommittee is divided as to whether the uniform act should contain provisions requiring the reporting of accidents and incidents during testing. The NHTSA recommends, and presently-enacted legislation requires, that manufacturers testing autonomous vehicles report to the state instances where an autonomous vehicle being tested is involved in an accident or a near-miss or where the driver is required to take control of the vehicle to ensure safe operation. Some subcommittee members agree that this information might be useful and they believe it is worth collecting. For example, it might enable states to curtail dangerous testing operations or to refute claims that testing operations were unduly dangerous.

Other subcommittee members believe, however, that collecting and retaining this data would be an unwelcome burden on many states and might have an adverse fiscal impact. They note that this information would not be particularly useful unless it was collected on a nationwide basis, something that would better be done by the NHTSA. One study committee observer raised the possibility that a requirement to report accidents might in some circumstances require that the manufacturer disclose proprietary information.

Summary of Reports and Presently-Enacted Legislation

The NHTSA "encourage[s]" states "to require businesses testing self-driving vehicles to submit to the state certain information including:

> "instances in which a self-driving vehicle, while operating in or transitioning out of self-driving mode, is involved in a crash or near crash; and
>
> "incidents in which the driver of one of their self-driving vehicles is prompted by the vehicle to take control because of a failure of the automated system or the inability of the automated system to function in certain conditions"

NHTSA Statement at 12.

The California regulations require that a manufacturer testing autonomous vehicles report to the DMV within 10 days any accident involving personal injury or property damage and that it report annually all incidents in which safety required disengagement of the autonomous technology. Cal. Regs. §§ 227.46, 227.48.

Nevada regulations require the reporting of any accident or traffic violation occurring during autonomous vehicle testing. Nev. Regs. § 10.4.

K. Mandated Safety Features

The subcommittee recommends that the uniform act contain provisions requiring that both test vehicles and vehicles sold to the public incorporate certain safety features like those mandated by the presently-enacted legislation. These might include a device to quickly disengage the automated system, a device to indicate whether or not the vehicle is operating in the autonomous mode, and a system to warn the operator that the autonomous system is malfunctioning. There is some concern that this is too much detail for a uniform act, but we note that the NHTSA recommends these and that most of the presently-enacted legislation requires them.

We note that this is an area in which a uniform act is likely to be preempted by federal regulations, but we believe that until such federal regulations are in place, the uniform act should provide for mandatory safety features. We considered the possibility of a provision expressly deferring to conflicting federal law, but we determined that legislative drafters in most states do not normally include such provisions.

Reports and Presently-Enacted Legislation

Device to disengage the automated systems

The NHTSA Statement says there should be quick and simple methods of retaking control, including override switch and brakes, accelerator or steering wheel.

The California statute requires, as a prerequisite to deployment (but not to testing), that the manufacturer certify that "[t]he autonomous vehicle has a mechanism to engage and disengage the autonomous technology that is easily accessible to the operator." Cal Vehicle Code §38750(c)(1)(A). It further requires certification that "[t]he autonomous vehicle shall allow the operator to take control in multiple manners, including, without limitation, through the use of the brake, the accelerator pedal, or the steering wheel, and it shall alert the operator that the autonomous technology has been disengaged." Cal. Vehicle Code §38750(c)(1)(D).

The Florida statute requires "a means to engage and disengage the autonomous technology which is easily accessible to the operator" Fla. Stat. § 319.145.

The D.C. regulations require this as a condition for registration of the vehicle. D.C. Regs. § 401.20(c). Like the California statute, the D.C. regulations also require that the operator be able to take control of the vehicle in multiple ways. D.C. Regs. § 401.20(h).

Device to indicate whether or not the vehicle is operating in the autonomous mode

California and Nevada require this for deployment but not for testing. Cal. Vehicle Code § 38750 (c)(1)(B), Nev. Regs. 8.2(b).

The Florida Statute requires this of all autonomous vehicles registered in the state. Fla. Stat. § 319.145(1)(b).

The D.C. regulations impose a similar requirement. D.C. Regs. § 401.20(d).

System to warn the operator that the automated systems have failed

The NHTSA statement says there should be a warning system alerting the driver that she must take control.

The California statute requires, as a prerequisite to operation on public roads, that the manufacturer certify that "[t]he autonomous vehicle has a visual indicator inside the cabin to indicate when the autonomous technology is engaged." Cal. Vehicle Code § 38750(c)(1)(B). This is required for deployment but not for testing.

The Nevada regulations require such a system both for test vehicles and for vehicles sold to the public. Nev. Regs. §§ 8.2(d) & 16.2(d). For deployed vehicles, the system must also be capable of safely stopping the vehicle in the event of a system failure if the operator does not do so. Nev. Regs. § 16.2(d).

The Florida Statute requires a means to indicate that the operator must take control because of technology failure. Fla. Stat. § 319.145(1)(c).

The D.C regulations also require a system to warn of technology failure. D.C. Regs. § 401.20(e).

Federally-mandated safety features to remain operative

The NHTSA recommends that any regulation allowing automated vehicles on public roads should ensure that federally-mandated safety features are not disabled. NHTSA Statement at page 13, paragraph III.B.

The California statute requires the manufacturer certify that the vehicle meets federal safety standards and that the autonomous technology does not make inoperative any federally-mandated safety equipment. Cal. Vehicle Code §§38750(c)(1)(D)&(E). These requirements do not apply to vehicles used only for testing.

L. Requirement that an Autonomous Vehicle Carry a Special License Plate or Other Indicator that it is an Autonomous Vehicle.

The subcommittee believes that this is an issue the drafting committee should consider. It would be useful for law enforcement personnel, among others, and any associated costs could be offset by fees charged for the plates. We note, however, that it has been suggested that if autonomous vehicles are identified as such other motorists may intentionally create hazardous situations to observe the reaction of the autonomous vehicle. On the other hand, the identification of the vehicle as an autonomous vehicle might prompt most motorists to take extra precautions and to attempt to avoid creating the sort of ambiguous situations that autonomous vehicle are not yet capable of dealing with.

The University of Washington students have developed a creative proposal for a system of indicator lights surrounding the license plate. These would indicate the status of the vehicle as a test vehicle or a deployed vehicle and also indicate whether or not the vehicle was operating in the autonomous mode. UW Recommendations, *supra* para. II.E., at 3. We recommend that the drafting committee consider this proposal.

Summary of Presently-Enacted Legislation

The Nevada Regulations provide for a special license plate for testing as well as for deployment. Nev. Regs. § 6.3.

The D.C. regulations also provide for a special plate. D.C. Regs. § 436.

The Michigan statute, which contemplates only testing of autonomous vehicles, provides for a special plate. Mich. Comp. Laws § 257.225.

M. State Approval Before an Autonomous Vehicle is Deployed for Purposes Other Than Testing.

The subcommittee notes that California requires approval by the California DMV before an autonomous vehicle is deployed for purposes other than testing. (The statute appears to contemplate approval by model, although the literal language of the statute would require approval of each individual vehicle.) The subcommittee believes that the drafting committee should consider the extent to which states may, in the absence of comprehensive federal legislation, want to exercise this much control. We note, however, that such an approval scheme would have a significant cost and that it might be more appropriate to draft general standards (e.g., a specified number of accident-free test miles before deployment) rather than having a state agency directly involved in evaluating vehicles.

Nevada deals with the problem by requiring that a "certificate of compliance" be issued before an autonomous vehicle is offered for sale. The certificate of compliance is issued by the manufacturer or an "autonomous vehicle certification facility" licensed by the state. The certificate may be issued only if the vehicle meets the requirements set forth in the Nevada regulations. Nev. Regs. § 16.

N. Requirement for a Special License or Endorsement to Operate an Autonomous Vehicle for Purposes Other Than Testing

The subcommittee recommends that the drafting committee consider whether a person operating an autonomous vehicle for purposes other than testing should be required to hold a special license (or an endorsement to their existing license). The members of the subcommittee are divided as to whether such a license or endorsement should be required, but all agree that it is an issue the drafting committee should consider.

Some subcommittee members argue that operating an autonomous vehicle will not be more difficult or complicated than operating a standard automobile, while others would analogize an autonomous vehicle to a truck or motorcycle, for which a special license or endorsement is required. Some also note that this issue might better be left for state-by-state determination. The issue may become clearer as the technology advances and we have a better idea of way autonomous vehicles will operate when deployed.

Summary of Reports and Presently-Enacted Legislation

NHTSA recommends that states require all operators of autonomous vehicles to hold a special license or an endorsement to a standard driver's license. It recommends that this license or endorsement be conditioned on completion of a training course conducted by the manufacturer and that the curriculum of the training course be approved by the state. NHTSA Statement at 11.

For testing, California requires that the driver have undergone training by the manufacturer. Cal. Regs. §227.20. California regulations concerning deployment have not yet been published, but they are due to be published on or before January 1, 2015. Cal. Vehicle Code § 38750 (d)(1).

Nevada requires an endorsement to operate a deployed vehicle, but not to operate a vehicle for testing. Nev. Regs. § 10.2(a).

The District of Columbia regulations provide for a special endorsement. D.C. Regs. § 114.1. To get the endorsement, the applicant must certify that they have been trained by the manufacturer or dealer in the operation of the autonomous vehicle.

Florida and Michigan require only an ordinary driver's license. Fla. Stat. §316.85(1); Mich. Comp. Laws § 257.665(2)(c).

O. Crash Data Recorder

The subcommittee recommends that the drafting committee consider whether the uniform act should require that autonomous vehicles used for testing, autonomous vehicles sold to the public, or both have installed a crash data recorder. The consensus of the subcommittee is that the drafting committee should consider an optional (bracketed) provision setting forth requirements for an installed crash data recorder. In that way, if some states decide that crash data recorders should be required, the manufacturers would have a uniform set of requirements to deal with.

Summary of Reports and Presently-Enacted Legislation

The California statute requires a crash data recorder for autonomous vehicles sold to the public. It does not appear to require one for autonomous vehicles being tested. The statute contains fairly detailed requirements as to the capabilities of the recorders. Cal. Vehicle Code § 38750(c)(1)(G).

The Nevada statute is silent on the matter, but the regulations require recorders on autonomous vehicles used for testing as well as autonomous vehicles offered for sale to the public. The specifications parallel those of the California statute. Nev. Regs. §§ 8.2(b) & 16.2(a).

The NHTSA Statement also recommends test vehicles have installed a crash data recorder. NHTSA Statement, page 14, paragraph III.D.

P. Distracted Driving Laws

The subcommittee recommends that the drafting committee consider provisions that would amend the state's distracted driving laws. Such amendments might allow texting and similar activities when a vehicle is operating in the autonomous mode. One member of the subcommittee noted, however, that present state distracted driving laws vary considerably and that state legislators might wish to retain control over this issue.

Summary of Reports and Presently-Enacted Legislation

The RAND Study suggests there should be changes to state distracted driving laws because these rules may interfere with the development of autonomous vehicle communications systems. RAND Study at 139.

The Florida law banning texting while driving exempts persons "[o]perating an autonomous vehicle . . . in autonomous mode." Fla. Stat. § 316.305(b)7. Michigan has a similar provision. Mich. Comp. Laws § 257.602b(4)(e).

IV. THE SUBCOMMITTEE RECOMMENDS THAT THE UNIFORM ACT NOT ADDRESS THE FOLLOWING ISSUES:

A. Major Changes in the Existing Law With Respect to the Liability of Vehicle Owners and Operators

The subcommittee recommends that a uniform act should not contain major changes to liability rules, but rather allow autonomous vehicles to be subject to the liability rules as they now exist and as they evolve. The states have already developed robust product liability frameworks, and these laws have successfully been applied to a wide variety of products. No existing statute has attempted to wade into this minefield to substantially alter the legal landscape in favor of manufacturers or in favor of

consumers. The subcommittee believes that the existing product liability laws should be able to accommodate this new product, and substantial changes would adversely impact enactability.

Academics and think-tanks have considered this issue extensively. Their conclusions are summarized in the memorandum attached to this report as Appendix B.

B. Data and Privacy Issues

Operation of autonomous vehicles is expected to generate a large volume of data that will be in the possession of the manufacturers of the vehicles. This is expected to include much personal information about the operator of the vehicles. The study committee fully appreciates the gravity of questions such as what party owns the data, who may have access to it, and how may it be used.

The breadth of issues this raises has led the study committee to determine that they are best considered separately. These issues require expertise different from that required to deal with AV issues generally, and an effort to address data and privacy issues in an act dealing with autonomous vehicles may involve so much effort that the drafting committee could have difficulty completing the project in a reasonable amount of time. The committee also notes that the data and privacy issues are not limited to autonomous vehicles alone, and a broader effort to address these issues may be considered at another time. Finally, an effort to load these issues into the act governing autonomous vehicles could also adversely impact its enactability.

C. Insurance Requirements

The subcommittee recommends that the uniform act not impose special insurance requirements on autonomous vehicles. The subcommittee notes California and Nevada have a $5 million requirement to test AVs on state roads. But there is a concern this dollar amount may keep small manufacturers out of the development of autonomous vehicles. The subcommittee therefore recommends leaving this issue to existing liability laws, such as was done in Michigan.

Summary of Presently-Enacted Legislation

California requires $5 million of insurance or self-insurance for any manufacturer testing autonomous vehicles. Cal. Vehicle Code § 3875(b)(3).

Nevada requires $1 million of insurance to test five or fewer vehicles, $2 million to test 6 to 10 vehicles, and $3 million to test more than 10. Nev. Regs. §. 8.4.

Florida requires $5 million of insurance for autonomous vehicles being tested. Fla. Stat. § 316.86.

Michigan appears to require only the normal insurance required for all vehicles. Mich. Comp. Laws § 257.665(1).

There does not appear to be any specific insurance requirement in the D.C. statute or regulations.

D. Accident or Incident Reporting Requirements for Owners of Deployed Autonomous Vehicles.

The subcommittee believes that owners and operators of deployed autonomous vehicles should be subject to the same accident reporting requirements as other vehicle owners. Some states have imposed requirements that operators of autonomous vehicles for testing submit data on near misses and autonomous technology malfunctions, but the subcommittee believes that most states will not wish to incur the expense associated with collecting this data with respect to deployed autonomous vehicles.

University of Washington School of Law Technology Law Clinic
Comments on ULC (undated)

Appendix A

The Risks of Federal Preemption of State Autonomous Vehicle Regulations

The Technology Law and Public Policy Clinic
at the University of Washington School of Law

Overview of risks: The National Highway Traffic Safety Administration (NHTSA) is unlikely to preempt state regulation in the areas of testing, permitting, licensing, test-driver training, and conditions for the operation of specific types of autonomous vehicles (AVs). It has stated in its 2013 Preliminary Statement of Policy Concerning Automated Vehicles (hereinafter Statement) that states are competent in regulating these areas. However, the Statement implied NHTSA's intention to create broad safety regulations and standards for new AVs and automating equipment, and it put states on not-so-subtle notice that the NHTSA will likely preempt them in this area. There are, however, elements of safety regulation where the NHTSA will seek to work with states – specifically, inspection regimes to monitor after-market modifications that turn traditional cars into AVs. Lastly, the NHTSA has the power to preempt state tort law *only* where it conflicts with a significant regulatory objective. Moreover, the current Administration appears unwilling to preempt state tort law even where such conflicts exist.

Overview of recommendations: To minimize the risk of federal preemption of provisions in its draft legislation, the ULC should focus on regulating:

- Testing, test permitting, test-driver licensing, and training programs for test drivers.
- Insurance requirements for manufacturers conducting testing and for the future operators/buyers of AVs.
- AV licensing or "endorsement" regimes for the future operators/buyers of AVs.
- Broad operational requirements for commercially available AVs relating less to safety and more to informing/enabling operators and ensuring compliance with state traffic laws.

The NHTSA's mandate and scope of authority:

- The NHTSA's purpose and policy is to "reduce traffic accidents and deaths and injuries resulting from traffic accidents."[3] To achieve this purpose, it has the authority to "prescribe motor vehicle safety standards for motor vehicles and motor vehicle equipment in interstate commerce."[4]
- Motor vehicle safety is defined as the "performance of a motor vehicle or motor vehicle equipment in a way that protects the public against unreasonable risk of accidents occurring because of the design, construction, or performance of a motor vehicle, and against unreasonable risk of death or injury in an accident, and includes nonoperational safety of a motor vehicle."[5]

[3] 49 U.S.C.A. § 30101 (West).
[4] *Id.* § 30101(1).
[5] 49 U.S.C.A. § 30102(a)(8) (West) (emphasis added).

- "The agency does not regulate the actions of vehicle owners, the operation of motor vehicles on public roads or the maintenance and repair of vehicles-in-use."[6]

Unlikely NHTSA will preempt state regulations surrounding TESTING of autonomous vehicles:

- States can take the lead in regulating testing without much risk of preemption. One of the purposes of NHTSA's Statement was to "recommend[] principles that States may wish to apply as part of their considerations for driverless vehicle operation, especially with respect to testing and licensing."[7]
- The NHTSA "believe[s] that states are well suited to address issues such as licensing, driver training, and conditions for operation related to specific types of vehicles . . . [but it] does not recommend at this time that states permit operation of self-driving vehicles for purposes other than testing."[8]

Unlikely NHTSA will preempt ADMINISTRATIVE REGULATIONS like licensing, permitting, driver training:

- The NHTSA appears to have no interest in regulating administrative issues such as "licensing, driving training, and conditions for operation related to specific types of vehicles."[9] States can, therefore, expect to fully control the permitting for test cars and drivers and the requirements for test-driver training programs.
- At this time, the NHTSA does not believe that AVs have reached the necessary level of sophistication to be "authorized for . . . general driving purposes."[10] But when AVs have reached that stage, states can expect to exert considerable control in the areas of longer-term licensing or "endorsement" for consumer drivers, similar to the current scope of state highway-safety programs.[11]

NHTSA is highly likely to preempt most, but not all, SAFETY STANDARD regulations related to AVs:

- "NHTSA has considerable concerns . . . about detailed state regulation on safety of self-driving vehicles, and does not recommend at this time that states permit operation of self-driving vehicles for purposes other than testing."[12]
- Safety standards appear to be what the National Traffic and Motor Vehicle Safety Act intended the NHTSA to regulate.[13] A large portion of the Statement is devoted to the NHTSA's "Research Plan for Automated Vehicles."[14] The Human Factors Research program has already yielded results,[15] and as funds permit, the NHTSA hopes to complete the first phase of research in three

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[6] Stephen P. Wood et. al., *The Potential Regulatory Challenges of Increasingly Autonomous Motor Vehicles*, 52 SANTA CLARA L. REV. 1423, 1435 (2012).

[7] Statement at 2, http:// www.nhtsa.gov/staticfiles/rulemaking/pdf/Automated_Vehicles_Policy.pdf, (May 30, 2013).

[8] *Id.* at 10.

[9] *Id.*

[10] *Id.* at 14.

[11] *See generally* 23 U.S.C.A. § 402 (West).

[12] Statement, *supra* note 7, at 10.

[13] *Id.* ("NHTSA's authority, expertise, and mandate is to establish uniform, national standards needed for vehicle safety.").

[14] *Id.* at 5-9.

[15] *See generally* NHTSA, *Human Factors for Connected Vehicles: Effective Warning Interface Research Findings*, http://www.nhtsa.gov/DOT/NHTSA/NVS/Crash%20Avoidance/Technical%20Publications/2014/812068-HumanFactorsConnectedVehicles.pdf, (Sept. 29, 2014).

to four years.[16] Upon completion, if the NHTSA determines that "the vehicle or item of equipment falls under [its] authority[,] . . . that there is a safety need, and that the standard will meet that need,"[17] it is likely to promulgate regulations preempting state safety standards.

- NHTSA has the authority to regulate two different areas of safety standards:
    - Safety standards for new vehicles & equipment.
        - Broad statutory definitions give the NHTSA correspondingly broad authority "to issue safety standards that apply . . . to vehicles that were originally manufactured with autonomous capabilities" and to establish standards for "the individual pieces of equipment that . . . enable [AVs] to drive autonomously."[18]
        - "[T]he transition from mechanical to electromechanical systems has had no significant effect on the extent of NHTSA's authority over motor vehicle performance" because the statutory definitions cover all motor vehicle equipment regardless of the type of technology used.[19]
    - Safety standards for after-market technologies and modifications to used vehicles.
        - The NHSTA's "jurisdiction over after-market equipment is significant in regard to autonomous driving technologies because providers of advanced crash avoidance and autonomous driving technologies might wish to market these technologies for installation on used vehicles."[20]
        - But NHTSA's authority diminishes after the first sale where it must work with the states to conduct "periodic inspections to ensure that certain basic safety equipment on vehicles remains intact and functional after vehicles cease to be new."[21]
        - Given that NHTSA has authority to establish standards applicable to after-market equipment, but has only limited means to regulate modifications made by car owners, it is conceivable that NHTSA will need to work in a type of shared-power regime with states to regulate "after-market modifications."
- "Until such time as NHTSA has developed vehicle safety standards pertinent to self-driving technologies,"[22] the Agency suggested *basic principles* for things like "safe, simple, and timely" transition from self-driving mode to driver control that states can use to ensure safe operation of AVs.

The NHTSA may preempt STATE COMMON LAW TORT LIABILITY only if it conflicts with a "significant regulatory objective." Moreover, the current administration appears unwilling to preempt here.

- The statutory language is vague regarding NHTSA's power to preempt state common law:
    - On one hand, the preemption provision of the Safety Act expressly asserts federal authority by stating that "[w]hen a motor vehicle safety standard is in effect under this chapter, a State . . . may prescribe or continue in effect a standard applicable to the

[16] Statement, *supra* note 7, at 7-8.
[17] Wood, *supra* note 6, at 1435.
[18] *Id.* at 1439-40.
[19] *Id.* at 1441.
[20] *Id.* at 1443.
[21] *Id.* at 1436; *see also*, U.S. Gov't Accounting Office, GAO-11-603, *Auto Safety: NHTSA Has Options to Improve the Safety Defect Recall Process*, http://www.gao.gov/assets/320/319698.pdf, at 28-30 (June 2011).
[22] *Id.* at 13.

same aspect of performance of a motor vehicle or motor vehicle equipment only if the standard is identical to the standard prescribed under this chapter."[23]
    - On the other, the statute also provides a clause bolstering state tort common law: "Compliance with a motor vehicle safety standard prescribed under this chapter does not exempt a person from liability at common law."[24]
    - For years, this ambiguous and seemingly self-contradictory setup left courts and the NHTSA struggling to grapple with the exact scope of the intended preemptive power.[25]
- Supreme Court precedent indicates that preemption will be found only in the narrow context where the state tort action actually interferes with the achievement of a "significant regulatory objective."
    - There are two Supreme Court cases that directly outline the NHTSA's preemption power: *Geier*[26] and *Williamson*.[27]
        - In *Geier*, the defendant challenged a state design defect claim on the ground that such claim was preempted by the provision of Safety Act and Federal Motor Vehicle Safety Standards 208 (FMVSS 208).[28] The Court first concluded that the saving clause removes the state tort action from the scope of express preemption.[29] However, the Court held that the principle of implied conflict preemption still applied despite the saving clause.[30] Ultimately, the Court concluded that the state tort claim conflicted with the regulatory intention to provide manufacturers with options of different choices and was, therefore, preempted.[31]
        - In *Williamson*, the Supreme Court clarified the *Geier* decision by holding that state tort claims do not give rise to conflict preemption when the claim would foreclose a design option permitted under the FMVSS, unless giving the manufacturer a choice is a "significant regulatory objective."[32] Furthermore, *Williamson* provided a framework that lower courts should utilize to determine whether the "significant regulatory objective" standard is met. Specifically, the court should review (1) the regulation, (2) its history, (3) the agency's view of the regulation's objective at the time it was promulgated, and (4) the agency's current view on the regulation's preemptive effect.[33]
- The current Administration appears to be unwilling to preempt state tort law.
    - The *Williamson* case demonstrated that the Court will accord significant deference to NHTSA's determination of a regulation's objective in evaluating its preemptive effect.[34] Some commentators went further to argue that an agency's position on preemption is

[23] 49 U.S.C.A. § 30103(b)(1) (West) (emphasis added).
[24] *Id.* § 30103(e).
[25] *See, e.g.*, Catherine Sharkey, *Product Liability Preemption: An Institutional Approach*, 76 GEO. WASH. L. REV. 449, 454 (April 2008) (indicating that Congress failed to address the preemption question through its vague statutory language which left the Supreme Court with inconsistent decisions) [hereinafter Sharkey: *Institutional Approach*].
[26] *Geier v. Am. Honda Motor Co.*, 529 U.S. 861 (2000).
[27] *Williamson v. Mazda Motor of Am., Inc.*, 131 S.Ct. 1131 (2011).
[28] *Geier*, 529 U.S. at 865.
[29] *Id.* at 867-68.
[30] *Id.* at 869-70.
[31] *Id.* at 886.
[32] *Williamson*, 131 S.Ct. at 1139-40.
[33] *Id.* at 1136.
[34] *Id.*

nearly determinative in the Court's final decisions.[35] Therefore, it is worth examining the different Administrations' positions on preemption.

- After *Geier*, the Bush Administration took a pro-preemption stance and conducted an aggressive preemption campaign to eliminate state common law tort liability.[36] After taking office, President Obama issued a Presidential Memorandum in 2009, in which he condemned the previous Administration's preemption practice and called on all federal agencies to review relevant regulations and decisions within the last ten years.[37]
- In response to the Presidential Memorandum, NHTSA drastically shifted away from its previous pro-preemption position in a series of rulemakings.[38] More notably, in August 2010 the solicitor general, on behalf of NHTSA, submitted an amicus brief to the U.S. Supreme Court in *Williamson*, arguing against preemption.[39] In the brief, the solicitor general outlined a sharply circumscribed view of the implied preemption under *Geier*, whereby NHTSA safety standards should generally be read as minimum standards unless the regulatory history demonstrates the agency's contrary affirmative policy.[40]
- In sum, the Obama Administration has brought a substantial shift in NHTSA policy away from federal preemption of state tort law, and this is likely to hold in the next couple of years for any state tort law related to autonomous vehicles.[41] But, the NHTSA has indicated that the ongoing first phase of its research is unlikely to be completed until 2017.[42] Therefore, NHTSA's ultimate determination on preemption of state tort laws related to AVs may depend on the policy of future Administrations.

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[35] *See, e.g.*, Sharkey, *Institutional Approach*, *supra* note 25, at 477; Kelly Savage Day, *Preemption of State-Law Tort Claims: Change of Heart in Federal Agencies*, The WLF Legal Pulse, available at http://wlflegalpulse.com/2010/10/26/preemption-of-state-law-tort-claims-change-of-heart-in-federal-agencies (last visited Nov. 4, 2014).

[36] *See, e.g.*, Thomas McGarity, *Curbing Abuse of Corporate Power: The Perils of Preemption*, 44-Sep Trial 20 (2008); Catherine M. Sharkey, *Inside Agency Preemption*, 110 MICH. L. REV. 521 (2012) [hereinafter Sharkey, *Agency*]; David C. Vladeck, *The Emerging Threat of Regulatory Preemption*, American Constitution Society for Law and Policy, available at https://www.acslaw.org/files/Vladeck%20Issue%20Brief.pdf (last visited Nov. 4, 2014); Catherine M. Sharkey, *The Politics of Preemption: NHTSA, State Tort Law & Automobile Safety*, Torts Prof Blog, available at http://lawprofessors.typepad.com/tortsprof/2010/10/guest-blogger-cathy-sharkey-on-the-politics-of-preemption-nhtsa-state-tort-law-automobile-safety.html (last visited Nov. 4, 2014) [hereinafter Sharkey, *Politics*].

[37] Preemption: Memorandum for the Heads of Executive Departments and Agencies, 74 Fed. Reg. 24,693, 24,693-94 (May 20, 2009) [hereafter 2009 Preemption Memorandum], available at http://www.gpo.gov/fdsys/pkg/FR-2009-05-22/pdf/E9-12250.pdf#page=1 (last visited Nov. 4, 2014).

[38] *See, e.g.*, Federal Motor Vehicle Safety Standards; Rearview Mirrors, 74 Fed. Reg. 9478 (proposed Mar. 4, 2009) (to be codified at 49 C.F.R. pt. 571) (replacing the previous rulemaking's preemption language with boilerplate language that stated that preemption of state law is merely a "possibility"); Federal Motor Vehicle Safety Standards, Child Restraint Systems; Hybrid III 10-Year-Old Child Test Dummy, 75 Fed. Reg. 71,648, 71,661 (proposed Nov. 24, 2010) (to be codified at 49 C.F.R. pt. 571); Federal Motor Vehicle Safety Standards; Electric-Powered Vehicles; Electrolyte Spillage and Electrical Shock Protection, 75 Fed. Reg. 33,515, 33,524 (June 14, 2010) (to be codified at 49 C.F.R. pt. 571) (stating that AAJ's discerning of preemptive intent in the boilerplate language fundamentally misunderstood the NHTSA's intent).

[39] Brief for the United States as Amicus Curiae Supporting Petitioner at 10-31, *Williamson*, slip op. (No. 08-1314).

[40] *Id*. at 9.

[41] *See, e.g.*, Day, *supra* note 35; Sharkey, *Politics*, *supra* note 36; Sharkey, *Agency*, *supra* note 36.

[42] Statement, *supra* note 7, at 8.

Appendix A

Recommendations to the ULC on drafting legislation that will avoid substantial federal preemption:
To avoid spending time and resources on regulations that the NHTSA is likely to preempt, states and the ULC *could* focus on regulating the following areas:

- **AV testing and test permitting:**
  - Designate the vehicle conditions that must be satisfied in order for manufacturers to obtain a test permit (such as the existence of a driver's seat, steering wheel, and pedals and that a driver must be able to reassume control).
  - Specify the necessary conditions for a test driver to obtain a permit (a clean driving record and completion of the manufacturer's training program).
  - Define the training program for test drivers that a manufacturer must satisfy (including requirements that an expert teach the training and that the trainee receive practical defensive-driving training).
  - Identify the preconditions for obtaining a permit for testing on public roads (e.g., that controlled tests be completed before applying for a permit for tests on public roads).
- **Insurance requirements:**
  - For testing (California and Nevada require that manufacturers who want to test AVs obtain $5 million in insurance or a bond).
  - For the eventual consumer operation of AVs.
- **"Endorsement" regimes for AV operators on their existing driver's licenses:**
  - Allow ordinary drivers to obtain "endorsements" for operation of AVs on public roads.
  - This could be as simple as a supplementary certification on one's existing driver's license.
- **Broad operational requirements for commercially-available vehicles of the future:**
  - The vehicle should be equipped with a means to easily engage/disengage AV technology (e.g., a button to engage AV technology and mechanisms to allow drivers to simply reassume control over the steering wheel in order to disengage the AV technology).
  - There should be a visual indicator telling the driver when AV technology is active.
  - Include a broad provision that requires the AV comply with state laws and federal safety standards before it can be driven.

Appendix B

Summary of Reports and Articles Addressing Autonomous Vehicle Liability

Numerous studies, reports, and academic articles have addressed the question of what, if any, changes to general rules of liability should be made to accommodate AVs. Their conclusions may be divided into three groups: Group One--those that believe the present is adequate and that the courts will be able to adapt it to whatever new challenges AVs present. Group Two--those that believe a significant change in the liability regime is necessary in order to either (a) achieve justice between injured parties and potential defendants or (b) prevent the development of AV technology from being unduly hindered. Group Three—those that believe it is too early to tell what must be done.

Within Group Two there is no consensus as to what must be done. Some writers argue that the law should impose strict liability on owners of AVs, others believe it is the manufacturers that should be strictly liable, while a third group of commentators would shield manufacturers and owners from some or all of the liability they would incur under the law as it now stands. None of those who propose a large-scale change in the law appears to anticipate that it would be done through legislation at the state level. To the extent they explain how their ideas should be implemented, they generally contemplate either federal legislation or judicial decisions changing the common law.

Below are summaries of some the writings from all three groups.

GROUP ONE WRITINGS

John Villasenor, *Products Liability and Driverless Cars: Issues and Guiding Principles for Legislation* (April 24, 2014), available at http://www.brookings.edu/research/papers/2014/04/products-liability-driverless-cars-villasenor

> This is a paper published by the Brookings Institution. The author is a professor of electrical engineering and public policy at UCLA. He has very impressive credentials. Although he is not a lawyer, his paper shows a good understanding of products liability law. He states that "[i]n some very specific, narrow respects, state-level clarity regarding autonomous vehicle liability can be beneficial." As an example of such a specific situation, he cites the state statutes exempting original equipment manufacturers from liability for automation systems installed by third parties. The author's overall conclusion, however, is that "[t]he 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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James M. Anderson, et al., *Autonomous Vehicle Technology: A Guide for Policymakers* (2014) available at http://www.rand.org/pubs/research_reports/RR443-1.html

This study by RAND Corporation notes that liability concerns may slow or limit the adoption of AVs. It discusses possible legislative or judicial action that might be taken to prevent this. Among other things, it discusses the possibility of a no-fault system, which it notes might be "politically unrealistic." It also discusses the possibility of creating an irrebuttable presumption that the driver (which would presumably include the person setting in motion a totally-autonomous vehicle) is in control of the vehicle. After discussing these possibilities, however, the authors conclude that the existing tort system should be allowed to sort out the issues:

> While it is certainly possible that liability concerns may delay introduction of some of this technology, legislative intervention in the tort system is complex and difficult. While there are some policy interventions that might reduce this risk, it is not clear they outweigh their disadvantages. The tort system serves important social goals of providing incentives for safety and compensating the injured, and interventions to reduce liability may do more harm than good. In contrast, it is easier for courts to continue to incorporate cost-benefit analysis in product-liability determinations.

Bryant Walker Smith, *Proximity-Driven Liability*, 102 Georgetown L. Rev. 1777 (2014) available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2336234

The author is Assistant Professor of Law at the University of South Carolina, a Fellow of the Center for Internet and Society at Stanford Law School, and a Fellow of the Center for Automotive Research at Stanford University. He is by far the most prolific author on the subject of legal aspects of AVs. In this article he argues that the ease with which sellers of products, particularly AVs, can gather data from their customers and provide customers with warnings, updates, and the like will cause courts to impose new duties to warn, update, or recall, etc. and that to avoid liabilities based on these new duties, sellers will make unprecedented efforts to monitor the use of their products and to remedy defects post sale.

GROUP TWO WRITINGS

Alice Guerra & Daniel Pi, *Robotic Torts: Liability for Autonomous Vehicles* (July 24, 2014) https://www.google.com/search?q=guerra+robotic+torts&ie=utf-8&oe=utf-8&aq=t&rls=org.mozilla:en-US:official&client=firefox-a&channel=sb# (follow the first link on this page)

The authors are economics professors at the University of Bologna. Using economic analysis, they determine that "a strict liability regime on manufacturers with a defence of comparative negligence on product users is an efficient and viable legal framework for fully-automated

technologies." The paper was written as a basis for further analysis, rather than as a plan to be adopted in any jurisdiction, so it says nothing about how its recommendations might be implemented or even whether such implementation is feasible.

Sophia H. Duffy & Jamie Patrick Hopkins, *Sit, Stay, Drive: The Future of Autonomous Car Liability*, 16 S.M.U. Science & Technology Law Review 101 (2013) available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2379697

The authors are, respectively, Assistant Professor of Employee Benefits and Assistant Professor of Tax, both at The American College in Bryn Mawr, Pennsylvania. Analogizing to the legal rules for liability of pet owners, they argue that owners of autonomous vehicles should be strictly liable for damage caused by their vehicles.

Kevin Funkhouser, *Paving the Road Ahead: Autonomous Vehicles, Products Liability, and the Need for a New Approach*, 2013 Utah L. Rev. 437 (2013) available at http://epubs.utah.edu/index.php/ulr/article/view/1097/810

The author, a law student, argues that the federal government should adopt for AVs a no-fault compensation scheme, "[t]he exact makeup of [which] is beyond the scope of this Note." The compensation scheme would be similar to that established by the National Childhood Vaccine Injury Act. Under that act, the federal government collects an excise tax on vaccines. The proceeds go to a trust fund that pays awards to persons injured by the vaccines.

GROUP THREE WRITINGS

Kyle Graham, *Of Frightened Horses and Autonomous Vehicles: Tort Law and the Assimilation of Inventions*, 52 Santa Clara Law Review 1241 (2012) available at http://digitalcommons.law.scu.edu/lawreview/vol52/iss4/4/

The author is assistant professor of law at Santa Clara University. Professor Graham quotes from another author, who writing about technology in general: "It is inevitable that legal disputes concerning [a] new technology will be handled under the preexisting legal scheme in the early stages of technological development. At this stage, there often will not be enough information and knowledge about nascent technologies to develop and modify legal rules." The actual article is more narrow than this. It notes that while some have argued that tort liability, unless restricted, may seriously impede the development of AVs, other new technologies have enjoyed a honeymoon period where lawsuits against manufacturers were limited by social factors and court decisions. He believes that manufacturers and users of AVs may similarly benefit.

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Gary E. Marchant & Rachel Lindor, *The Coming Collision Between Autonomous Vehicles and the Liability System*, 52 Santa Clara L. Rev. 1321 (2012) available at http://digitalcommons.law.scu.edu/lawreview/vol52/iss4/6/

> The authors are, respectively, Professor of Law and Research Director of the Center for Law, Science and Innovation at Arizona State University. The article discusses the way autonomous vehicle liability would be treated under existing law and concludes that liability concerns might become an impediment to the development of autonomous vehicles. It then suggests that if this occurs, state or federal legislation might be enacted to give limited or full immunity to manufacturers. The authors are supply few details of the legislation they contemplate, and they note that such legislation would reduce the incentive for manufacturers to improve the safety of their products. While this article could arguably be placed in Group Two, it is placed it in Group Three because it contemplates legislation only if and when manufacturer liability becomes a problem.

Autonomous Vehicle Law Report and Recommendations to the ULC

Based on Existing State AV Laws, the ULC's Final Report, and Our Own Conclusions about What Constitutes a Complete Law

Introduction: This report was created by the University of Washington's Technology Law and Policy Clinic for the Uniform Law Commission (ULC). It was created at the request of Robert Lloyd, Professor of Law at the University of Tennessee and a member of the ULC's subcommittee for autonomous vehicles. The report aims to do three things: (1) present the existing autonomous vehicle provisions on the books in California, Michigan, Florida, Nevada, and Washington, D.C.; (2) analyze these provisions, address related questions raised in the ULC's Final Report, and make recommendations to the ULC; and (3) offer draft provision language to illustrate our recommendations.

Our analysis sometimes favors select state provisions that we think get it right and sometimes creatively suggests provisions that no state has adopted. Professor Lloyd asked us to be forward-looking and creative in our thinking, particularly as it relates to provisions surrounding the deployment, sale, and consumer-operation of autonomous vehicles (relatively uncharted territory). This report reflects this charge, while attempting to firmly ground itself in the wisdom of existing state provisions and surrounding scholarship. The report starts by addressing definitional provisions, moves to provisions related to the testing and certification of autonomous vehicles, and concludes with provisions covering deployed and salable autonomous vehicles.

I. Definitions of an "Autonomous Vehicle"

- **State definitions**
  - Nevada: "A motor vehicle equipped with autonomous technology. . . . '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."[1]
  - California: "A vehicle operated without the active physical control or monitoring of a person." [2]
  - Florida: "Any vehicle equipped with autonomous technology. The term 'autonomous technology' means technology installed on a motor vehicle that has the capability to drive the vehicle on which the technology is installed without the active control or monitoring by a human operator."[3]
  - Michigan: "a motor vehicle on which automated technology has been installed, either by a manufacturer of automated technology or an upfitter that enables the motor vehicle to be operated without any control or monitoring by a human operator. The definition does not include a motor vehicle enabled with 1 or more active safety systems or operator assistance systems, … unless 1 or more of these technologies alone or in combination with other systems enable the vehicle on which the technology is installed to operate without any control or monitoring by an operator."[4]

[1] Nev. Rev. Stat. § 482A.
[2] Cal Vehicle Code § 38750.
[3] Fla. Stat. § 316.003.
[4] Mich. Comp. Laws § 257.2b.

- **Recommended definition:** An "autonomous vehicle" is a motor vehicle equipped with autonomous technology that can drive the vehicle without the active physical control or monitoring of a human for any duration of time.
    - **Addressing concerns raised in the ULC Report by adding "any duration of time":** This addition may address the concern raised in Section II of the ULC Subcommittee's November 15 Final Report – that some manufacturers might claim their vehicles are not "autonomous" because they require active monitoring most of the time, even while expecting consumers to use the car's autonomous capabilities in certain contexts (like freeway driving). By adding "any duration of time", the legislation would cover some Level II automated vehicles that combine lane-centering, lane changing, and/or speed modulation to allow automation without active human control and monitoring during limited highway driving. Such combined-function technologies present significant risks (possibly more risks than Level Three and Four AVs), and yet may fall outside regulation if the definition of autonomous vehicle is not appropriately nuanced.

      Alternatively, if the ULC would rather not capture combined-function, Level Two AVs under its primary "autonomous vehicle" regulatory framework, we suggest addressing the risks in a stand-alone provision for such technologies (discussed at the end of this report). This might require manufacturers to develop systems to warn users that they must *actively* monitor the road and vehicle while the technology is functioning. In general, we recommend the ULC anticipate a hodge-podge of automated vehicles on the road, from Levels One through Four, and that it draft legislation covering all four levels of automation. While it is possible that the term "autonomous vehicle" should be exclusively reserved for Level Three and Four AVs, the draft law should nevertheless address Level One and Two autonomous technology. This is in no small part because manufacturers will widely deploy such technology sooner than Level Three and Four technology.
- **Additional recommended definitional language**
    - The term "autonomous vehicle" does not include vehicles with independently-functioning automated systems, such as blind spot detection, emergency braking, adaptive cruise control, lane keeping, and lane changing.
    - The term does apply to a vehicle employing any combination of these automated systems that allows driving without active human monitoring and control for any duration of time.
    - Manufacturers deploying combined-function autonomous technology that allows a vehicle to function autonomously in limited contexts, but who do not consider the vehicle an "autonomous vehicles," must adequately warn users to *actively monitor* the road and system while the technology is engaged.
    - Common terms that should be defined (and are by most states with laws on the books):
        - "Autonomous technology" is technology installed on a motor vehicle that can drive without the active physical control or monitoring of a human operator for any duration of time.
            - Note: A car can have automated technology (such as Level One and Two automated vehicles) and yet not be an "autonomous vehicle".
        - A vehicle is in "autonomous mode" when its autonomous technology is engaged and operating the vehicle without the active control or monitoring of a human.

- Note: This term is likely to be highly relevant for the foreseeable future as Level Three autonomous vehicle operators switch their AVs in and out of autonomous mode. As will be discussed, potential liability between the manufacturer and driver shifts every time "autonomous mode" is engaged or disengaged.

- **Recommended categories for AVs at different stages in testing and certification**
  - **A "private-test autonomous vehicle"** is a vehicle that can operate in private, controlled environments without the active physical control or monitoring of a person.
    - Note: Such vehicles require no state permitting, but companies are subject to basic negligence and work-place-safety common law standards.
  - **An "unlimited public-test autonomous vehicle"** is a state-permitted vehicle that a manufacturer must reasonably conclude and certify can operate safely and lawfully on any public road under all foreseeable testing conditions without the active physical control or monitoring of a person.
  - **A "limited public-test autonomous vehicle"** is an autonomous vehicle with a limited state permit for testing on certain public roads on which the manufacturer must reasonably conclude the vehicle can be safely tested under certain testing conditions without the active physical control or monitoring of a person.
    - Note: This allows for a more gradated approach between controlled private testing and completely unlimited public testing. Permits can be granted for testing on only certain types of roads (e.g. residential roads) and under limited driving conditions (e.g. day driving). More on this below.
  - **A "certified autonomous vehicle"** is a state-certified vehicle that has demonstrated that it can operate safely and in compliance with state and federal laws without the active physical control or monitoring of a person. The vehicle is certified for deployment, sale, and use by consumers.

II. Regulation of the Testing of Autonomous Vehicles

- **Insurance requirements for testing**
  - **State provisions**
    - Three states - California, Nevada, and Florida - have the same requirement: Manufacturers must have a $5 million insurance policy, take out a $5 million bond, or make a $5 million deposit or bond with the DMV as proof of financial responsibility and the ability to cover possible liabilities for damage to persons and/or property.[5]
    - Michigan does not have a minimum dollar-value requirement, but requires the submission of proof to the Secretary of State that a test vehicle is insured.[6] Manufacturers need only buy the insurance other drivers would buy, but they must submit proof of having bought such insurance before testing (a higher burden than on other drivers).
  - **Recommendation:** We agree with the ULC's Final Report that there does not seem to be a clear need for a $5-million-minimum insurance requirement, or any specified minimum amount. There is no evidence that test vehicles will be more dangerous on the

[5] Nev. Rev. Stat. § 482A.060; Fla. Stat. § 316.86; Cal. Vehicle Code § 3875(b)(3).
[6] Mich. Comp. Laws § 257.665(1).

road than ordinary vehicles and their drivers. Nor is there evidence that an ordinary car insurance plan would be unable to cover the costs of an accident, should one occur. Insurance companies will also be in the best position to price their insurance premiums for specific manufacturers according to a myriad of risk factors.

The ULC draft should, however, include a provision making it clear that AV manufacturers must acquire some insurance before beginning testing on public roads. It may also want to require proof of insurance be submitted to the Secretary of State, as in Michigan. This would set a minimum standard that creates the potential for state review of the adequacy of insurance without setting a barrier to entrepreneurs had can't afford expensive insurance. We, therefore, support Michigan's approach.

- **Suggested draft language along Michigan's lines:** Manufacturers testing autonomous vehicles on public roads must purchase insurance capable of adequately covering foreseeable liabilities for damages to persons and/or property proximately caused by testing. Manufacturers must provide proof of purchase [to the Secretary of State or DMV] prior to beginning testing.

- **Requiring that test drivers can reassume control (driver's seat, steering wheel, etc.)**
  - **State provisions**
    - In California, Nevada, Michigan, and Florida, test drivers must be able to reassume immediate control at any time in the event of an AV failure or emergency, which requires two things[7]:
      - There must be a driver's seat with a steering wheel and pedals.
      - The driver must be in the driver's seat and monitoring safe operation at all times.
  - **Recommendation:** The ULC should adopt this logical provision. However, it may also want to provide an avenue for exceptions, vehicles without steering wheels (level four vehicles) can be tested on select or all public roads. Language such as, "unless otherwise permitted by state regulatory authorities," would create a range of possible future exceptions that the DMV might make to allow for completely driverless cars, without steering wheels and pedals, to be tested first on portions of public roads and eventually on any public roads. Because we believe such completely driverless cars are an eventuality, they should be contemplated in any draft legislation.
  - **Recommended provision language:** Unless otherwise permitted by state regulatory authorities, licensed test drivers on public roads must be able to immediately re-assume full control of the vehicle at any time in the event of an AV failure or emergency. This requires that the driver is actively monitoring the roadway and performance of the autonomous vehicle while seated in the driver's with immediate operational access to the steering wheel and pedals.
  - **[A more optional provision on when test drivers *must* re-assume control**
    - Test drivers must re-assume control of an autonomous vehicle if the autonomous technology appears to be failing, violating state and/or local traffic laws, endangering persons or property, or when such intervention is necessary to accommodate the efficient flow of traffic.
      - The purpose of this type of a provision is to counter any incentive for test drivers to not intervene in order to avoid the obligation to report an

[7] Cal. Regs. § 227.18; Nev. Rev. Stat. § 482A.060; Mich. Comp. Laws § 257.665(1).

intervention or to see if the autonomous vehicle can maneuver on its own in a dangerous situation. More on this below.]

- **Required reporting of evasive disengagement from autonomous mode, crashes, near misses**
  - **State provisions:** California requires that manufacturers must collect and report to the department data related to disengagement from autonomous mode by the test driver resulting from a failure of the autonomous technology.[8] Nevada regulations require the reporting of any accident or traffic violation occurring during autonomous vehicle testing.[9] The NHTSA recommends that states require manufacturers report incidences in which a test vehicle is involved in an accident or a near crash, or where the driver is required to take control due to an inability of the automated vehicle to function properly in certain conditions.[10]
  - **Recommendation:** Requiring the above reporting is important as it creates a safety check that the public will expect. But, states may not want too much reporting because it requires compiling the information and reviewing it, which implicates some potential burdens and costs for manufacturers and the state. California attempts to strike a balance by requiring reporting crashes within 10 days and near-misses and incidences of disengagement once a year. The 10-day requirement for crashes makes sense, as this is what DMVs should be most concerned about. But, we also think any traffic citations should be reported within 10 days as well. California's one-year reporting requirement for incidences of disengagement and near misses is also probably too lax – allowing potentially dangerous testing operations to continue on public roads for a year. A biannual or quarterly reporting requirement seems more appropriate if the state is truly interested in checking hazardous testing operations. It should also be noted that listing incidences of near-misses and disengagement from autonomous mode does not seem highly burdensome for manufacturers (this is data test drivers should be collecting anyway). Nor does it seem highly burdensome for the state to read a two or ten page list of these incidences a couple times a year and make a basic determination as to any abnormal hazard. We therefore recommend at least a biannual reporting requirement of disengagements and near-misses.
  - **Recommended provision language**
    - Manufacturers must report within 10 days any accident involving a public-test autonomous vehicle in autonomous mode that results in personal injury or property damage. Manufacturers must also report within 10 days any traffic citation involving a public-test autonomous vehicle in autonomous mode.
    - Manufacturers must continually collect and report biannually to the DMV data related to: disengagement from autonomous mode by the test driver resulting from a failure of the autonomous technology or the inability of the automated system to function in certain conditions; near accidents with other vehicles, bikers, or pedestrians; and any other incidents in which the autonomous vehicle put persons or property at risk.
    - Manufacturer can report this information in any appropriate form and can submit accompanying comments and explanations of incidents. Manufacturers

[8] Cal. Regs. § 227.46.
[9] Nev. Regs. § 10.4.
[10] NHTSA Study at 12.

must certify that all reports are complete and accurate under penalty of perjury. Based on submitted reports, the DMV reserves the right to make a determination as to whether a manufacturer's testing must be limited in scope as to geography or conditions or whether the manufacturer's permit must be suspended or permanently revoked.

- **Geographical and environmental categories – limited public-test permits**
  - **State provisions**
    - California, Michigan, and Florida have no geographical limits for testing. AVs can be tested on any public road, assuming they meet the standard for certification.[11]
    - Nevada is more nuanced, allowing unlimited permits and limited permits for testing on public roads in six different "geographic categories" and five "environmental types." [12] The idea is to "allow applicants to determine which locations they have proven testing experience in, and which locations they would like to apply for on their testing license."[13]
      - **Six geographical categories**
        - Interstate highways
        - State highways
        - Urban environments
        - Complex urban environments
        - Residential roads
        - Unpaved or unmarked roads
      - **Five environmental types**
        - Night driving
        - Rain
        - Fog
        - Snow/Ice
        - High crosswinds (gusts above 30 mph)
  - **Recommendation:** We recommend a hybrid between California and Nevada's approaches. It is (and should be) very challenging to meet the standards for an unlimited public-test permit that would allow an AV to, for example, drive in the worst downtown traffic, at night, and in pouring rain. Recognizing that there is a huge gap between such forms of unlimited public testing and controlled private testing, Nevada's approach allows manufacturers to apply for more limited testing permits with presumably less demanding requirements. This allows manufacturers to more quickly transition from controlled private testing to limited forms of public testing, facilitating experimentation and innovation at the same time as minimizing public risks. The downside is that it may involve a manufacturer applying for multiple modified permits over the course of a few years as its competency grows, thus creating greater state permit-review burdens. However, because states can expect only a handful of manufacturers to be testing AVs and thus only a handful of permit applications each year, these burdens seem manageable and worthwhile.

[11] Cal. Regs. § 227.00(b); Mich. Comp. Laws § 257.665(1); Fla. Stat. § 316.86.
[12] *Nevada Autonomous Vehicle Testing License,* NEVADA DEPARTMENT OF MOTOR VEHICLES, (Revised: December, 2013) http://www.dmvnv.com/pdfforms/obl326.pdf
[13] *Id.*

- **Suggested language:** Applicants can seek one of two forms of permits: (1) An Unlimited Public Test Permit allowing testing on any public road if an applicant reasonably believes, and can demonstrate in its application based on controlled tests, that its autonomous vehicle can safely operate on *any* public road in *any* conditions; (2) A Limited Public Test Permit, if the applicant reasonably believes, and can show in its application based on controlled tests, that its autonomous vehicle can safely operate in limited categories of public roads under limited environmental conditions. For a Limited Public Test Permit, manufacturers can apply to test within any combination of the following road-types and environmental conditions:
    - **Six road types**
        - Interstate highways
        - State highways
        - Urban environments
        - Complex urban environments
        - Residential roads
        - Unpaved or unmarked roads
    - **Seven environmental conditions**
        - Day driving
        - Night driving
        - Clear weather (no precipitation, visual limitations, severe wind)
        - Rain
        - Fog
        - Snow/Ice
        - High crosswinds (gusts above 30 mph)

  Manufacturers can later apply to expand the scope of their testing permit to include a greater number of road types and environmental conditions or to apply for an Unlimited Public Test Permit.

- **Autonomous vehicle and test-driver permitting requirements**
    - **Requirement of completion of controlled testing before permitting for public roads**
        - **State provisions:** California requires for permitting: Manufacturers must have completed prior controlled tests that simulate real-world conditions before putting their vehicles on public roads, and the manufacturer must reasonably conclude that the vehicle is safe to operate on public roads.[14] Nevada requires that a vehicle be driven in autonomous mode for "not less than 10,000 miles."[15] It also requires manufacturers "provide proof that such autonomous vehicle or vehicles of the applicant have been driven in various conditions for a number of miles that demonstrates the safety of the vehicle or vehicles in those conditions" for which they seek a permit.[16]
        - **Recommendation:** Use a hybrid of California's and Nevada's rules here. The "reasonably conclude" standard that California uses is a tort standard. It is likely included to hold manufacturers liable if an accident occurs during testing and a reasonable person in the same position looking at the results from the

[14] Cal. Regs. § 227.24(b).
[15] Nev. Rev. Stat. § 482A.110(3)(b).
[16] *Id.*

controlled tests would have concluded that it was unsafe to start testing on a public road. This will provide a substantial check on manufacturers rushing forward without adequate controlled testing.

- **Requiring manufacturer certification that AV is safe for public testing:** The ULC could go a step further than California and require that: A manufacturer must certify, based on the results of controlled testing, that it has reasonably concluded testing can be safely performed on public roads.

  Requiring that manufactures sign this type of a certification during permitting could provide an additional layer of assurances to deter manufacturers that have no business testing on public roads.
- **Requiring presentation of objective evidence to the DMV:** The ULC's draft could also require, like in Nevada, that manufacturer present proof, objective evidence based on controlled testing, that testing can be safely performed on public roads. Such proof requirement seems logical, as the DMV must approve or disapprove applications based on objective evidence.
- **Requiring 10,000 miles in controlled settings:** Nevada's requirement that manufactures test their AV models for no less than 10,000 miles in controlled conditions before applying for a public-test permit is certainly a significant hurdle for manufacturers. However, it also seems to be a reasonable one. Manufacturers should not be working out basic kinks on public roads, where lives are at risk. 10,000 miles seems a sound number to ensure a vehicle model is reasonably safe to test on public roads. An ambitious tester could log 10,000 miles in two or three months' time. The downside for smaller manufacturers may be that access to suitable private roads may be limited or costly. But, the alternative of allowing novice testers on public roads is not tolerable.
- **Requiring manufacturers submit a plan to minimize risks:** As suggested by the NHTSA, a manufacturer could be required to submit a specific plan to minimize the risks of their testing.[17] This seems to be a reasonable request of manufacturers, as it is something they should be contemplating in any case. While this is another document that the state must review, it would be highly relevant to any determination to grant or deny a permit for public-road testing. And, again, because we expect only a handful of manufacturers will apply for public-road test permits each year in any given state, DMVs should be able to review these application materials without great difficulty.

- **Requiring fees to cover costs of DMV reviewing manufacturers' applications:**
  - **State provisions:** California requires that manufacturers must pay a fee of $150 to submit their application, allowing the operation of up to 10 autonomous vehicles and up to 20 autonomous vehicle test drivers.[18] Manufacturers may

[17] NHTSA Statement at 11.
[18] Cal. Regs. § 227.26(a)(1).

add additional sets of 10 vehicles and 20 drivers by submitting a fee of $50 for each set of 1 to 10 vehicles and 1 to 20 drivers.[19]

- **Recommendation:** The ULC could follow a similar model to California, but possibly suggest that states create flexible fee structures for applications, test-vehicle permitting, driver licensing, and final certifications that could fully cover cost burdens to the state. This would respond to the Final Report's concerns regarding costs in cash-strapped states. The ULC could provide a model provision requiring that DMVs develop fee structures resulting in cost-neutrality to the state. Motivated for-profit manufacturers would likely be willing to pay such fee structures, assuming they are within reason.

- **Require Manufacturer Certificates of Compliance**
  - The ULC Final Report raised the issue that requiring state approval of each individual test vehicle might be too great a burden for the state. It pointed to Nevada's approach as a possible solution, where manufacturers are allowed to issue "certificates of compliance" for the autonomous technology they intend to test on one or more of its autonomous vehicles.[20] These certificates must affirm that the autonomous technology allows for safe operation on public highways and that it includes a switch to engage and disengage the autonomous technology and a system to alert the operator to take control if a failure is detected, among other requirements. The key is that the certificates of compliance are for the autonomous technology itself, which can be tested on multiple vehicles. The state would, therefore, merely review the autonomous technology, the certificate of compliance for it, and the results in controlled tests of this technology. The state would not review applications for each individual vehicle. This is a sensible approach that limits the burden on the state while holding manufacturers accountable.
- **Test-Driver Permit and Training Requirements**
  - **Test driver permitting:** California requires that test drivers must obtain a Test Vehicle Operator Permit from the state. This requires that the test driver complete the manufacturer's autonomous vehicle test-driver training program in order to obtain the permit.[21] The test driver must also have a clean driving record with no at-fault accidents resulting in injury or death and no convictions for driving under the influence of intoxicants in the past 10 years.[22] Florida and Michigan, by contrast, require only a regular driver's license to test.[23]
    - **Recommendation:** The ULC should probably follow California's approach, setting a requirement that test drivers must complete a manufacturer's training program, but not requiring that state government itself create a training program (an expense and challenge states are unlikely to accept). As in D.C., the law should require that applicant test drivers certify that they have completed the course.[24]

[19] Cal. Regs. § 227.24(a)(2).
[20] Nev. Rev. Stat. § 482A.110(2).
[21] Cal. Regs. § 227.20(a).
[22] Cal. Regs. § 227.20(b).
[23] Fla. Stat. §316.85(1); Mich. Comp. Laws § 257.665(2)(c).
[24] D.C. Regs. § 114.1.

        - **Test driver training program:** California requires that the test-driver training program must instruct on AV automated technology and provide behind–the-wheel instruction by an experienced driver on the capabilities and limitations of the vehicle. It also must provide defensive driver training, including practical experience recovering from hazardous driving scenarios.
            - **Recommendation:** The ULC should adopt this provision in its entirety.
    - **Requiring two test drivers – a driver and co-driver**
        - **Recommendation:** Nevada requires two licensed drivers in a test vehicle.[25] This is an onerous and duplicative requirement – what is the co-driver doing that the primary test driver is not already doing? Only one driver can intervene if the AV system fails. If the test driver is required to be attentive, he or she should be entrusted to monitor the car alone without a co-driver. Requiring a second driver also dramatically increases the costs of testing. The ULC should avoid this approach.
    - **Responding to ULC Final Report Inquiry on Test-Driver Permitting for Each AV**
        - The Final Report reads: "We further recommend that the drafting committee consider whether a person (an individual or entity) would be issued a blanket permit for all of the autonomous vehicle testing to be done by that person or whether they would be required to obtain individual permits for each individual autonomous vehicle or each model of autonomous vehicle to be tested."[26]
        - **Recommendation:** We believe a test driver's completion of a manufacturer's training program certifies the individual to drive any of that manufacturer's autonomous vehicles (assuming they deploy the same basic autonomous technology). The job function is the same in each vehicle – to monitor the operations and reassume the standard wheel/pedal controls in the event of an abnormal or unsafe occurrence. This relatively basic role suggests a single test-driver permit for any of that manufacturer's AVs is all that is required. If a test driver tests for multiple manufacturers (a contractor), it is probably reasonable to require them to receive training by each manufacturer for their specific technology and certify that they have received this training.
- **Who must conduct the testing – employees, contractors, designees**
    - **State provisions:** California requires the manufacturer itself must conduct the testing and test drivers must be employees, contractors, or designees that the manufacturer certifies and authorizes to operate the vehicle.[27]
    - **Recommendation:** This seems like a reasonable provision to ensure clear lines of responsibility and liability back to the manufacturer.
- **Requiring manufacturers to identify their test vehicles and license plates with the DMV**
    - **State provisions:** California requires that in order to test a permitted autonomous vehicle on public roads, a manufacturer must identify the vehicle, its make and model, and its license plate to the DMV.[28] The permit must be carried at all times in the vehicle.

[25] Nev. Regs. § 10.2.
[26] ULC Final Report at 5.
[27] Cal. Regs. § 227.34(a).
[28] Cal. Regs. § 227.16(a).

This does not mean that license plates or test vehicles must be marked in any way for visual identification (addressed later).

- **Recommendation:** This provision makes clear sense and should be included by the ULC. Any vehicle on public roads should be registered with the state and have a license plate.

- **Blanket lawful-driving requirement for test vehicles**
  - **State provisions:** California requires that the test vehicle and driver must obey all provisions of the state Vehicle Code and the local highway laws.[29]
  - **Recommendation:** This is a good blanket, gap-filler provision. But it also requires some exceptions – for example, from distracted-driver laws.
  - **Recommended provision language:** Operators of autonomous vehicles must obey all provisions of the state Vehicle Code and state and local highway laws, unless otherwise specified here.

III. Requiring Special License Plates for Test and/or Deployed AVs

- **State provisions:** Nevada provides for a special license plate for testing (red ones) and deployment (green ones)[30], as does D.C.[31]. Michigan, which only allows for testing, also requires special plates on test cars.[32]
- **Recommendation:** Colored plates for test vehicles (red) and for deployed vehicles (green) makes sense. But this alone is not sufficient. We recommend, in addition to colored plates, manufacturer-provided and correspondingly-colored lighting arrays surrounding AV license plates (again, red lights for a test vehicle and green lights for a deployed/certified vehicle). The lights would automatically turn on when the autonomous vehicle is in autonomous mode and turn off when the vehicle is in manual mode. The light indicator would be required by law and the costs borne by the manufacturer.

  This approach acknowledges that the majority of autonomous vehicles will not, for the next couple decades and possibly indefinitely, always operate in autonomous mode; drivers will frequently engage and disengage the technology as their preferences demand and as the circumstances require (more on this below). Therefore, an ideal visual identifier must indicate whether the vehicle is, at any given moment, operating in autonomous mode. A colored license plate does not achieve this goal. A simple colored lighting system around the license plate (and possibly also by the sensors on top of the vehicle) would achieve this goal.

  There are many merits to a colored-license-plate and lights-based model for identifying autonomous vehicles and whether they are operating in autonomous mode:

  - First, it puts law enforcement officers on notice as to what they are dealing with, which could be highly relevant during traffic stops and to an officer's understanding of whether the autonomous technology or the human operator were in control at the time of an incident (e.g., does the officer need to conduct a field sobriety test or was it the autonomous technology that was causing the swerving?). It would also be critical to an officer's testimony following accidents or crimes regarding whether they observed the vehicle in or out of autonomous mode.

[29] Cal. Regs § 227.18(c).
[30] Nev. Regs. § 6.3.
[31] D.C. Regs. § 436.
[32] Mich. Comp. Laws § 257.225.

- Second, it enables bystanders and victims to testify as to whether the autonomous-mode lights were on prior to an accident. This is critical to tort liability challenges surrounding AVs (addressed further below), where the manufacturer's liability or the driver's liability will depend on whether the vehicle was in or out of autonomous mode.
- Third, colored license plates with lighting arrays will put other drivers on notice that they should not drive erratically around the vehicle, and perhaps they will give autonomous vehicles extra berth as a result. With regard to concerns that other drivers might toy with or test an autonomous vehicle so identified, this would probably be a very rare occurrence – it is more likely that other drivers will be more cautious than otherwise out of concern for their *own* safety. Behavior designed to create hazards for autonomous vehicles would almost certainly be covered under reckless driving statutes. To make it explicit and to deter bad apples, however, the draft statute could clarify that meddling with the testing or operation of an autonomous vehicle is considered reckless driving or worse as the facts may dictate.
- Fourth, these indicators will alert other drivers that hand gestures or eye contact toward a driver in an AV in autonomous mode will be ineffectual. This allows other drivers to focus their attention on an autonomous vehicle's basic cues and to conduct their own driving in deliberate ways that the AV can readily understand (turn signals, pauses, clear forward motion, etc.).
- Fifth, it alerts pedestrians, construction workers, and traffic police that verbal communications directed at the driver may be ineffectual. For construction workers and police officers, the light indicator may suggest to them that they use very deliberate hand signals that the AV can interpret and respond to.

IV. Requiring Crash Data Recorders on Test and/or Deployed AVs

- **ULF Final Report recommendation:** The subcommittee recommended that the drafting committee consider an optional (bracketed) provision setting forth requirements for an installed crash data recorder on test or deployed autonomous vehicles.[33] We have drafted below what such a provision might look like and offer our recommendations.
- **State provisions and NHTSA recommendations:** California requires crash data recorders for autonomous vehicles sold to the public with detailed requirements for their use, but it does not require them for testing.[34] Nevada requires recorders on autonomous vehicles used for testing as well as autonomous vehicles offered for sale to the public.[35] The NHTSA recommends test vehicles have crash-data recorders.[36]
- **Recommendations:** Recorders should probably be required for both testing and deployment, but at a minimum they should be required for deployment.

  The benefits of crash data recorders in deployed vehicles will be substantial in helping resolve tort and criminal liability questions (important public interests). The driver could be liable (because the vehicle was not in autonomous mode and crashed because the driver made a mistake) or the manufacturer could be liable (because the vehicle was in autonomous mode and the autonomous technology malfunctioned). Data recorders will help resolve these civil or

[33] ULC Final Report at 12.
[34] Cal. Vehicle Code § 38750(c)(1)(G).
[35] Nev. Regs. §§ 8.2(b) & 16.2(a).
[36] NHTSA Statement, page 14, paragraph III.D.

criminal liability issues by answering the question: "was the vehicle in autonomous mode when the collision or incident occurred?" It may also help assess precisely when the accident occurred and any abnormal events leading up to the crash – for example, whether the autonomous mode had been disengaged by the driver immediately before the accident or whether the autonomous mode had been engaged immediately before the accident. It may also be critical in assessing which part of the AV system failed and the need for any recalls or fixes.

The benefits of recorders in the testing phase are similar, but a little different. If an accident does occur with a test autonomous vehicle, the state will be in a position with the data recorder to assess what exactly when wrong, who was at fault, whether the manufacturer was liability, whether it was the technology or test driver's fault, and whether the failure requires suspending or revoking the manufacturer's permit to test on public roads. This data will also ultimately affect the decision of the state to certify the vehicle. The recorder will be less valuable in determining whether the test driver or manufacturer are liable (because they are one and the same, assuming a driver is acting within the scope of his employment when an accident occurs). Nevertheless, determining whether an accident or malfunction is the result of test-driver or vehicle error is valuable information both to the state and to the manufacturer. It will allow manufacturers to understand the malfunctions that cause accidents and to learn and respond, and, again, will allow the state to assess worthiness for certification.

V. Regulation of the Operation of Deployed AVs

- **Requiring that State DMVs Draft Requirements Regarding Deployment**
  - **State provisions:** Nevada requires that the DMV adopt specific regulations for the operation of autonomous vehicles on public roads prior to their deployment.[37]
  - **Recommendation:** This makes sense. State DMVs will be able to promulgate more specific provisions related to autonomous vehicles. However, the interest of uniformity does suggest that some level of detail be provided in the ULC's draft legislation itself. Moreover, state legislatures have an interest in passing a relatively detailed framework through its more democratic and accountable process.
  - **Suggested draft language:** The DMV shall make all necessary regulations of autonomous vehicles appropriate to carry out the purpose of this act within one year of enactment of this law. The DMV must adopt regulations authorizing AVs on public roads prior to their deployment and commercial sale.
- **Broad Requirement that the Operation of AVs Must Meet Federal and State Traffic Standards**
  - **State provisions:** Nevada requires that any deployed autonomous vehicle must meet federal standards and regulations for operation on public roads and comply with all state traffic laws.[38]
  - **Recommendation:** The ULC should include the same requirement, and may want to list some of the basic state and federal requirements with which any AV technology must comply (just as any human driver must comply). This will help clarify for manufactures the specific requirements their technology must meet to drive on public roads. It will also clarify for legislators and the broader public the minimum requirements for the technology. These requirements include that an autonomous vehicle must be able to:

[37] Nev. Rev. Stat. § 482A.100.
[38] Nev. Rev. Stat. § 482A.190.

- **Drive within the speed limit at all times in all speed zones**: Obeying 25 mph speed limits in residential areas, 35 mph speed limits on arterials, slower speed limits in school zones and around construction sites, speed limits around difficult turns, 55 mph speed limits on certain highways, 65 mph limits on others. This will demand that an Autonomous Vehicle's software have both continually updated information on these various speed zones and sensors aboard that can read road signs and adjust speed accordingly.
- **Read traffic lights, road signs, and road markings and respond appropriately:** Autonomous vehicles must be able to distinguish a green light from a red light, a blinking red light from a constant red light, a turn light from other lights, a yield sign from a stop sign, a merge sign from a turn sign, and markings on roads indicating a lane is for turning or indicating bikes have a right to the shoulder of the road.
- **Respond appropriately to temporary road signs to merge, slow, detour:** Not all road signs are permanent, so a simple database of expected road signage will not suffice. The vehicle must be able to respond to temporary and unexpected signage, following the instructions to slow, merge, take a detour, etc.
- **Respond to turn signals from other drivers:** An autonomous vehicle must be able to respond to turn signals from other drivers. This is essential at intersections, particularly where a turn signal from another driver indicates whether it is safe for a vehicle to proceed in the intended direction. It is also critical on freeways, where another driver may be signaling intent to merge.
- **Give turn signals with appropriate notification:** An autonomous vehicle must be able to signal at an appropriate time the vehicle's intention to turn or merge.
- **Yield to pedestrians:** AVs must be able to yield to pedestrians at crosswalks and recognize that they are intending to cross. They must also recognize when a pedestrian is in the road way outside of designated crosswalks and keep a safe distance.
- **Avoid collisions with bikers:** AVs must be able to avoid collisions with bikers, recognizing when they are near and keeping a safe distance. With bike commuting increasing in popularity, and cities accommodating such commuting, AVs must be able to recognize when bikers are present and to safely respond.

Additional requirements where AVs may need to actively give control back to a human

- **Respond appropriately to ambulance or police sirens and lights:** An autonomous vehicle must be able to respond appropriately to sirens and flashing lights or hand control back to a human driver to respond. If the sirens and lights are close enough, the vehicle must be able to safely pull over. Or, the vehicle must notify the driver that the autonomous technology needs human intervention to decipher the circumstances and respond appropriately.
- **Respond to signals from construction employees and traffic police:** AVs must be able to recognize temporary signage held by construction employees, such as "stop" and "slow" or safely hand back control to a human to respond. They must also be able to decipher signals from traffic police in the street, such as hand signals and light-wand signals, or notify the driver that the autonomous technology needs human intervention.

        - **Park safely and legally:** An autonomous vehicle must be able to park itself safely and legally or safely hand back control to a human to do so. The vehicle must be able to, as the circumstances require, park parallel, at an angle, or straight in, or notify the driver that human intervention is required. An autonomous vehicle must obey the speed limit in parking lots and garages and be capable of responding to sudden changes, such as a vehicle pulling out of a spot, a door opening and obstructing the way, or a person darting across the way in a parking space, or it must be able to notify the driver that their assistance is required to navigate these challenges.
    - **Why summarize and list these basic as well as advanced requirements?** It creates a clear and transparent expectation among both legislators and manufacturers about the challenges AVs must surmount in order to become commercially salable either as Level Three autonomous vehicles (autonomous, but allowing human intervention) or Level Four autonomous vehicles (fully autonomous and allowing no human intervention). In this sense, it will help guide AV innovations toward certification and commercial sale.
    - **What this list says about the challenges facing full level 4 automation:** We believe the above list highlights the immense hurdles AVs must overcome to achieve full, Level Four automation, where human intervention is not required and not even allowed. We conclude, therefore, that fully autonomous vehicles (with not steering wheels, etc.) are at least a decade away. We also believe that the market for fully autonomous Level Four AVs will be limited even once the technology is ready. This is because consumers will continue to enjoy aspects of manual driving and will prefer the ability to choose between manual and autonomous driving. In addition, drivers will always have compulsive intermediate destinations (e.g., because their kids in the back seat ask to stop at the ice cream store or because they remember they need to get milk at the grocery store). Drivers will likely prefer the ability to reassume control and make these quick route changes. Lastly, drivers will probably distrust fully autonomous vehicles for the next decade or two, particularly on roads remaining dominated by human drivers.

      For these reasons, we believe it is critical that any ULC law focus on provisions that accommodate Level Three autonomous vehicles that can switch between autonomous mode and manual mode. “Autonomous mode” is likely to be the most important term surrounding autonomous vehicles, and the law must include provisions that manage its implications.

      Part of the challenge will be deciphering between circumstances an AV must be able to handle in “autonomous mode” and ones it is permitted to hand back over to a human driver. The law should allow deployment of autonomous vehicles that *cannot* handle *all* circumstances on the road, but that *can* properly identify the situations they *cannot* handle and notify the driver that human intervention is required. The law must, however, require a *baseline of requirements* that any autonomous vehicle must meet without any human intervention (basic road-safety requirements, as outlined above), and decipher those requirements from circumstances where the vehicle can notify the driver that human assistance is needed.
- **Whether to require operators to actively monitor AV (no, but require passive monitoring)**
    - **Recommendation**: Drivers should not be required to actively monitor an autonomous vehicle while it is in autonomous mode, and this should be explicitly stated in the draft legislation. But, drivers should be required to *passively monitor* the roadway, including

staying awake, alert, upright, maintaining at least peripheral eye contact with the road, and occasionally checking that the autonomous vehicle is operating correctly. While we may be able to rely on autonomous vehicles with one-hundred percent confidence in the medium-to-long-term, the below provisions should be required in the interim. By adding "until state or federal regulations permit otherwise," the state creates flexibility to adopt laws in the future allowing for zero human monitoring and full Level-Four automation.

- **Recommended provision language:** Drivers need not actively monitor an autonomous vehicle and the roadway while the vehicle is in autonomous mode. However, until state or federal regulations permit otherwise, a driver of an autonomous vehicle must passively monitor the roadway and vehicle at all times. This requires, at a minimum, that the driver:
  - Faces the roadway in an upright position
  - Remains awake, alert, and unimpaired
  - Maintains at least peripheral eye-contact with the road in front during forward driving. [This means the driver can view cars and objects before them even if not focused on them].
  - Maintains an unobstructed field of view out from the vehicle to the road in front and sides as well as behind the vehicle with the aid of side and rearview mirrors. [This means the driver cannot place a newspaper in front of the individual so that they cannot see the roadway or a TV screen up on top of the dashboard].
  - Maintains an unobstructed area around the steering wheel as well as gas and brake pedals to allow for immediate driver intervention.
  - Occasionally checks that the autonomous vehicle is operating correctly and has not encountered a situation it is incapable of handling.
  - Actively intervenes whenever the safety of other drivers or efficient use of the roadways requires.

- **Amending Distracted Driving Laws:**
  - **ULC final report questions:** "The subcommittee recommends that the drafting committee consider provisions that would amend the state's distracted driving laws."[39]
  - **Recommendation:** Existing distracted driver laws should be amended to simply read "except as otherwise provided in state and federal laws governing the operation of autonomous vehicles in autonomous mode." The above passive-monitoring requirement then defines the scope of attentiveness required by operators of AVs while in autonomous mode.
- **Requirement that drivers intervene when safety and efficiency so requires:**
  - **Recommendation:** Without a requirement that drivers intervene when the autonomous vehicle fails and/or when the safety and/or efficient use of the roadways requires, drivers may have a perverse incentive to avoid intervening. This is in no small part because the manufacturer will be liable in such instances. The law may need, therefore, to require intervention when safety and efficiency so requires.
  - **Suggested provision language:** The driver of an autonomous vehicle must actively and physically intervene and disengage the vehicle from autonomous mode whenever roadway safety or efficiency so requires.

[39] ULC Final Report at 13.

- **Required gauges and functionalities on consumer AVs:**
  - **State provisions**
    - Nevada requires the following of AVs operated by consumers on public roads:
      - Must be equipped with an accessible way to engage/disengage AV technology.
      - Visual indicator when autonomous technology is active.
      - Capable of alerting drivers to take control if AV technology fails.[40]
    - California requires as a prerequisite to deployment (but not for testing) that the manufacturer certify: "[t]he autonomous vehicle has a mechanism to engage and disengage the autonomous technology that is easily accessible to the operator."[41] It also requires that manufacturers certify that "[t]he autonomous vehicle shall allow the operator to take control in multiple manners, including, without limitation, through the use of the brake, the accelerator pedal, or the steering wheel, and it shall alert the operator that the autonomous technology has been disengaged."[42]
    - Florida requires "a means to engage and disengage the autonomous technology which is easily accessible to the operator"[43]
    - D.C. requires as a prerequisite for registration of the vehicle that the operator be able to take control of the vehicle in multiple ways.[44]
    - Each jurisdiction requires for deployed vehicles an indicator of whether or not the vehicle is operating in autonomous mode. The Final Report also outlines that all states require for both testing and deployment some indicator that the AV system has failed.
  - **Recommendations:** Start with Nevada's provisions and expand on them. While it is certainly possible that some of these provisions will be preempted by the NHTSA as "safety-related", some also may be viewed as more operational and consumer-information related. In addition, it is important to remember that these provisions can provide valuable certainty and guidance to manufacturers in the interim of longer-term NHTSA regulations.
  - **Recommended provision language:** All autonomous vehicles, whether undergoing testing or deployed for consumer use, must be equipped with the following features:
    - An accessible means to immediately engage or disengage the autonomous technology, such as a button, knob, or lever.
    - A means to immediately disengagement the autonomous technology when a human driver reasserts control by turning the steering wheel or depressing the gas or brake pedal.
    - A prominent and immediate visual indicator that the autonomous technology has been activated or deactivated and a continuing indication that the technology remains active or inactive. The indicator must be viewable by any visually-enabled individual in the driver's seat.

    All deployed autonomous vehicles must be equipped with the following features:

[40] Nev. Rev. Stat. § 482A.190.
[41] Cal Vehicle Code. §38750(c)(1)(A).
[42] Cal Vehicle Code. §38750(c)(1)(D)
[43] Fla. Stat. § 319.145.
[44] D.C. Regs. § 401.20(h).

        - An immediate auditory indicator that the autonomous technology has been activated or deactivated.
            - [Comment: Having both a visual and auditory indicator ensures that the driver is fully aware that the technology is engaged. Without both, a driver might inadvertently activate or deactivate the AV technology without knowledge – particularly a concern for disengagement, where the driver might accidently nudge the steering wheel or a pedal and disengage the autonomous technology without seeing the visual indicator.]
        - Both visual and auditory alerts if the autonomous technology malfunctions.
            - [Comment: Both types of alerts are important if autonomous technology fails – it is critical that the driver be made aware and a visual or auditory alert alone may be insufficient].
- **Federally-mandated safety features must remain operative while in autonomous mode**
    - **State provisions**
        - California requires manufacturers certify that the vehicle meets federal safety standards and that the autonomous technology does not make inoperative any federally-mandated safety equipment.[45]
        - The NHTSA recommends that regulations allowing automated vehicles on public roads should prevent manufacturers from disabling federally-mandated safety features.[46]
    - **Recommendation:** This makes sense, particularly for AVs that allow for human driving and intervention – when a human is driving, that human should certainly benefit from federal safety regulations and standards. However, it is likely in the future that these federal standards will change to allow for fully autonomous Level Four vehicles without certain safety standards that are highly specific to human control (e.g., pedals and ABS brakes, a steering wheel, etc.). This won't affect the language in state laws (requiring that manufacturers follow federal standards inherently allows for changes in federal law), but it is important to recognize that some changes in these federal safety requirements are likely over time.
    - **Suggested provision language:**
        - A manufacturer must certify that a deployed and salable vehicle meets all federal safety standards and that its autonomous technology does not make inoperative any federally-mandated safety equipment.

VI. Endorsements of AV Operators' Driver's Licenses:

- Nevada requires that the local DMV shall establish an endorsement system for AV operator driver's licenses.[47] In other words, the DMV can "endorse" an individual's existing driver's license for the operation of an autonomous vehicle. The District of Columbia requires a special endorsement by operators certifying they have been trained by the manufacturer or dealer in the operation of the autonomous vehicle.[48] The NHTSA recommends a form of D.C.'s approach,

[45] Cal. Vehicle Code §§38750(c)(1)(D)&(E).
[46] NHTSA Statement at page 13, paragraph III.B.
[47] Nev. Regs. § 10.2(a).
[48] D.C. Regs. § 114.1.

that a license or endorsement should be conditioned on completion of a manufacturer-provided training course and that the curriculum be approved by the state.[49] In Florida and Michigan, operators need only have a regular driver's license to operate an AV.[50]

- **Recommendation:** The ULC should outline and bracket for state consideration a form of Nevada and D.C.'s provisions requiring AV operators obtain an endorsement on their driver's licenses. This should require that they certify *receiving* and *understanding* manufacturer-provided *instructions* on the safe and lawful operation of the vehicle. To keep costs to a minimum, and as recommended by the NHTSA, manufacturers should be required to provide this instruction on the safe and lawful operation of AVs and owners should be required to certify that they have read or watched that instruction. A step further would require that operators pass a manufacturer-provided "course", but forcing manufacturers to create such a course seems an onerous burden. More practical is requiring operators to certify that they have read or watched the manufacturer's instructions (which could be reviewed and approved by the state). On the same certificate, the state could list the basic requirements for the lawful operation of an AV and require operators certify that they have read and understand those requirements.

  In general, an endorsement/licensing regime make sense because we anticipate drivers will frequently switch in and out of autonomous mode. It is, therefore, very important that they have a basic understanding of when and how it is safe to do so and their potential liability under different circumstances. It would also be important for them to certify acknowledgement that they must (as we've recommended) passively monitor the roadway and vehicle while it is in autonomous mode: requiring staying awake, sitting upright in the driver's seat, keeping at least peripheral vision on the roadway, maintaining an unobstructed view with nothing on the dashboard, and ensuring nothing obstructs the driver from assuming immediate physical control. If states adopt such provisions, or similar ones, it is critical that drivers know and understand them and certify acknowledgment.
- **Recommended provision language:** Drivers of autonomous vehicles must obtain a state endorsement on their driver's licenses in order to demonstrate that they can safely and lawfully operate an autonomous vehicle on public highways. The DMV shall establish detailed requirements for a driver to obtain an endorsement. In order to obtain an endorsement, drivers must:
  - Certify with the DMV that they have received and understand manufacturer-provided instructions.
  - Certify with the DMV that they acknowledge the legal requirements for monitoring an autonomous vehicle while it operates in autonomous mode. These include that the driver must passively monitor the vehicle and roadway at all times, which requires: (see the above list of passive monitoring requirements)
  - Certify that they will intervene and physically reassume control of an autonomous vehicle in the event that public safety or the efficient use of the roadways so requires.
  - Certify that before re-selling an autonomous vehicle, the holder of the endorsement will obtain a certificate of compliance from a licensed certification agency.

  Manufacturers must provide with the sale of an autonomous vehicle instructions on the safe and lawful operation of the vehicle.

[49] NHTSA Statement at 11.

[50] Fla. Stat. §316.85(1); Mich. Comp. Laws § 257.665(2)(c).

VII. Tort Liability Provisions:

- **Provision stating manufacturers not liable for damages caused by 3rd-party modifications:**
  - Nevada, Florida, and Michigan require: If a third party makes changes to an AV and those changes cause harm, the manufacturer is not liable for damages unless the defect was present when originally manufactured.[51]
  - **Recommendation:** While this provision merely restates applicable tort law, it also may provide some useful clarity and certainty to manufacturers. It also places third-party modifiers on notice about the liability implications of their modifications.
- **Broader tort law issues and recommendations:** We agree with the ULC's Final Report and its general recommendation that no major changes to tort law should be made. But, there may be a role for regulation to clarify potential liability under the common law for both the driver and the manufacturer, depending on if the vehicle is in or out of autonomous mode.

  Products liability law is sufficiently advanced to assign liability for damages resulting from the failure of an autonomous vehicle, whether by manufacturer negligence, design defect, manufacturing defect, failure to warn, or breach of express or implied warranty.[52] All of these product liability theories are highly developed, given the advance of technology in and out of cars for well over a century, and are capable of covering autonomous vehicles.[53]

  Current tort law is also sufficiently advanced to assign liability for damages resulting from AV-driver negligence, for example when a driver causes an accident when the vehicle is not in autonomous mode, inappropriately reassumes control of an autonomous vehicle and then causes an accident, or engages the autonomous mode in a negligent manner (perhaps right before colliding with another vehicle).

  Despite the capacity of the highly-agile common law system to adapt and respond to this technology, the ULC may want to clarify that manufactures and drivers can both be liable under the common law. It might also want to provide a bracketed alternate summary for states with no-fault laws (more below). The ULC could also recommend a model provision for completely autonomous vehicles of the future, which would not allow human-intervention, invariably making the manufacturer liable.
- **Suggested provision for states with ordinary negligence laws on public roads (not no-fault):** Drivers are subject to liability under the common law for negligent or reckless driving while operating an autonomous vehicle when it is not in autonomous mode. Drivers may also be subject to liability for the negligent engagement or disengagement of autonomous technology, when a reasonable person would view it as unsafe to do so.
  - Manufacturers are subject to liability under the common law for accidents that are proximately caused by an autonomous vehicle operating in autonomous mode. They may also be liable under the common law under theories of manufacturer negligence, design defect, manufacturing defect, failure to warn, or breach of express or implied warranty.
- **Recommendations on no-fault liability laws in some states:** Twelve states have no-fault liability laws that relieve drivers from personal liability in the event of minor accidents, with drivers' insurance paying out to the injured party regardless of fault.[54] Such laws would certainly affect

[51] Nev. Rev. Stat. § 482A.090; Fla. Stat. § 316.86(2); D.C. Code § 50-2353; Mich. Comp. Laws § 257.817
[52] *See* John Villasenor, *Who Is at Fault When a Driverless Car Gets in an Accident?*, THE ATLANTIC, (April 25, 2014).
[53] *Id.*
[54] See *Autonomous Vehicle Technology – A Guide for PolicyMakers*, RAND, (2014)

the above recommended provisions, and the ULC could provide bracketed provision recommendations for such states. Under such a regime, it is certainly possible that the driver's insurance should pay out for any minor damages, even if they are caused while the car is in autonomous mode. For "serious accidents" (already statutorily defined in these no-fault states), the question of manufacturer vs. driver negligence may then become more relevant, with manufacturers generally liable and their insurance paying out if the vehicle was in autonomous mode and driver's and their insurance paying out if the vehicle was in manual mode (with exceptions for when a driver negligently engages or disengages the autonomous technology). Drawing these lines may be where state regulators can play a role.

- **Recommendations on strict liability and design defect liability questions:** In its 2014 report on autonomous vehicles, RAND discusses strict liability as "the theory most often used by plaintiffs in suits against manufacturers involving the design of automobiles."[55] It suggests, therefore, that it "will play a central role in litigation over responsibility for crashes associated with AV technologies."[56] The courts will generally decide the applicability of any strict liability standard and associated manufacturing defect, design defect, and failure to warn theories of liability. But legislatures may have a role here too because the "existing liability regime does a poor job of aligning private incentives with the public good," according to RAND.[57] That is, even while autonomous technology may be safer for drivers and society overall, it may present greater liability risks for manufacturers that deter them from investing in the technology's development. RAND sees a role for the state in cost-benefit balancing to address these barriers:

  > To maximize the social benefits of this technology, policymakers need to structure the liability and regulatory regime to encourage the development of this technology without undermining marginal incentives for safety. Careful thought and further research may be necessary to determine which costs and benefits should be included in the cost-benefit analysis that accompanies product liability.[58]

  While this does not answer the question, it does help frame the problem and a potential role for legislators or agencies.

  To solve the problem in a flexible manner, state legislators could simply acknowledge in AV legislation the benefits of AV technology, the need to incentivize deployment, and the need to incentivize safety. They could then leave it to the courts to perform cost-benefit balancing tests. Courts are fully capable of performing such tests and determining which standards to adopt, but they often rely on legislative intent and history in doing so. To the extent that legislation can provide courts with a cue or mandate to perform such balancing, courts will be more willing to integrate such tests in developing legal standards for AV-manufacturer liability. Such cues can be provided in the legislative history or in the recitals section of legislation with a "whereas" clause. It could also be done with a stand-alone provision that simply acknowledges the need for courts to perform forward-looking balancing tests.

VIII. Allowing Operation without a Driver Aboard:

- **Recommendation:** Allowing the operation of an autonomous vehicle without a driver aboard is risky this early in the development of the technology. While the goal may be to enable things

[55] *Autonomous Vehicle Technology – A Guide for PolicyMakers*, RAND, (2014)
[56] *Autonomous Vehicle Technology – A Guide for PolicyMakers*, RAND, (2014)
[57] *Id.*
[58] *Id.*

like the parking of the vehicle after a human has been dropped off, there are many foreseeable situations in which the vehicle will incorrectly interpret road signs, parking-garage signs, or subtle communications with another driver in the tight quarters of a parking garage – all situations in which human intervention may be required. While these challenges are likely surmountable in the medium to long-term, regulators should be wary of allowing AVs to operate without humans aboard in the near future. The ULC draft, however, should keep the door open to modification in the future with "unless otherwise permitted" language.

- **Suggested language:** Unless otherwise permitted by state or federal regulation, autonomous vehicles must be operated with a human aboard and in the driver's seat.

VI. Regulating Level Two, Combined-Function Automation:

- **Recommendation:** Level Two combined-function automation presents unique and immediate risks (the technology is being sold in cars that are already on public roads[59]). Combined-function lane centering, lane-changing, and adaptive cruise control create the potential for a driver on a highway to turn full control over to the vehicle, tune out, read a book, text message, or perhaps fall asleep. This is even while the technology cannot operate completely autonomously without active human monitoring. This presents significant risks that the ULC draft law should address.
- **Suggested provision language:** Vehicles that combine automated functions such as lane centering, lane changing, and adaptive cruise control for limited automation on public roads must be accompanied by the driver's active monitoring when these systems are engaged. Drivers may not read, text, email, sleep, or otherwise distract themselves. Existing distracted-driving laws apply to the operation of vehicles with such combined-function automation and which do not qualify as "autonomous vehicles" under this statute.
    - Manufacturers introducing such combined-function automation must provide sufficient warning to drivers that they are lawfully obligated to actively monitor the road and system while the technology is engaged.
    - Manufacturers introducing such combined-function automation must include sensors that can detect when a driver is falling asleep and alert the driver with auditory warnings.
        - [Note: The risk that a driver engages combined-function technology, relaxes, and falls asleep are very high. This is particularly true during nighttime driving. This would leave the vehicle in a stranded state of limited automation, presenting potentially great danger to other drivers. The risk is significant enough that manufacturers should be obligated to provide accompanying sleep-detection technology and an auditory warning system. Manufacturers]

[59] Michael Casey, *Want a self-driving car? Look on the driveway* FORTUNE (December 6, 2014) http://fortune.com/2014/12/06/autonomous-vehicle-revolution/

University of Washington School of Law Technology Clinic Model Bill

Draft Autonomous Vehicles Legislation for Washington State

Introduction

This draft legislation was researched and written by the University of Washington's Technology Law and Policy Clinic at the request of Washington State Representative Chad Magendanz. Representative Magendanz is a member of the House Technology and Economic Development Committee, which is considering legislation to regulate the testing and operation of autonomous vehicles in Washington. The draft below is an independent product intended to inform the committee's process. It is the result of extensive research by the University of Washington Clinic and reflects the thinking found in a 20-page report the Clinic submitted to the Uniform Law Commission on December 12, 2014. The report provided detailed analysis of the autonomous-vehicle provisions on the books in California, Nevada, Florida, Michigan, and Washington, D.C., made recommendations to the ULC, and offered draft provision language. Our draft legislation draws heavily from this report. It also draws substantially from California's law because we have concluded it provides the best example among states with enacted laws (although California's law provides limited guidance beyond AV testing regulations). While we root our draft in the sound thinking of other states, we fill many gaps and expand further into regulatory questions surrounding deployment, sale, and operation of autonomous vehicles by consumers.

Provisions

We propose the following for addition to Title 46 RCW as a new Chapter:
RCW Chapter 46.99 "Autonomous Vehicles"

Section 1 – Declarations:

The Legislature finds and declares the following:

(1) Researchers, automobile manufacturers, and technology companies are rapidly developing new technologies that − with the use of computers, sensors, and other systems − permit a motor vehicle to operate without the active control and monitoring of a human operator. Motor vehicles with this technology, referred to as "autonomous vehicles," offer safety, mobility, and commercial benefits for individuals and businesses in Washington state and elsewhere.

(2) Autonomous vehicles have been operated safely on public roads in a number of states in recent years by entities developing and testing this technology.

(3) Washington state, which presently does not prohibit or specifically regulate the operation of autonomous vehicles, aims to encourage the current and future development, testing, and operation of autonomous vehicles on the public roads of the state. The state seeks to avoid interrupting these activities while at the same time creating appropriate rules intended to ensure that the testing and operation of autonomous vehicles in the state are conducted in a safe and efficient manner.

Section 2 – Purpose:

(1) Toward the ends expressed in Section 1, the Legislature finds it appropriate to authorize the establishment of specific requirements for the testing and operation of autonomous vehicles, and to require that future testing and operation of autonomous vehicles in the state comply with those requirements.

(2) A motor vehicle shall not be operated in autonomous mode on public roads in Washington except as permitted under RCW Chapter 46.99 - "Autonomous Vehicles".

(3) This article shall become effective 120 days after the date of adoption by the department.

Section 3 – Definitions: For purposes of this Chapter, the following definitions apply:

(1) "Autonomous technology" is technology installed on a motor vehicle that can drive without the active physical control or monitoring of a human operator for any duration of time.

(2) An "autonomous vehicle" is a motor vehicle equipped with autonomous technology that can drive the vehicle without the active physical control or monitoring of a human for any duration of time.

(a) The term "autonomous vehicle" does not include vehicles with independently-functioning automated systems, such as blind spot detection, emergency braking, adaptive cruise control, lane keeping, and lane changing.

(b) The term does apply to a vehicle employing any combination of these automated systems that allows driving without active human monitoring and control for any duration of time.

(3) "Autonomous mode" means an autonomous vehicle is driving with the autonomous technology engaged and without the active physical control or monitoring by a human sitting in the vehicle driver's seat.

(4) "Manual mode" means the vehicles is under the active physical control of a human sitting in the driver's seat driving the vehicle with the autonomous technology disengaged.

(5) A "manufacturer" is a creator of autonomous technology or autonomous vehicles from raw materials, new basic components, or the installation of technology systems.

(6) An "operator" of an autonomous vehicle is the person seated in the driver's seat.

(7) "Driving" means the operation and movement of a motor vehicle in any manner.

(7) A "test driver" is a human with the proper certification to operate an autonomous vehicle on public roads.

(8) A "designee" is a human identified by the manufacturer to the department as a person authorized to drive the manufacturer's autonomous vehicle or vehicles on public roads.

(9) "Public road" means "highway" as defined in [RCW XXX], "offstreet public parking facility" as defined in [RCW XXX], and "street" as defined in [RCW XXX].

(10) "Department" means the Department of Motor Vehicles.

Section 4 – Primary Requirements for Testing on State Roads.

A manufacturer may not conduct testing of autonomous vehicles on public roads in Washington unless the following requirements are met:

(1) The manufacturer obtains an Autonomous Vehicle Manufacturer's Testing Permit from the department, provides all necessary certifications for the permit, performs consistent with those certifications for the duration of its testing, and the permit remains valid.

(2) The manufacturer obtains certification from the department for its Test Driver Training Program, the test driver completes the training program, the manufacturer identifies the test driver to the department, the manufacturer certifies to the department that the driver meets all requirements of this statute, and the manufacturer and test driver perform consistent with those certifications for the duration of testing.

Section 5 – Requirements for a Manufacturer to Obtain a Testing Permit.

To obtain an Autonomous Vehicles Manufacturer's Testing Permit, a manufacturer must submit an application to the department, containing all of the following:

(1) Evidence of the manufacturer's ability to respond to foreseeable damages for personal injury, death, or property damage arising from its testing of autonomous vehicles on public roads with:

(a) An instrument of insurance issued by an insurer admitted to issue insurance in Washington;

(b) A surety bond issued by an admitted surety insurers or an eligible surplus lines insurer;

(c) Or a certificate of self-insurance.

(2) Objective evidence from controlled tests simulating real-world conditions supporting the manufacturer's reasonable belief that testing can be performed safely and efficiently on public roads under real-world conditions.

(3) The manufacturer's certifications that it will not test on public roads unless:

(a) The manufacturer will, for the duration of its testing, continue to maintain insurance, a surety bond, or proof of self-insurance.

(b) The manufacturer will only test an autonomous vehicle on roads and in conditions where it reasonably concludes the vehicle can safely and efficiently operate based on prior testing in controlled and public environments.

(c) The autonomous vehicle has all of the following components:

(i) A mechanism to engage and disengage the autonomous technology that is easily accessible to the test driver.

(ii) A visual indicator inside the cabin to indicate when the vehicle is in autonomous mode.

(iii) A system to alert the test driver if an autonomous technology failure is detected while the autonomous technology is engaged and that allows the test driver to take control of the vehicle.

(iv) Systems to allow the operator to take control in multiple manners, including, without limitation, through the use of the brake, the accelerator pedal, or the steering wheel.

(d) The manufacturer identifies to the department in writing: the identification number of the autonomous vehicle to be tested on public roads; its make, model, and model year; and the license plate number and state of issuance.

(e) The manufacturer is conducting the testing and all test drivers are or will be employees, contractors, or designees of the manufacturer.

(i) Test drivers will be trained in the manufacturer's Test Driver Training Program.

(ii) Test drivers will sit in the driver's seat and either manually control the vehicle or actively monitor the vehicle's operations and be capable of taking immediate physical control.

(iii) The test driver is required as a condition of their employment or contract to obey all provisions of the Vehicle Code and local regulation applicable to the operation of motor vehicles, whether the vehicle is in autonomous mode or manual mode.

(iv) The manufacturer ensures the test driver knows the limitations of the vehicle's autonomous technology and is capable of safely operating the vehicle in all conditions under which the vehicle is tested on public roads.

(4) An application fee determined by the department for the processing of the application which will permit the operation of up to 10 autonomous vehicles and up to 20 autonomous vehicle test drivers.

(a) The manufacturer may supplement the application with additional pages to add more than 10 vehicles and more than 20 drivers by submitting a fee determined by the department for each set of 1 to 10 vehicles and 1 to 20 drivers.

(b) The manufacturer may also submit revisions to an existing permit if changes or modifications are required during the term of an existing permit.

(5) The signature of a person authorized to bind the manufacturer, with penalty of perjury under the laws of Washington, in order to certify the application and all materials submitted to the department.

Section 6 – Requirements for Test Driver Certification.

A manufacturer shall not allow any person to act as an autonomous vehicle test driver for testing autonomous vehicles on public roads unless all of the following conditions have been met:

(1) The manufacturer has certified to the department that each of its test drivers meets the following requirements:

(a) The test driver has completed the manufacturer's autonomous vehicle Test Driver Training Program and received a certificate of completion from the manufacturer.

(b) The test driver has been licensed to drive a motor vehicle for the three years immediately preceding application to the department, and at that time the driver:

(i) Was not the at-fault driver of a motor vehicle involved in an accident that resulted in injury or death of any person.

(ii) For the ten years immediately preceding application to the department was not convicted for driving or operating a vehicle under the influence of alcohol or any drug, and did not suffer any driver's license suspension or revocation for driving a vehicle under the influence of alcohol or any drug.

(c) The manufacturer has identified the autonomous vehicle test driver to the department in writing, providing the driver's full name, his or her driver's license number, and the jurisdiction of issuance of the license.

(2) The manufacturer has submitted the course outline of the Test Driver Training Program to the department and the department has approved the program.

(a) The program must include the following elements:

(i) Instruction on the automated driving system technology to be tested in the manufacturer's vehicles, including behind-the-wheel instruction provided by an experienced driver on the capabilities and limitations of the manufacturer's automated driving systems. For the purposes of this section, an "experienced driver" is one who through training and experience has developed skill and knowledge in the operation of the manufacturer's autonomous technology.

(ii) Defensive driver training, including practical experience in recovering from hazardous driving scenarios.

(3) A person authorized by the manufacturer to bind the manufacturer, under penalty of perjury under the laws of Washington, has signed and certified all submissions and representations to the department.

Section 7 – Review of Manufacturer's Permit Application and Driver Training Course Outline.

(1) The department shall review the application for a Manufacturer's Testing Permit as well the course outline for the Test Driver Training Program and notify the manufacturer within 10 days whether they are complete or deficient. The department shall, within a reasonable time, approve a complete permit application or certify a complete course outline only if they are sufficient.

Section 8 – Term of Permit and Certification of the Driver's Training Program.

(1) Manufacturer's Testing Permits shall be valid for a period of one year from midnight of the last day of the month of issuance unless sooner revoked or surrendered. Renewal of the permit for the ensuing year may be obtained by the manufacturer to whom the permit was issued upon application to the department more than 60 days prior to expiration date, payment of the same fee(s) required by subsection (X), and approval by the department.

Section 9 – Refusal, Suspension, and Revocation of a Manufacturer's Testing Permit.

(1) The department may refuse an application for a Manufacturer's Testing Permit or for the renewal of a Manufacturer's Testing Permit, and may suspend or revoke a Manufacturer's Testing Permit:

(a) For a violation of Vehicle Code section XXX

(b) For any act or omission of the manufacturer or one of its agents, employees, contractors or designees which the department finds makes the manufacturer's testing on public roads an unreasonable risk to the public.

Section 10 – Demand for Hearing after Refusal, Non-Renewal, Suspension, or Revocation

(1) Upon refusal by the department to issue or renew a Manufacturer's Testing Permit or upon suspension or revocation of a permit, the manufacturer shall be entitled to demand in writing a hearing before the director or his or her representative within 60 days after the notice.

(2) The hearing shall be conducted pursuant to standards established by the department.

Section 11 – Autonomous Vehicle Testing, Permitting, and Certification Categories.

(1) Manufacturers can test autonomous vehicles in private, controlled environments without a state permit, assuming they comply with common law workplace-safety and negligence standards.

(2) Manufacturers can apply for an Unlimited Public Test Permit, which allows a manufacturer to test on any public road under any driving conditions in which the manufacturer reasonably concludes and certifies the vehicle can safely and efficiently operate.

(a) To qualify for an Unlimited Public Test Permit, manufacturers must:

(i) Test an AV model for no less than 10,000 miles in controlled conditions and/or with a Limited Public Test Permit.

(ii) Present in their application to the department evidence from controlled tests and/or limited public tests that the vehicle can safely and efficiently operate on any foreseeable public road under any foreseeable driving conditions.

(3) Manufacturers can apply for a Limited Public Test Permit, which allows testing on limited public roads and under limited testing condition in which the manufacturer reasonably concludes and certifies the vehicle can safely and efficiently operate.

(a) A manufacture can apply for a Limited Public Test Permit selecting from any combination of the following:

(i) Road types: Interstate highways, state highways, urban environments, residential roads, unpaved or unmarked roads.
(ii) Environmental conditions: Day, night, clear weather (no precipitation, visual limitations, severe wind), rain, fog, snow/ice, high crosswinds (gusts above 30 mph).

(b) To qualify for a Limited Public Test Permit, manufacturers must:
(i) Present in their application to the department evidence from controlled tests that the vehicle can safely and efficiently operate on any of the road types or environmental conditions specified.

(4) Manufacturers can apply for an Autonomous Vehicle Certification, which allows an autonomous vehicle model to be sold and/or used on public roads if:
(a) The manufacturer presents evidence to the department that the autonomous vehicle model has been tested safely and efficiently on public roads for not less than 100,000 miles.
(b) The manufacturer certifies that the vehicle can operate safely and efficiently on all reasonably foreseeable public roads and driving conditions.

(5) Manufacturers can apply for an Autonomous Technology Certification, which allows autonomous technology to be sold to autonomous vehicle manufacturers and used on public roads if:
(a) The manufacturer presents evidence to the department that the autonomous technology has been tested safely and efficiently on public roads for not less than 100,000 miles.
(b) The manufacturer certifies that the autonomous technology can operate safely and efficiently on all reasonably foreseeable public roads and driving conditions.

Section 12 – Requirements for Sale and Consumer Use of Autonomous Vehicles.

A manufacturer may not distribute or sell for use on public roads any autonomous vehicle unless:

(1) The manufacturer certifies to the department that the autonomous vehicle includes all of the following features:
(a) A mechanism to engage and disengage the autonomous technology that is easily accessible to the operator.
(b) A visual indicator inside the cabin to indicate when the vehicle is in autonomous mode or manual mode.
(c) An auditory system to alert the operator that the autonomous technology has been engaged or disengaged.
(d) A system to safely alert the operator if an autonomous technology failure is detected while the autonomous technology is engaged and that allows the operator to take immediate physical control of the vehicle.
(e) Systems to allow the operator to take immediate control in multiple manners, including, without limitation, through the use of the brake, the accelerator pedal, or the steering wheel.
(f) A mechanism to capture and store the autonomous technology sensor data for at least 30 seconds before a collision occurs between the autonomous vehicle and another vehicle, object, or natural person while the vehicle is operating in autonomous mode. The autonomous technology sensor data shall be captured and stored in a read-only format by the mechanism so that the data is retained until extracted from the

mechanism by an external device capable of downloading and storing the data. The mechanism must also be able to clearly and reliably indicate whether the vehicle was in autonomous mode at the moment of collision and if the autonomous technology was engaged or disengaged within 30 seconds of the collision. The data shall be preserved for three years after the date of the collision.

(2) The manufacturer certifies to the department that its autonomous vehicle:

(a) Meets Federal Motor Vehicle Safety Standards for the vehicle's model year and all other applicable safety standards and performance requirements set forth in state and federal law and the regulations promulgated pursuant to those laws.

(b) Does not make inoperative any Federal Motor Vehicle Safety Standards for the vehicle's model year, other applicable safety standards and performance requirements set forth in state and federal law, or the regulations promulgated pursuant to those laws.

Suggestions for State Legislation, excerpted from

Bryant Walker-Smith
Automated Vehicles are Probably Legal in the United States, 1 Texas A&M L. Rev. 411, 508-16 (2014).

E. *States May Wish to Clarify the Legal Status of Automated Driving*

The draft bill language that follows begins to address some of the issues raised in this article. However, a bill that simply adopts this language would be incomplete and possibly premature. The language does not directly address vehicle standards, general tort liability, insurance, data collection, transportation planning, environmental impact assessment, or other areas relevant to automated vehicles. In addition, it is subject to revision; a current version is available at the website provided.[595]

The main feature of this draft is its distinction between an automated vehicle's ordinary and "virtual" drivers.[596] The natural person occupying or otherwise using an automated vehicle is subject to existing rules of the road unless the manufacturer or insurer of the vehicle has assumed these responsibilities by registering as a virtual driver. Explanation of the other provisions is provided in the accompanying footnotes.

1. Background.

1.1. Legislative intent. It is the intent of the Legislature to facilitate the development and deployment of automated vehicles in a way that improves highway safety.[597]

1.2. Conventional operation. Nothing in this Act is intended or shall be construed to change existing statutory law as applied to vehicles neither under nor transitioning from automated operation.[598]

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593. Mich. Act No. 231 of 2013 (2014), *available at* www.legislature.mi.gov/documents/2013-2014/publicact/pdf/2013-PA-0231.pdf. Notably, Michigan's legislation provides that "a person shall not operate an automated motor vehicle upon a highway or street in automatic mode" unless that person is an approved manufacturer operating the vehicle for research or testing purposes in accordance with specified requirements. *Id.* secs. 663, 665.

594. Gabriel Weiner and Bryant Walker Smith, *Automated Driving: Legislative and Regulatory Action*, cyberlaw.stanford.edu/wiki/index.php/Automated_Driving:_Legislative_and_Regulatory_Action (last visited Dec. 23, 2013).

595. Bryant Walker Smith, *Automated Driving: State Model Bill*, cyberlaw.stanford.edu/wiki/index.php/Automated_Driving:_State_Model_Bill.

596. *See infra* §§ 3.7–3.9, 5, 7.3.

597. This language provides a legislative basis for courts and administrative agencies to more flexibly interpret existing and new law with respect to automated vehicles.

598. This provision expressly preserves existing interpretations of driving laws as applied to conventional vehicles and automated vehicles being operated conventionally. The "transitioning" language is necessary to cover cases where automated operation has ended but no human has resumed real-time input or where a platoon is dispersing. *See infra* §§ 3.7–3.9, 7.6. Some new provisions in this draft, however, do apply to both conventional and automated vehicles. *See, e.g.*, *infra* §§ 4, 7.8, 7.9.

1.3. Vehicle owners. Nothing in this Act is intended or shall be construed to abridge the existing statutory civil liability of any vehicle owner.[599]

1.4. Geneva Convention. The Legislature hereby finds that automated operation of vehicles under the conditions prescribed herein is consistent with article 8 of the Convention on Road Traffic because (1) such operation has the potential to significantly improve highway safety, one of the objects of the Convention; (2) this State shall make such operation reasonably knowable to the foreign visitors contemplated by the Convention; (3) the Convention implicitly permits indirect control over vehicles and animals; (4) there shall remain a licensed driver of each vehicle who shall be able to specify or accept the parameters of operation; and (5) these parameters shall be consistent with the traffic laws of this State.[600]

2. Agency implementation.

2.1. The Department shall by rule define certain automation profiles.[601]

2.2. The Department shall by rule define certain test vehicle profiles.[602]

2.3. The Department shall by rule establish requirements for automation-only licenses.[603]

2.4. The Department shall by rule establish requirements for virtual licenses.[604]

2.5. The Department may by rule establish standards for the collection, transmission, retention, disclosure, use, or ownership of data generated by or for motor vehicles.[605]

2.6. The Department shall make and maintain all other rules necessary to fully implement this Act, except that the Department may in its sole discretion decide to act through in-

599. This language ensures that state statutes regarding owner liability (for the purpose of, inter alia, insurance, moving and parking violations, and driver negligence) are not affected by changes to, inter alia, the definition of driver and the rules of the road. *See supra* Part VI.A.3; *infra* §§ 3.7–3.9, 7. For example, even if the vehicle owner does not directly initiate automated operation, the vehicle's effective driver would still be considered a permitted driver for the purpose of vicarious civil liability. However, this language does not preclude specification of minimum levels of *criminal* culpability. *See infra* §§ 7.9–7.10.

600. *See supra* Part IV.E.4.

601. *See infra* § 3.5.

602. *See infra* §§ 3.11–3.12.

603. *See infra* § 5.

604. *Id.*

605. This language covers privacy and security of and access to data, including logs for crashes and other incidents.

formal adjudication rather than through informal rulemaking.[606]

2.7. The Department shall implement this Act in accordance with (1) all standards enacted by the National Highway Traffic Safety Administration and, to the extent that the Department in its sole discretion deems practicable, (2) relevant guidelines enacted by the National Highway Traffic Safety Administration, (3) relevant standards adopted by SAE International or the International Organization for Standardization, and (4) relevant regulations adopted by the Department of Motor Vehicles of the State of California.[607]

2.8. The Department shall implement this Act in consultation with [the State Highway Patrol] and [the Department of Transportation], but the failure to consult shall not provide a basis for judicial invalidation of an otherwise lawful rule or decision.[608]

2.9. The Department may recommend additional statutory changes to the Legislature.[609]

3. Definitions.

3.1. Automated operation means computer direction of a vehicle's steering, braking, and accelerating without real-time human input.[610]

3.2. Automated vehicle means a motor vehicle capable of automated operation.[611]

3.3. Automation package means the combination of hardware and software necessary for automated operation.[612]

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606. This provision gives the Department the authority, but not the obligation, to enact rules other than those specifically mandated in this section. This is because an extensive ex ante rulemaking process may be futile, wasteful, or limiting when many questions of implementation, including the proper treatment of particular technologies and products, are likely to be highly novel or contextual.

607. This language recognizes (and perhaps invites) federal preemption. *See supra* Part V. It also encourages other means of standardization. SAE International has an autonomous vehicle standards committee (on which I serve). *See* sources cited *supra* note 36. California is the most populous state and may be one of the first to promulgate automated vehicle performance standards. *See supra* Part VI.D.3.

608. Vehicle automation implicates issues and expertise that may lie outside a department of motor vehicles. The names and organizational relationships of agencies vary by state.

609. Florida's autonomous driving statute requires such a report. *See supra* Part VI.D.2.

610. *See supra* Part III. This definition may be broader than those adopted to date. *See supra* Part VI.D. However, the Department may define multiple automation profiles. *See supra* § 3.5; *infra* § 6.3.

611. *Id.* Accordingly, an automated vehicle is not necessarily under automated operation.

612. The Nevada, Florida, and California laws use the term "autonomous technology" to refer to a similar concept. *See supra* Part VI.D. The concept is particularly relevant to the conversion of a conventional production vehicle into an automated vehicle. *See infra* § 4.2.

3.4. Automation period means the moment that automated operation begins until the moment that a natural person (1) provides real-time input other than to mitigate an imminent risk, (2) turns off the vehicle, or (3) otherwise acts as specified by rule of the Department.[613]

3.5. Automation profile means a set of technical characteristics describing a particular kind of automated operation.[614]

3.6. Department means the [Department of Motor Vehicles].[615]

3.7. Drive and operate each mean [as provided in the vehicle code and case law], except that the effective driver exclusively drives and operates an automated vehicle during an automation period.[616]

3.8. Driver and operator each mean [as provided in the vehicle code and case law], except that the effective driver is the exclusive driver and operator of an automated vehicle during an automation period.[617]

3.9. Effective driver means:

3.9.1. If automated operation is initiated to mitigate an imminent risk, the natural person operating the vehicle immediately prior to such initiation;[618]

3.9.2. Else the vehicle's virtual driver;[619]

3.9.3. Else the natural person who actually or, by rule of the Department, presumptively initiates automated operation;[620]

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613. *See infra* §§ 3.7–3.9. The transition from automated operation raises difficult questions regarding responsibility. Even if automated operation has terminated, the effective driver's responsibility continues until an ordinary human driver has actually intervened. This language also balances, no doubt imperfectly, the risk of a human intervening when inappropriate with the risk of a human failing to intervene when needed.

614. This refers to the relevant characteristics of the vehicle, human, and environment, including the level of automation and the domain of operation. *See supra* Part III.

615. Agency names and responsibilities vary by state. *See also* sources cited *supra* note 608.

616. *See supra* § 3.4; text accompanying *supra* note 596.

617. *Id.* Depending on the jurisdiction, the modifier "exclusive" may be too restrictive. *Cf., e.g.*, sources cited *supra* note 312.

618. This provision specifies that the ordinary human driver remains responsible if an emergency intervention system engages automatically because of an impending crash or because that driver has become incapacitated.

619. This applies only if the vehicle actually has a virtual driver. *See infra* §§ 3.13, 5.2.

620. If there is no virtual driver, then the person who initiated automated operation is the effective driver. This is similar to Nevada and Florida law. *See supra* Parts VI.D.1–2. The Department may establish a presumption that another person, such as the vehicle occupant nearest the conventional apparatus, has initiated automated operation. *Cf. supra* Part VI.D.3 (California driver rule for autonomous vehicles); *supra* note 362 (Wisconsin driver presumptions).

3.9.4. Else the vehicle's owner;[621]

3.9.5. Additionally any person who in willful or wanton disregard for the safety of persons or property initiates, permits, or tampers with automated operation.[622]

3.10. Manufacturer means any person engaged in the business of constructing or assembling vehicles of a type required to be registered under [this title].[623]

3.11. Test vehicle means a vehicle registered as a platform for research, development, or demonstration of automated operation or, by rule of the Department, other safety-critical vehicle systems.[624]

3.12. Test vehicle profile means a set of technical characteristics describing a particular kind of test vehicle operation.[625]

3.13. Virtual driver means, with respect to an automated vehicle, any person holding a virtual license covering that vehicle for the pertinent part of its automation profile.[626]

4. Vehicle registration.

4.1. When registering or renewing the registration of any motor vehicle, the Department shall ascertain and record that vehicle's (1) automation profile and (2) virtual driver, if any.[627]

4.2. Any modification to a motor vehicle or its equipment that alters its automation package shall invalidate its registration, unless such alteration is (1) required by law, (2) by or on behalf of the vehicle's manufacturer, (3) to a test vehicle

621. This applies if no natural person initiates automated operation, which could conceivably occur with automated taxi dispatch, carsharing fleet management, fully automated delivery, and other advanced logistics applications.

622. This language potentially broadens the criminal and civil liability of a person who causes or could cause harm with an automated vehicle but who may not otherwise be considered a driver.

623. *See* UNIF. VEH. CODE § 1-152 (2000); *infra* § 5.2.3. This definition excludes a person who only manufacturers or installs an automation package.

624. *See supra* § 2.2.

625. This refers to the relevant characteristics of the vehicle, human, and environment, including the level of automation and the domain of operation. *See supra* Part III.

626. *See supra* § 3.9; *infra* § 5.2. This language leaves open the possibility that, for example, a vehicle may have a virtual driver during automated parking but not during highway cruising.

627. This provision enables the Department to identify the technical capability of every vehicle registered in the state. Current vehicle identification numbers (VINs), for example, do not indicate whether vehicles have any driver assistance systems. *See* sources cited *supra* note 268. The provision also links certain vehicles with virtual drivers. *See infra* § 5.2.

in accordance with its registration, or (4) otherwise permitted by rule of the Department.[628]

4.3. The Department may decline to register or, with reasonable notice to the owner and the virtual license holder, suspend, revoke, or decline to renew the registration of any motor vehicle that it determines to be unsafe, improperly equipped, or otherwise unfit to be operated on a highway.[629]

4.4. In making a determination regarding the registration of any motor vehicle, the Department may by rule or practice treat as conclusive a decision by the responsible agency of another state to permit or restrict the registration, sale, operation, or testing of the relevant make, model, kind, or category of motor vehicle or equipment.[630]

4.5. The registration of a motor vehicle shall create no presumption as to the safety of that vehicle or its equipment.[631]

5. Driver licensing.

5.1. Automation-only license.[632]

5.1.1. Any natural person of legal driving age who solely by reason of physical disability is ineligible for a [regular noncommercial] driving license shall be eligible for an automation-only license.

5.1.2. Each automation-only license shall specify conditions of operation, including particular automation profiles to which it is restricted.

5.1.3. Any person who holds a valid automation-only license may operate an automated vehicle in accordance with those conditions of operation.

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628. The vehicle registration process can provide a mechanism for supervising the safety of automated vehicles, including aftermarket conversions of conventional vehicles. If an automation package is installed, customized, or changed on a vehicle, the owner of that vehicle must reregister it. Voluntary and involuntary recalls, manufacturer upgrades, and changes to certain test vehicles are exempted. In addition, the Department can promulgate rules that provide flexibility in the application or administration of this provision.

629. *See id.* This provision enables the Department to indirectly prohibit (albeit not prevent) the operation of any vehicle that it determines to be unsafe, provided that the vehicle is registered in the state. This provision complements the direct prohibition on such operation, which also applies to out-of-state vehicles. *See infra* § 7.8.

630. This is intended to facilitate standardization and reduce the workload on the Department. *See also supra* § 2.7.

631. This specifies that no court should deem a vehicle to be safe or lawful simply because it is registered.

632. This draft maintains the requirement that drivers be licensed and therefore enables certain persons who are currently ineligible for a license to receive a conditional license valid only for automated vehicles with certain characteristics, regardless of whether such vehicles yet exist. *See supra* Part VI.D.1. Operation may involve simply starting a vehicle and initiating automated operation. *See supra* § 3.9.

5.2. Virtual license.[633]

5.2.1. Any person, natural or otherwise, who meets requirements established by the Department shall be eligible for a virtual license.[634]

5.2.2. Each virtual license shall cover a specific kind of automated vehicle for all or part of its automation profile.[635]

5.2.3. The Department may require that the holder of a virtual license be the manufacturer or insurer of the vehicles covered by that license.[636]

5.2.4. Any statutory requirements for a driving license that in the Department's determination reasonably pertain only to a natural person shall not apply to an applicant for a virtual license who is not a natural person.[637]

5.2.5. The Department may, with reasonable notice to the license holder and owner of any covered vehicle, suspend, revoke, or restrict a virtual license.[638]

6. Equipment.

6.1. General. [This title's] vehicle and equipment provisions shall be interpreted to facilitate the development and deployment of automated vehicles in a way that improves highway safety.[639]

6.2. Standards. Any vehicle sold, registered, modified for sale, or operated on any highway in this State shall comply with (1) all applicable standards enacted by the National Highway Traffic Safety Administration and (2) all applicable standards enacted by the Department.[640]

6.3. [Automated vehicles.][641]

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633. *See* text accompanying *supra* note 596.

634. Requirements might address, *inter alia*, the performance of the automated vehicles and the ability of the applicant or its insurer to pay any judgments entered against it. *See also infra* note 636.

635. Again, this language leaves open the possibility that, for example, a vehicle may have a virtual driver during automated parking but not during highway cruising. *See* sources cited *supra* note 626.

636. This language expressly permits but does not require the Department to restrict virtual licenses to entities that are already subject to well-established regulatory regimes and that have a connection to the vehicles covered. Such a requirement may also ensure that virtual licenses are not used to limit liability exposure. *Cf., e.g.*, Walkovsky v. Carlton, 223 N.E.2d 6 (N.Y. 1966).

637. *See, e.g.*, sources cited *supra* notes 399–401.

638. *Cf. supra* § 4.3.

639. *Cf. supra* § 1.1.

640. *See supra* § 4.3; *infra* § 7.8. This provision also applies to vehicles registered outside the state.

641. This draft does not address specific substantive safety standards for automated vehicles.

7. Rules of the road.

7.1. General. [This title's] rules of the road shall be interpreted to facilitate the development and deployment of automated vehicles in a way that improves highway safety.[642]

7.2. Qualitative standards. No rule shall be interpreted to impose a greater obligation on drivers of automated vehicles than on drivers of vehicles that are not automated, unless the Department by rule specifies otherwise.[643]

7.3. Virtual drivers. Any language in [this title] that [the Department] by rule determines cannot reasonably refer to a virtual driver shall instead refer to a different person or to no person at all, in each case as specified in such rule.[644]

7.4. Unattended vehicles. A vehicle that is under automated operation by a virtual driver shall not be deemed unattended unless it is not lawfully registered, poses a risk to public safety, or unreasonably obstructs other road users.[645]

7.5. Abandoned vehicles. A vehicle that is under automated operation by a virtual driver shall not be deemed abandoned unless it is not lawfully registered, poses a risk to public safety, or unreasonably obstructs other road users.[646]

7.6. Following distance. A platoon that consists of at least one vehicle under automated operation by a virtual driver and that is otherwise lawful and operating lawfully shall not be deemed in violation of following-distance requirements.[647]

7.7. Reckless driving. Any person who in willful or wanton disregard for the safety of persons or property initiates, permits, or tampers with automated operation of a vehicle is guilty of reckless driving.[648]

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642. *Cf. supra* § 1.1. This draft also assumes that the state code specifies that violating a traffic law constitutes a punishable offense. *See, e.g.*, UNIF. VEH. CODE § 11-102(a) (2000) ("It is unlawful, and unless otherwise declared in this chapter with respect to particular offenses, it is a (misdemeanor) (violation) for any person to do any act forbidden or fail to perform any act required in this chapter."). If the state code does not contain such language, particular offenses corresponding to provisions in this draft should also be defined.

643. *See supra* Part VI.C.3.

644. *See, e.g.*, *supra* Part VI.D.2.

645. *See, e.g.*, *supra* Part VI.D.2. This exception applies only if the vehicle has a virtual driver.

646. *See, e.g.*, *supra* Part VI.D.2. This exception applies only if the vehicle has a virtual driver.

647. *See infra* Part VIII. This exception applies only if the vehicle has a virtual driver.

648. Under this provision, certain persons who are not operating an automated vehicle might nonetheless commit reckless driving. References to other vehicular crimes, such as vehicular homicide, may also be appropriate. *Cf. also supra* § 3.9.5.

7.8. Unsafe vehicles. No person shall operate any vehicle that is unsafe, improperly equipped, or otherwise unfit to be operated.[649]

7.9. Vehicular felonies. No person shall be guilty of any felony specified in [this title] without a culpability at least equal to that specified or, if none is specified, [gross negligence].[650]

7.10. Vehicular misdemeanors. No person shall be guilty of any misdemeanor specified in [this title] without a culpability at least equal to that specified or, if none is specified, [negligence].[651]

7.11. Due care in vehicles under automated operation. Notwithstanding other provisions of [this title] or of any local ordinance, every driver or occupant of a vehicle under automated operation shall exercise due care as circumstances require to avoid injury to any natural person.[652]

The foregoing draft language might provide at most a starting point for any jurisdiction's analysis. Consistency among states—and coordination with the federal government—may be highly desirable. At the same time, as this article has documented, state vehicle codes vary in both form and substance. A legislature may want or need to delegate more or less discretionary authority to its department of motor vehicles or other responsible agency. And new technologies or business cases may require or merit revision of certain provisions—or even the entire approach. For these reasons and others, a current version of this language is available at the website provided.[653] The law of automated vehicles is necessarily living.

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649. This language restates a common statutory provision. *See supra* Part VI.C.1. It provides a basis to remove unsafe vehicles from a highway, regardless of where or if they are registered.

650. The application of existing traffic laws to automated vehicle users could produce certain anomalous results, particularly in the absence of a virtual driver. This provision establishes a minimum level of culpability for certain offenses, some of which may be specified in other titles.

651. *See* sources cited *supra* note 650.

652. A person who can prevent a foreseeable injury should not fail to do so simply because she is not the legal driver of her vehicle.

653. Bryant Walker Smith, *Automated Driving: State Model Bill*, *supra* note 595.

Appendix H: Analysis of Product Liability Claims against OEMs in Texas in Car Crashes involving C/AVs

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October 19, 2015

Introduction

This memo will outline the potential liability of original equipment manufacturers (OEMs) of AVs and CVs. It will begin descriptively by outlining the features of products liability law, with a specific focus on idiosyncratic or unique elements of Texas law. In the second part, this memo will analyze, through the lens of products liability law, potential issues arising from the use of AVs and CVs. Because AV/CV operators will not actually be driving and will leave vehicle movement and function control up to the vehicle itself, some academics have posited that as AV/CV technology is implemented, potential liability will shift, in an increasing number of instances over time, from the drivers to OEMs.[1] This memo will analyze that claim while remaining conscious of the time frames of AV/CV implementation. Finally, the memo will conclude with a section detailing areas that may require further research or clarification. Any assumptions used in the various analyses will be clearly stated and sources will be in footnotes throughout.

Section 1: Products Liability Law

Introduction: Statutory Basis for Products Liability and Theories of Recovery

Products liability refers to the liability of manufacturers for harms caused by their products.[2] The law of products liability is a relatively new area of the law. It has undergone significant changes and evolution since the decision in the foundational case *MacPherson v. Buick Motor Co.* was handed down in 1938. Originally based upon negligence, products liability underwent a significant shift towards strict liability in the 1960s and '70s, after which, during the '80s and '90s, courts across the nation reinserted principles of traditional negligence.[3] While a history and a detailed analysis of the tort theories of liability, negligence, and strict liability are beyond the scope of this memo, it is important to remember that, because of the evolution of products liability law, the boundaries between negligence and strict liability are often unclear.

In Texas, a "products liability action" means:

> any action against a manufacturer or seller for recovery of damages arising out of personal injury, death, or property damage allegedly caused by a defective product whether the

[1] Anderson, James et al. "Autonomous Vehicle Technology: A Guide for Policymakers" RAND Corporation. (2014) At 118.

[2] Kane, Rachel & Barbera Slotnik "Products Liability" § 1. 59 Tex. Jur. 3rd

[3] Owen, David G. Products Liability Law. 2nd Edition. At 29, 33. Thompson West (2008)

> action is based in strict tort liability, strict products liability, negligence, misrepresentation, breach of express or implied warranty, or any other theory or combination of theories.[4]

This definition captures the main theories of recovery for products liability actions: negligence, strict liability, and breach of warranty. Because breach of warranty claims is rooted in contract law, these claims will be analyzed after the negligence and strict liability claims sections.

The following information on the tort theories of liability is included as a necessary foundation for the reader. For the purposes of this memorandum and the liability of OEMs of AVs and CVs in general, the differences between the two theories may not be particularly relevant. Today, most jurisdictions, including Texas, tend to overlook the formal aspects of the underlying theory of liability and instead focus on whether the product was defective.[5] As one court put it:

> Although a negligence claim requires a different showing from a strict liability claim, it is not logical for a manufacturer to be held liable for failing to exercise ordinary care when producing a product that is not defective because: (1) if a product is not unreasonably dangerous because of the way it was manufactured, it was not negligent to manufacture it that way; and (2) even if the manufacturer was somehow negligent in the design or production of the product, that negligence cannot have caused the plaintiff's injury because the negligence did not render the product "unreasonably dangerous." This analysis applies when a defective product theory encompasses and subsumes a negligence theory, that is, when the allegations and evidence are directed to whether the product is "unreasonably dangerous" and no other potentially negligent conduct is alleged or the subject of evidence. In such a case, whether a plaintiff seeks recovery because of negligence or a theory of strict liability in tort, the burden is on the plaintiff to prove that the injury resulted from a defect in the product. [Citations omitted for clarity][6]

Negligence and strict liability differ in their respective elements and proof requirements. Negligence focuses on "the acts of the manufacturer and determines if it exercised ordinary care in design and production."[7] For negligence, a plaintiff must prove that:

1. A manufacturer or seller had **a duty** to use reasonable care in the design, manufacture, or sale of its product
2. That the duty was **breached** by violating the standard of care, which is "reasonableness under the circumstances."
3. That the breach (proximately and factually) caused
4. Injury.[8]

Contrastingly, strict liability eschews manufacturer conduct/fault and instead focuses on "the product itself and asks whether if it is defective."[9] Strict liability as a theory grew out of a concern that

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[4] Tex. Civ. Prac. & Rem. Code Ann. § 82.001(2) (West 2015)

[5] Owen, David G. Products Liability Law. 2nd Edition. At 34, Thompson West (2008)

[6] *Ford Motor Co. v. Miles*, 141 S.W.3d 309, at 315 (Tex. App. Dallas 2004)

[7] *Caterpillar, Inc v. Shears,* 911 S.W.2d 379, at 384 (Tex. 1995)(citations omitted)

[8] Kiely, Terrence & Bruce Ottley, Understanding Products Liability Law. LexisNexis, (2006), at 87-88.

[9] *Caterpillar, Inc v. Shears,* 911 S.W.2d 379, at 384 (Tex. 1995)(citations omitted).

plaintiffs were frequently unable to prove that manufacturers acted unreasonably.[10] Additionally, courts have cited several other policy reasons for the adoption of strict liability, including that it provides an incentive for safer products and that manufacturers are better able to absorb the cost of defective products than consumers via price increases.[11] For strict liability, a plaintiff has to prove:

1. That the product was in a "defective condition unreasonably dangers to the user or consumer or to his property"
2. That the seller of the product must have been "engaged in the business of selling such a product."
3. That the product must have been expect to and did reach the user or consumer "without substantial change in the condition in which it is sold."[12]

There are a variety of factors that would lead a plaintiff to choose either or both negligence or strict liability. Firstly, several states do not recognize strict liability as a theory of recovery (Delaware, Massachusetts, Michigan, North Carolina, and Virginia); accordingly, negligence is the only option for plaintiffs in those states.[13] Secondly, numerous strategic considerations, such as a potential for higher jury awards or increased discovery capabilities, favor the bringing of a negligence claim alongside a strict liability claim.[14]

For strict liability, Texas has adopted the strict liability section, Section 402A, of the influential Restatement (Second) of Torts, which states that, "One who sells any product in a **defective condition unreasonably dangerous** to the user or consumer or to his property is subject to liability for physical harm thereby caused to the ultimate user or consumer, or to his property, if...[the product] is expected to and does reach the user or consumer without substantial change in the condition in which it is sold."[15]

The Texas Supreme Court has stated that a product may be "unreasonably dangerous" because of a defect in design, manufacturing, or marketing.[16] Practically speaking, these are the three main types of product's liability claims, all of which can be brought under the theories of negligence and/or strict liability. The three formal types of claims are design defect claims, manufacturing defect claims, and failure to warn claims (which themselves are also called marketing defect claims). This memo will focus on the claims and their broad outlines.

Design Defect Claims

Design defect claims involve design and manufacturing choices made by OEMs. Design defects occur when "a product complies with all design specifications, but the design itself renders the product unreasonably dangerous."[17]

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[10] Kiely, Terrence & Bruce Ottley, Understanding Products Liability Law. LexisNexis, (2006), at 92.

[11] *Id.*

[12] *Id* at 89.

[13] *Id* at 88.

[14] *Id.*

[15] Restatement (Second) of Torts, § 405(a) (1965) *adopted in McKisson v. Sales Associates, Inc.,* 416 S.W.2d 787, at 787-789 (Tex. 1967).

[16] *Caterpillar, Inc v. Shears,* 911 S.W.2d 379, at 382 (Tex. 1995)

[17] Vol 2, Edgar & Sales, Texas Torts and Remedies, at § 41.04(1) (Matthew Bender, Rev. Ed.)(LEXIS 2015).

For design defect claims brought under negligence, the crucial element is whether a OEM acted reasonably in choosing a particular design.[18] A variety of factors are usually assessed by the factfinder to determine whether a OEM acted reasonably, including:

> [t]he likelihood and gravity of the potential harm and the burden of precautions that effectively would avoid the harm; the style, type, and particular purpose of the product; the cost of an alternative design, since the product's marketability may be adversely affected by a cost factor that greatly outweighs the added safety...and the price of the product itself.[19]

Contrastingly, for strict liability claims, the focus is on whether the design of the product has rendered it to unreasonably dangerous.[20] In general, to determine if a product is unreasonably dangerous, courts have developed and used two different tests: the Consumer Expectations Test and the Risk-Utility Test.[21] Jurisdictions vary in the use and exact formulations of the tests. For example, some states use a two-pronged approach, requiring a plaintiff to prove design defectiveness under both tests.[22] Others use the Consumer Expectations Test for simple products and the Risk-Utility Test for more complex products.[23] Others, like Texas, rely exclusively on a form of the Risk-Utility Test.[24]

The Consumer Expectations test looks at the product from the perspective of an ordinary consumer and asks whether the danger posed by the defective design is greater than the danger an ordinary consumer would have expected when using the product in an intended or foreseeable way.[25]

The Consumer Expectations test has been heavily criticized as being overly simplistic, incapable of capturing the complicated series of decisions that go into the design of a product, and as being too focused on the individual consumer as opposed to consumers as whole.[26] As a result of these criticisms, courts developed the Risk-Utility Test. First pronounced in *Barker v. Lull Engineering Co. Inc.,* the Risk-Utility Test asks the factfinder to balance the risk from the design against the design's utility to determine if the product is unreasonably dangerous.[27] Developed by Professor John Wade, the original Risk-Utility Test consisted of the following factors:

1. The usefulness and desirability of the product, i.e., its utility to the user and to the public as a whole
2. The safety aspects of the product, i.e., the likelihood that it will cause injury and the probable seriousness of the injury
3. The availability of a substitute product that will meet the same need and not be as unsafe
4. The manufacturer's ability to eliminate the unsafe character of the product without impairing its usefulness or making it too expensive to maintain its utility

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[18] Kiely, Terrence & Bruce Ottley, Understanding Products Liability Law. At 128 LexisNexis, (2006)

[19] *Id.*

[20] *Id* at 129.

[21] *Id* at 134.

[22] Owen, David G. Products Liability Law. 2nd Edition. At 538.Thompson West (2008)

[23] Kiely, Terrence & Bruce Ottley, Understanding Products Liability Law. At 141 LexisNexis, (2006)

[24] *Turner v. General Motors Co.,* 584 S.W.2d 844, 846-847 (Tex. 1979).

[25] Kiely, Terrence & Bruce Ottley, Understanding Products Liability Law. At 135 LexisNexis, (2006)

[26] *Id* at 142.

[27] *Id* at 144.

5. The user's ability to avoid danger by the exercise of care in the use of the product
6. The user's anticipated awareness of the dangers inherent in the product and their avoidability because of public general knowledge of the obvious condition of the product, or the exercise of suitable warnings or instructions.[28]

Courts differ in their formulation and application of the factors.[29] Common to most approaches, however, is the focus on the third factor, commonly known as a *reasonable alternative design*. In fact, some states, like Texas, statutorily require a plaintiff to prove the existence of a reasonable alternative design. A safer alternative design is usually judged by weighing an increase in safety to consumers against the costs of making the product safer, potential new dangers of the proposed design, and loss of overall utility of a product.[30] For example, a court would not consider adding two more wheels, doors, and a roof to a motorcycle a reasonable alternative design because the added safety benefits of this design would completely destroy the utility of a motorcycle.

Despite the differences between the Consumer Expectations Test, the Risk-Utility Test, and negligence, the inquiry in most design defect cases is generally the same: did the product's design render it unreasonably dangerous. Thus, in cases where design defect claims are brought under both theories of liability, the distinction between the two theories is irrelevant as it is logically impossible for one to have reasonably chosen an unreasonably dangerous design, just as it is logically impossible to have unreasonably chosen a safe design.[31] Therefore, most cases hinge on whether the design itself rendered the product unreasonably dangerous.[32]

In Texas, regardless of the underlying theory, in order to prevail the plaintiff must prove that 1) the product was defectively designed so as to render it unreasonably dangerous; 2) a safer alternative design exists, and 3) the defect was the cause of the injury alleged.[33] In short, the plaintiff has to satisfy two tests: a Risk-Utility Test and a Safer Alternative Design Test.

Texas uses a modified version of the Risk-Utility Test that incorporates consumer expectations to determine if a product is unreasonably dangerous. Some of the factors that have been used by the Texas Supreme Court include:

1. The utility of the product to the user and to the public as a whole weighed against the gravity
2. The availability of a substitute product which would meet the same need and not be unsafe or unreasonably expensive
3. The manufacturer's ability to eliminate the unsafe character of the product without seriously impairing its usefulness or significantly increasing its costs
4. The user's anticipated awareness of the dangers inherent in the product and their avoidability because of general public knowledge of the obvious condition of the product or of the existence of suitable warnings or instructions

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[28] *Id* at 145

[29] *Id* at 146

[30] Owen, David G. Products Liability Law. 2nd Edition. At 524.Thompson West (2008)

[31] *Id* at 501

[32] *Id*

[33] *Timpte Indus. v. Gish,* 286 S.W.3d 306, 311(Tex.2009); Tex. Civ. Prac. & Rem. Code Ann. § 82.005(a) (1)-(2) (West 2015)

5. The expectations of the ordinary consumer.[34]

The Court has cautioned that these factors must be looked at in the context of the product's intended use and its intended users.[35] Furthermore, whether a product is unreasonably dangerous is usually a question of fact; however, in cases where reasonable minds cannot differ, a product may be unreasonably dangerous as a matter of law.[36]

In Texas, a "safer alternative design" means:

> A product design other than the one actually used that in reasonable probability:
>
> (1) would have prevented or significantly reduced the risk of the claimant's personal injury, property damage, or death without substantially impairing the product's utility; and
>
> (2) was economically and technologically feasible at the time the product left the control of the manufacturer or seller by the application of existing or reasonably achievable scientific knowledge.[37]

To illustrate, the plaintiff in *Genie Industries* alleged that a design defect of an aerial lift (a platform that can be raised and lowered and is commonly used in the construction industry) rendered the lift unreasonably dangerous and that this defect was the cause of the plaintiff's injuries.[38] The plaintiff alleged that the aerial lift was unreasonably dangerous as designed because, when it was fully extended vertically, the lift would tip over when moved horizontally.[39] A jury found that the design of the lift was defective and ruled for the plaintiff.[40]

In reviewing the jury's judgment, the Texas Supreme Court did not mention the theory of liability presented at trial and instead conducted a full product liability analysis under Texas law. First, the Court held that, while the evidence was weak, the plaintiff had successfully introduced enough evidence for a jury to conclude that a safer alternative design existed for the aerial lift.[41] The plaintiff introduced alternative designs, such as including a locking mechanism, that would have prevented the machine from being moved horizontally while the lift was fully extended.[42]

Turning next to the question of whether the lift was unreasonably dangerous as designed, the Court applied the Risk-Utility factors. In its analysis, the Court found that, overall, the risk of someone moving the lift horizontally while it was fully extended was slight compared to the utility of the lift as designed.[43] As such, the Court held that the product was not unreasonably dangerous as a matter of law and reversed the jury in favor of the defendant manufacturer.[44] Thus, *Genie* demonstrates the need for

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[34] *Timpte Indus. v. Gish,* 286 S.W.3d 306, 311(Tex.2009)

[35] *Id* at 312.

[36] *Id.*

[37] Tex. Civ. Prac. & Rem. Code Ann. § 82.005(b) (1)-(2) (West 2015)

[38] *Genie Indus., Inc. v. Matak,* LEXIS 437 (May 8 2015)

[39] *Id* at *1-2

[40] *Id* at *2

[41] *Id* at *13-18.

[42] *Id.*

[43] *Id* at *19-26

[44] *Id* at *27

plaintiff to satisfy both the Safer Alternative Design Test and the Risk-Utility Test in order to prevail on a design defect claim under Texas law.

Manufacturing Defects Claims

A manufacturing defect claim involves a product that "deviates, in terms of its construction or quality, from the specifications or planned output in a manner that renders it unreasonably dangerous."[45]

Today, because of increases in advances in quality control and improvements in mass production technology, manufacturing defects represent a small portion of products liability cases that reach trial.[46] Additionally, since manufacturing defects are quite clear when they appear, there is a great incentive for defendants to settle instead of fully litigating a case.[47]

For manufacturing defect claims brought under negligence, a plaintiff has to prove that the manufacturer failed to exercise reasonable care in the manufacturing of the product at issue.[48] The reasonableness of a manufacturer's behavior is judged using the traditional negligence principle of reasonableness under the circumstances, which takes into account a variety of factors including the risk of foreseeable harm and the foreseeability of the harm itself balanced against the cost or burden of preventing the harm that occurred.[49]

Like other products liability claims, however, a plaintiff may have difficulty proving that a manufacturer acted unreasonably. As such, it is far more common for a plaintiff to bring a strict liability manufacturing defect claim.[50] In fact, even when a manufacturer did act with reasonable care, they may still be strictly liable for the harms caused; Section 402(a), which Texas had adopted in full, explicitly states that a seller/manufacturer of a defective product is liable even if they exercised "all possible care."[51] In order to prevail on a strict liability manufacturing defect claim, a plaintiff must prove both that "[1]the product deviates, in terms of its construction or quality, from the specifications or planned output in a manner that [2] renders it unreasonably dangerous."[52]

Some states, including Texas, use a Consumer Expectations Test to determine whether a manufacturing defect has rendered a product unreasonably dangerous.[53] Under this test, courts ask whether consumers expect that a "mass-produced product will not differ from its siblings in a manner that makes it more dangerous than the others."[54] Implicit in the Consumer Expectations Test is the requirement that the plaintiff used the product as it was intended to be used.[55] Essentially, the test asks whether the defect has rendered the product unreasonably "dangerous beyond the safety expectations of the ordinary consumer."[56] In Texas, juries are instructed that products are unreasonably dangerous as

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[45] *American Tobacco v. Grinnell*, 951 S.W.2d 420, at 434 (Tex. 1997)

[46] Owen, David G. Products Liability Law. 2nd Edition. At 448 Thompson West (2008)

[47] *Id.*

[48] Kiely, Terrence & Bruce Ottley, Understanding Products Liability Law. At 167 LexisNexis, (2006)

[49] Owen, David G. Products Liability Law. 2nd Edition. At 455 Thompson West (2008)

[50] *Id.*

[51] Restatement (Second) of Torts, § 405(a) (1965)

[52] *American Tobacco v. Grinnell*, 951 S.W.2d 420, at 434 (Tex. 1997)

[53] Kiely, Terrence & Bruce Ottley, Understanding Products Liability Law. At 168 LexisNexis, (2006)

[54] *Ford Motor Company v. Pool,* 688 S.W.2d 879, 881 (Tex.App—Texarkana, 1985)

[55] Kiely, Terrence & Bruce Ottley, Understanding Products Liability Law. At 169 LexisNexis, (2006)

[56] Owen, David G. Products Liability Law. 2nd Edition. At 458 Thompson West (2008)

the result of manufacturing defects when the product is rendered "dangerous to an extent beyond that which would be contemplated by the ordinary user of the product, with the ordinary knowledge common to the community as to the product's characteristics."[57]

Plaintiffs often find it difficult to prove the existence of a manufacturing defect due to a lack of direct evidence.[58] As such, courts have applied various doctrines that allow a factfinder to infer the existence of a manufacturing defect via circumstantial evidence.[59] For claims based on negligence, courts apply the doctrine of *res ipsa loquitor*, a tool that can be used in all negligence claims, not just products liability.[60] *Res ipsa* "means simply that the nature of the occurrence itself furnishes circumstantial evidence of negligence."[61] *Res ipsa* is applicable when "(1) the character of the incident is such that it would not normally occur in the absence of negligence, and (2) the instrumentality causing the injury is shown to have been under the management and control of the defendant."[62]

Courts have been reluctant to use *res ipsa* for strict liability claims, however, as *res ipsa* is focused on the behavior of the defendant and not on the defective nature of the product.[63] Because of this reluctance, courts in most jurisdictions now recognize what is known as the "malfunction doctrine."[64] Under the malfunction doctrine, a factfinder is permitted to infer the existence of a manufacturing defect from circumstantial evidence if "(1) the product malfunctioned, (2) the malfunction occurred during proper use, and (3) the product had not been altered or misused in a manner that probably caused the malfunction."[65] Essentially, the malfunction doctrine allows a plaintiff to avoid proving the existence of a *specific* defect if circumstantial evidence demonstrates that the product was probably defective in some way.[66] This doctrine is now considered widespread and has been adopted in the Restatement (Third) of Products Liability § 3.[67]

Texas, however, has refused to adopt this section. The Texas Supreme Court has expressly stated that, "even if section 3 were the law in Texas, it would generally apply to new or only new products."[68] Plaintiffs, however, can still rely on normal principles of circumstantial evidence to establish the existence of a manufacturing defect. They simply must introduce enough evidence to allow a reasonable jury to infer the existence of a defect, without relying on the product's malfunction alone.

To illustrate an example of a manufacturing defect claim, in *Fitzgerald Marine Sales*, the plaintiff alleged that a manufacturing defect caused his injuries when, while driving a boat, he grabbed onto the steering wheel, which broke off, throwing him into the water.[69] Reviewing the jury's judgment in favor of the plaintiff, the Court found that the steering wheel was in fact defective; the Court found that both the

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[57] Vol 2, *Edgar & Sales, Texas Torts and Remedies* at § 41.03 (Matthew Bender, Rev. Ed.)(LEXIS 2015)(citing Texas Pattern Jury Charges, Ch. 71, *Products Liability—Theories of Recovery*, § 71.3, at 160 (State Bar of Texas 2002).

[58] Owen, David G. Products Liability Law. 2nd Edition. At 464 Thompson West (2008)

[59] *Id* at 465-466.

[60] *Id.*

[61] *Porterfield v. Brinegar,* 719 S.W.2d 558, 559 (Tex. 1986).

[62] *Id.*

[63] Owen, David G. Products Liability Law. 2nd Edition. At 465Thompson West (2008)

[64] *Id.*

[65] *Id* at 466.

[66] *Id.*

[67] *Id* at 474.

[68] *Ford Motor Co. v. Ridgway*, 135. S.W.3d 598, 601-602 (Tex. 2004).

[69] *Fitzgerald Marine Sales v. LeUnes,* 659 S.W.2d 917 (Tex.App—Fort Worth, 1983)

fact that the wheel broke and that the plaintiff's evidence that the plastic on the wheel was not as strong as it should have been were sufficient for a jury to conclude a manufacturing defect had occurred.[70] However, the Court held that the wheel was not unreasonably dangerous because it found that the intended use of the steering wheel was steering the boat and that the wheel was not intended to be used as a restraining device; because the plaintiff had not introduced evidence to suggest that the wheel was unreasonably dangerous beyond the safety expectations of an ordinary consumer when used as a steering device, the Court reversed the judgment and ruled in favor of the defendant.[71] Thus, *Fitzgerald Marine Sales* illustrates the requirements that a plaintiff must meet in Texas to prevail on a manufacturing defect claim.

Failure to Warn Claims

Failure to warn claims may be brought under the theories of negligence, strict liability, or breach of warranty. Some commentators argue that, in practice, it does not matter what theory a plaintiff brings a claim under, as courts analyze the claim using principles of negligence.[72]

Failure to warn claims, also known as marketing defect claims, occur when a manufacturer has inadequately or failed to **warn or instruct** a consumer about the foreseeable harms that could result from using a product.[73] Inadequate warnings or instructions are considered defects that render a product unreasonably dangerous.[74] Failure to warn claims have several component issues, all of which will be discussed. These issues are whether a manufacturer had a duty to warn, whether the manufacturer did in fact warn the consumer, and whether that warning was adequate.

In order to prevail on a marketing defect/failure to warn claim in Texas, a plaintiff must prove that:

1. A risk of harm that is inherent in the product or that may arise from the intended or reasonably anticipated us of the product exists
2. The product supplier or manufacturer must actually know or reasonably foresee the risk of harm at the time the product is marketed
3. The product must possess a marketing defect, i.e., the absence or inadequacy of a warning or instruction
4. The absence of the warning and/or instruction must render the product unreasonably dangerous to the ultimate user
5. The failure to warn and/or instruct must constitute a causative nexus in the user's injury.[75]

The claim is based on the principal that manufacturers have a duty to warn to warn of "hidden product dangers" and to provide instructions on how to safely use a product.[76] The existence of a legal

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[70] *Id* at 918.

[71] *Id* at 918.

[72] Owen, David G. Products Liability Law. 2nd Edition. At 588 Thompson West (2008). *See also* Kiely, Terrence & Bruce Ottley, Understanding Products Liability Law. At 183 LexisNexis, (2006)

[73] *Id* at 180.

[74] Owen, David G. Products Liability Law. 2nd Edition. At 581 Thompson West (2008).

[75] *USX Corp. v. Salinas,* 818 S.W.2d 473, 483 (Tex.App—San Antonio, 1991

[76] Owen, David G. Products Liability Law. 2nd Edition. At 581 Thompson West (2008).

duty is a question of law, meaning a court or a judge, not a jury, determines whether a duty is owed.[77] Courts impose a duty when a manufacturer "knew or should have known that the product posed a sufficiently serious risk of harm when used for its intended or reasonably foreseeable purposes and had no reason to believe that the users or consumers of the product would be aware of and understand the risk of harm."[78] Texas courts have imposed a duty on manufacturers when "they know or should know of a potential risk of harm presented by the product but market it without adequately warning of the danger or providing instructions for safe use."[79] The types of harm that necessitate a warning or instruction are the following:

1. A risk or danger inherent in the design of a product [i.e., a rotating saw is inherently dangerous]
2. Foreseeable dangers or risks of harm from unintended uses of a product [also known as "foreseeable misuses"]
3. Risks or dangers that affect only a limited number of users susceptible to a danger in the product [i.e., toys with small, removable parts present a danger to young children but not older ones]
4. Unavoidably unsafe products [such as drugs][80]

Foreseeable risks are those risks that are "reasonable to anticipate."[81] In determining whether a risk was foreseeable, courts hold manufacturers to standard of an expert possessing knowledge of the latest scientific advances.[82] For example, in *Rawlings*, the Court held that the defendant, who manufactured football helmets, actually knew that its helmets would not protect against brain injuries or subdural hematomas when used and that the defendant knew that there was a significant risk of brain injury when its products were used as anticipated, i.e., during a football game.[83] As such, the Court held that the defendant had a duty to warn about the risks of brain injury from the use of its helmets and that its failure to do so constituted a breach of that duty.[84]

Thus, if a manufacturer has a duty to warn or instruct, it must do so. Obviously, a warning or instruction that doesn't exist is, by definition, inadequate. For cases where manufacturers actually furnished warnings or instructions, adequacy of the warning or instruction is usually a question of fact that must be decided by a jury.[85] In Texas, a warning or instruction is adequate if:

1. It could reasonably be expected to catch the attention of the reasonably prudent man in the circumstances of its use

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[77] Kiely, Terrence & Bruce Ottley, Understanding Products Liability Law. At 185 LexisNexis, (2006)

[78] *Id* at 187.

[79] *USX Corp. v. Salinas,* 818 S.W.2d 473, 482 (Tex.App—San Antonio, 1991).

[80] *Id* at 483.

[81] *Id*.

[82] *Id.*

[83] *Rawlings Sporting Goods co. v. Daniels,* 619 S.W.2d 435, 439 (Tex. App—Waco, 1981)

[84] *Id*.

[85] *Bituminous Cas. Corp. v. Black & Decker Mfg. Co.,* 518 S.W.2d 868, 873-875 (Tex.App—Dallas, 1974).

2. The content of the warning must be of such a nature as to be comprehensible to the average user and to convey a fair indication of the nature and extent of the danger to the mind of a reasonably prudent person.[86]

Some courts have added a third requirement that the warning warn with a "degree of intensity that would cause a reasonable man to exercise for his own safety the caution commensurate with the potential danger."[87] To illustrate, in *De La Lastra*, the Court held that sufficient evidence existed for a jury to conclude that the warnings were inadequate.[88] Specifically, the Court held that a jury could conclude that the warning, which only warned that the chemical was toxic and had possible harmful effects if the chemical came into contact with skin, was inadequate because the warning in general and the word "toxic" specifically did not convey the possibility of death and asphyxiation.[89]

If a warning or instruction is deemed inadequate, a plaintiff must also prove that the inadequacy was part of a causal nexus of their injuries. In short, the plaintiffs have to prove that had the warning or instruction been adequate they would not have been injured. To facilitate this, courts have applied what is known as the heeding presumption, which is a rebuttable presumption that a user would have read or heeded the warnings or instructions had they existed/been adequate.[90] This presumption can be rebutted by evidence that "the user was blind, illiterate, intoxicated at the time of the product's use, irresponsible, lax in judgment, or by some other circumstance tending to show that the improper use would have occurred regardless of the proposed warnings or instructions."[91]

In Texas, the presumption operates in two different ways. It always applies in cases where no warning or instructions were provided.[92] In cases where a defendant provides an inadequate warning, however, the inquiry is more complicated and is focused on whether following the inadequate warning would have prevented injury.[93] If following the inadequate warning or instruction would have prevented the injury, then no presumption applies and the plaintiff must introduce evidence to demonstrate that the inadequate warning caused, actually and proximately, the injury.[94] Furthermore, the presumption does not apply when a plaintiff ignores inadequate instructions.[95] On the other hand, if the inadequate warning would not have prevented the injury, then the rebuttable presumption applies.[96] For example, in *Hillhouse,* the Court held that the jury had sufficient evidence to conclude that the defendant's warnings on where to safely place a child's car seat were inadequate and were the cause of the plaintiff's daughter's injuries.[97] In *Hillhouse,* the plaintiff testified that she read both of the defendant's warnings but was confused by them; the Court, applying *Saenez*, held that in circumstances where the plaintiff is confused

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[86] *Id* at 872-873.

[87] *Id.*

[88] *General Chemical Corp. v. De La Lastra,* 815 S.W.2d 750, 755 (Tex.App—Corpus Christi, 1991).

[89] *Id* at 754-755.

[90] *Magro v.Ragsdale Bros. Inc.,* 721 S.W. 2d 832, 834 (Tex. 1986)

[91] *Id.*

[92] *General Motors Corp. v. Saenez ex rel. Saenez,* 873 S.W.2d 353, 359 (Tex. 1993)

[93] *DaimlerChrysler Corp. v. Hillhouse*, 161 S.W.3d 541, 550 (Tex.App—San Antonio, 2004).

[94] *Id*.

[95] *Id.*

[96] *Id.*

[97] *Id.*

or misled by warnings, it is "reasonable to presume" that a clearer warning would have been followed.[98] Thus, the rebuttable heeding presumption applies in different situations and may assist a plaintiff in proving that the inadequate warnings or instructions caused their injuries.

Unlike most states, Texas does not recognize a post-sale duty to warn of defects not discovered until after a product has been manufactured and sold.[99] Only two limited exceptions to this rule exist. These exceptions are best illustrated in the case of their origin, *Bell Helicopter Co. v. Bradshaw.* First, a manufacturer can assume a voluntary post-sale duty to warn. In *Bradshaw*, the Court affirmed the trial court's finding that the defendant manufacturer voluntarily assumed a duty when it instituted a program to inform users that the blades on its helicopters needed to be replaced; the program consisted of sending a service announcement to owners of the helicopter in question and a service bulletin to all of its authorized service agents[100]

Secondly, the Court in *Bradshaw* recognized another limited exception in situations where the manufacturer retains a significant degree of control over the product. The Court held that the defendant had a significant degree of control over the product after it was initially sold because the defendant manufacturer sold a helicopter, learned of a defect in the helicopter's blades, reacquired the helicopter via an authorized service station, and then resold the helicopter to another customer without changing the blades or warning of their defect.[101] Contrastingly, the Court, in *Dion*, affirmed the trial court's finding that the defendant did not have a significant degree of control over the product and thus did not have a duty to warn.[102] Specifically, the defendant in *Dion* never regained control of the defective tractor at issue in the case after it initially sold it; unlike the defendant in *Bradshaw*, the defendant in *Dion* never reacquired title to the tractor and never instituted a replacement part program for the defect of the tractor.[103] Thus, while a post-sale duty warn is generally not imposed, it may be imposed in certain circumstances.

Breach of Warranty

A plaintiff can also bring a claim for injuries suffered under breach of warranty. A breach of warranty claim is rooted in contract law and is governed by provisions of the Uniform Commercial Code, the relevant portions of which Texas has adopted.

While negligence and strict liability claims are the most common forms of products liability claims, plaintiffs often bring breach of warranty claims for a variety of strategic reasons, including easier burdens of proof and longer statute of limitations.[104] Additionally, if a person is not actually injured and only suffers economic loss due to a non-properly functioning product, they are limited to bringing a breach of warranty claim.[105]

There are, however, several limitations on breach of warranty claims, the most important of which is *privity*. Privity is the concept of a contractual relationship. For example, a buyer of an automobile from

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[98] *Id.*

[99] Miloch II, Theodore C. "Texas," Post-Sale Duty to Warn: A Report to the Products Liability Committee. At 129, American Bar Association, 2004. *See also Torrington, Co. v. Stutzman,* 46 S.W.3d 829, 836-837 (Tex. 2000)

[100] *Bell Helicopter Co. v. Bradshaw,* 594 S.W.2nd 519, 527 (Tex.App—Corpus Christi, 1979).

[101] *Bell Helicopter Co. v. Bradshaw,* 594 S.W.2nd 519, 528-531 (Tex.App—Corpus Christi, 1979).

[102] *Dion v. Ford Motor Co.,* 804 S.W.2d 302, 311-312 (Tex.App—Eastland, 1991).

[103] *Id.*

[104] Kiely, Terrence & Bruce Ottley, Understanding Products Liability Law. At 28-29 LexisNexis, (2006)

[105] *Id.*

a used car dealership would have privity with the used car dealership but not the original manufacturer of a car. Privity is not a requirement for breach of implied warranties of merchantabilities but is for express warranty claims.[106] Additionally, a buyer in breach of warranty claim must prove that the warranty was breached, i.e., the good did not conform to the warranty in order to recover.

A warranty is a form of a promise. The focus on breach of warranty claims is whether the product conformed to the promises of the seller.[107] There are three types of warranties: express warranties, implied warranties of merchantability, and implied warranties of fitness.

An express warranty is a "representation of fact made by the seller of a product to a potential buyer that the product has a particular quality and will perform in a specific manner."[108] An express warranty is created in three ways:

1. Any affirmation of fact or promise made by the seller to the buyer that relates to the goods and becomes part of the basis of the bargain creates an express warranty that the goods shall conform to the affirmation or promise.
2. Any description of the goods that is made part of the basis of the bargain creates an express warranty that the goods shall conform to the description.
3. Any sample or model that is made part of the basis of the bargain creates an express warranty that the whole of the goods shall conform to the sample or model.[109]

The "basis for the bargain" requirement "loosely reflects the common-law express warranty requirement of reliance."[110] Reliance is when an actor changes his or her position on the basis of another's statements or behavior. In this context, reliance essentially means that a potential buyer buys the product because of the seller's statements. It should be noted, however, that a seller's opinion on the goods or an affirmation of the value of the goods does not create an express warranty.[111]

An implied warranty of merchantability is a warranty that "the goods shall be merchantable" and is implied "in a contract for their sale when the goods are sold by a merchant who deals in goods of that kind."[112] A good is "merchantable" when it meets certain standards outlined in § 314 of the Texas Business and Commerce Code; for products liability purposes, the most relevant standard is that the goods be fit for their ordinary purpose for which such goods are used.[113] In order to recover under a claim for breach of implied warranty of merchantability, a plaintiff must notify the defendant of the breach, must sue the defendant, and must prove that the good was unmerchantable and that the plaintiff suffered injury.[114]

An implied warranty of fitness arises when the "seller at the time of contracting has reason to know any particular purpose for which the goods are required and that the buyer is relying on the seller's

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[106] Cochran, Stephen G. "Texas Consumer Law Handbook" 28A Tex.Prac.,Texas Consumer Law, Chapter 3A (Westlaw, 2014). *See also Nobility Homes of Texas, Inc. v. Shivers,* 577 S.W.2d 77 (Tex. 1977)

[107] Kiely, Terrence & Bruce Ottley, Understanding Products Liability Law. At 28-29 LexisNexis, (2006)

[108] *Id* at 30.

[109] Tex. Bus. & Com. Code § 2.313(a)(1)-(3) (West 2015).

[110] *American Tobacco v. Grinnell*, 951 S.W.2d 420, 436 (Tex. 1997)

[111] Tex. Bus. & Com. Code § 2.313(b) (West 2015).

[112] Tex. Bus. & Com. Code § 2.314(a) (West 2015).

[113] *Id* at (b)(3).

[114] *Hartford v. Lyndon-DFS Warranty Servs.,* LEXIS 4241, *28 (Tex. App—Houston, May 28, 2010)

skill or judgment to select or furnish suitable goods."[115] For example, in *Chandler*, the Court held that an implied warranty of fitness did not arise in a personal injury case involving an automobile and an airbag, because no evidence existed to support the conclusion that the buyer-plaintiff purchased the vehicle for any other purpose other than the ordinary purpose of the vehicle, i.e., transportation.[116]

Under the Uniform Comparative Code (UCC), all warranties may be disclaimed or excluded from a contract for sale, under certain circumstances.[117] Additionally, sales contracts can also contain provisions that limit a plaintiff's ability to sue or recover certain types of damages under the code. [118]

Thus, breach of warranty claims are another, albeit limited, potential source of liability for products manufacturers.

Other Relevant Elements of Texas Law

There are other elements of Texas's products liability law that may be relevant in the AV/CV context.

Most notably, § 82.008 of the Texas Civil Practice and Remedies Code allows a defendant in a products liability action to establish a rebuttable presumption that they are not liable if their product conforms to mandatory safety standards or regulations, or to pre-market licensing requirements promulgated by the federal government or a federal agency.[119] This presumption can be rebutted by a showing that the standards, regulations, or pre-market licensing requirements were inadequate to protect the public from unreasonable risks or damage or by a showing that the defendant withheld material information from the federal government or agencies.[120]

Another area of interest is the potential liability of component part manufacturers. The Supreme Court of Texas has held that "if the component-part manufacturer does not participate in the integration of the component into the finished product, it is not liable for defects in the final product if the component itself is not defective."[121]

Texas bars plaintiffs from using subsequent remedial measures to prove the existence of negligence, culpable conduct, a defect, or a need for a warning or an instruction.[122] A subsequent remedial measure is one that "would have made an earlier injury or ham less likely to occur."[123] Subsequent remedial measures are permitted to be introduced into evidence, however, if the issue of control or feasibility of precautionary measures is controverted.[124] A manufacturer's written notification to a purchaser of a defect in one of its products is admissible to prove the existence of a defect.[125]

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[115] Tex. Bus. & Com. Code § 2.315 (West 2015).

[116] *Chandler v. Gene Messer Ford Co.,* 81 S.W.3d 493, 504 (Tex.App—Eastland, 2011).

[117] Kiely, Terrence & Bruce Ottley, Understanding Products Liability Law. At 55 LexisNexis, (2006). See also Tex. Bus. & Com. Code § 2.316 (West 2015).

[118] *Id.*

[119] Tex. Civ. Prac. & Rem. Code Ann. § 82.008 (West 2015)

[120] *Id.*

[121] *Bostrom Seating, Inc. v. Crane Carrier Co*., 140 S.W.3d 681, 683 (Tex. 2004) ("if no evidence exists to indicate that the component part was itself defective, the component-part manufacturer should be relieved of any liability for a design or manufacturing defect in the final product, including any action for indemnification.")

[122] Tex. R. Evid. § 407(a) (West 2015).

[123] *Id.*

[124] *Id.*

[125] *Id.*

Defenses to Products Liability Claims in Texas

In Texas, the traditional defenses to products liability claims such as unforeseeable misuse of a product and assumption of risk have been subsumed under the state's contributory negligence law.[126] In Texas, a factfinder may take into account a plaintiff's conduct when determining liability.[127] If a factfinder finds that a plaintiff was more than 50% responsible for his or her own injuries, a defendant is not liable.[128] If, on the other hand, a plaintiff is less than 50% proportionately responsible for his or her injuries, then the defendant can be found liable and the plaintiff may recover a corresponding proportion of the damages awarded.

Application to Autonomous and Connected Vehicles

One of the biggest obstacles to implementation of AV and CV technology cited by scholars are the uncertain effects of the current liability system on AV and CV manufacturers. The secondary literature on AV and CV mostly examines the possible incentives and deterrence effects that the liability system could have on manufacturers. Furthermore, some of the literature examines how AVs and CVs would fit conceptually into the existing liability regime and how the law would potentially react to some of the novel features of AVs and CVs.

Some scholars have posited that the existing products liability framework can capture AV and CV technology and that the current framework is sufficiently adaptive to the implementation of this technology.[129] Additionally, some scholars claim that as the technology is implemented and drivers do less driving, manufacturers will face more liability, which may cause a chilling effect that could slow widespread implementation.[130] A major difficulty in assessing the validity of these claims is that the technology is not widely known or understood outside science and engineering circles.

A Note on Innovation and the Tort System in General

It is impossible, of course, to predict with any degree of certainty how the tort system will react to and incorporate AVs and CVs. Uncertainty about operation of the devices, unknown problems or risks associated with the technology or aspects of the technology, and the expertise required to understand the technology clouds the legal implementation with uncertainty. Furthermore, at least in the short term, the limited availability of these vehicles will limit the legal system's ability to fashion broadly applicable rules and standards. Thus, a practitioner's or stakeholder's ability to predict how the system will react to these vehicles is limited from the outset.

That being said, it may be possible to predict, using historical analogies, how the system will react in general to AVs and CVs. Examining the history of the tort system's reaction to the automobile, plane, and Tasers, Professor Kyle Graham of Santa Clara University posits that the system's past reactions to

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[126] Vol 2, *Edgar & Sales, Texas Torts and Remedies* at § 42.01[5] (Matthew Bender, Rev. Ed.)(LEXIS 2015).

[127] Tex. Civ. Prac. & Rem. Code Ann. § 33.003 West 2015)

[128] Tex. Civ. Prac. & Rem. Code Ann. § 33.001 West 2015)

[129] Villasenor, John. "Products Liability and Driverless Cars: Issues and Guiding Principles for Legislation" (Brookings, 2014).

[130] Kalra, Nidhi, James M. Anderson, and Martin Wachs, "Liability and Regulation of Autonomous Vehicle Technologies," at 17 California PATH Research Report (2009)

these innovations may provide a guide or a framework for understanding how the rules applied to AVs and CVs will develop. He cautions, however, that uncertainty will persist for quite some time.[131]

Professor Graham posits that the tort system reacts to innovations in five stages or ways. First, the first batch of cases lays down rules that survive for some time, even though these cases do not resemble the later cases.[132] For example, the earliest cases involving automobiles did not involve multicar collisions, suits against manufacturers, passengers against drivers, or pedestrians against drivers; the legal or factual perquisites for these types of claims did not exist at the time.[133] For example, there weren't that many cars on the road to begin with, so multicar collision cases were unlikely to occur.[134] Similarly, the doctrine of contractual privity generally precluded plaintiffs from suing manufacturers. Because of this, most early automobile cases involved frightened horses.[135] At the time, there already existed a large body of law about claims for injuries resulting from frightened horses. Horses shared the streets with other animals, trolleys, streetcars, and bicycles. As such, plaintiffs in early suits drew upon these cases for support in their automobile cases.[136] Initially, at least some courts were receptive to the idea that merely operating an automobile on a highway or road with horses could, at least, present a fact question as to whether the defendant had breached the standard of care.[137] Judges, however, came to realize that horses would eventually get used to cars and that these types of accidents would subside.[138] As a result, judges were reluctant to regulate from the bench and declined to hold drivers strictly liable, to find that cars were nuisances as a matter of law, and to hold that merely driving a car on a highway presented a fact question. This lack of judicial regulation yielded a set of forgiving principles that, according to Graham, formed the bedrock foundation for automobile jurisprudence.[139]

The second aspect of Graham's framework is that early cases tend to rely on analogies to existing technology that is similar in form to the new technology.[140] He argues that these analogies are eventually abandoned in favor of a more holistic analysis of the risks and benefits of the new technology itself.[141] He argues that this reliance on analogy is sensible from a practical point of view: given that the risks and benefits of the technology are unknown, it makes sense to rely on the known risks and dangers of a similar technology to decide a case.[142] For example, when airplanes were a new technology, courts struggled to fashion a liability rule governing cases involving damage from falling or crashed aircraft.[143] Borrowing from hot-air balloon damage cases, courts adopted a strict liability rule for planes; courts recognized that planes, like balloons, fly through the sky and, occasionally, crash to the ground.[144] Strict liability for planes

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[131] Graham, Kyle, *Of Frightened Horses and Autonomous Vehicles: Tort Law and its Assimilation of Autonomous Vehicles*, 52 SANTA CLARA L. REV 1241, 1269 (2012).

[132] *Id.* at 1243.

[133] *Id.* at 1243–46.

[134] *Id.* at 1243.

[135] *Id.* at 1247.

[136] *Id.*

[137] *Id.* at 1248.

[138] *Id.* at 1249–50.

[139] *Id.* at 1250.

[140] *Id.* at 1252

[141] *Id.*

[142] *Id.* at 1256.

[143] *Id.* at 1254.

[144] *Id.*

has persisted, despite the fact that planes have a different risk-benefit profile than hot-air balloons.[145] Recently, however, many academics have called for plane-falling cases to be analyzed using negligence principles, since planes are generally safer than hot-air balloons and because these types of cases occur relatively infrequently.[146]

Thirdly, Professor Graham argues that the tort system tends to either overestimate the risks and dangers of a new technology or underestimate them in favor of the technology's benefit.[147] To demonstrate this claim, Professor Graham uses the examples of hybrid cars and Tasers. Initially, many consumers were concerned that hybrid-electric vehicles, which operate silently while driving under certain speeds, would be dangerous to pedestrians and bicyclists.[148] Despite the fact that not a single case involving the lack of an alert noise on these vehicles has been decided, according to Professor Graham, President Obama recently signed a law mandating the inclusion of alert noises for these vehicles, 10 years after they first hit the streets.[149] Contrastingly, the Taser, when first introduced in the 1970s, was hailed as a wonderful, nonlethal alternative to firearms.[150] It is only recently that the public and the tort system have begun to grasp the risks associated with these devices in certain situations. Indeed, between 1987 and 2005, no Taser products liability cases appeared in the Westlaw federal and state case law database.[151] Thus, Professor Graham uses the hybrid car and Taser example to show that the tort system takes time to truly appreciate and grasp the risks and benefits of a novel technology. In the short term, the public and the system are likely to either over- or underestimate the risks and benefits, which could lead to reactionary rules or complacency in the face of danger.

Fourthly, Professor Graham claims that in early cases of new technologies courts tend to focus their attention on the consumer of the product or technology, rather than on the manufacturer.[152] Using the early automobile cases as a guide, Graham argues that the law regards early adopters as "taking their chances."[153] This tendency may be rooted in the inability of the courts to understand the actual risks or dangers of the product or its component causing the damage or problem.[154] For example, when cars were in their infancy, many commentators believed that car accidents were caused by reckless, speeding drivers instead of faulty steering equipment; one commentator claimed that it was difficult to fathom so many cars could be constructed faultily.[155] Today, of course, the law recognizes that this is often not the case. Until courts can fully appreciate the new technology, therefore, courts may simply place the blame on the user of the product as opposed to the manufacturer.

Fifthly and finally, Professor Graham argues that the tort system either rewards innovations with a "honeymoon" period or, sometimes, discourages innovation because of uncertainty.[156] He, however,

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[145] *Id.* at 1255.

[146] *Id.*

[147] *Id.* at 1246.

[148] *Id.* at 1257.

[149] *Id.*

[150] *Id.* at 1258.

[151] *Id.*

[152] *Id.* at 1260.

[153] *Id.*

[154] *Id.* at 1261.

[155] *Id.* at 1262.

[156] *Id.* at 1266.

argues that, more often than not, the system favors innovations.[157] Furthermore, Graham argues that while uncertainty about a given technology may stifle innovation and implementation, it just as easily could stifle the filing of claims and law suits; plaintiffs' lawyers may not risk filing a suit if they don't think their claims will be successful or even recognized.[158]

Ultimately, Professor Graham concludes that AV and CV will evolve over time and that, initially, these claims will arise as negligence claims or claims paralleling negligence.[159] Graham also believes that early products liability claims will be failure to warn claims due to the inherent difficulties in understanding the technology.[160] Finally, Graham argues that AVs and CVs will likely enjoy a "honeymoon" period and that we need not fear that liability will stifle innovation and implementation.

Whether or not AVs and CVs will mirror Professor Graham's innovation framework or whether his predictions are true remains to be seen. At the very least, however, his framework provides a potential way that the tort system can incorporate AVs and CVs.

Section 2: Potential Liability Issues related to C/AVs

Direct Application: Introduction and Baselines

Using Texas law as a legal baseline, this memo will analyze the potential liability issues facing manufacturers as AV and CV technology is implemented. In doing so, it will focus its analysis on the types of products liability claims. It will also describe the scenarios in which manufacturers could be held liable in an attempt to test the validity of the scholarly claims mentioned above.

This memo assumes that, in the short term, more Level 2 AVs will be introduced and that Level 3 vehicles will begin to be introduced. It also assumes that in the short and medium terms, more and more Level 3 vehicles will be introduced into the markets. Finally, it is assumed that manufacturers and consumers will eventually introduce and demand fully autonomous Level 4 vehicles.

With regards to CVs, this memo also assumes that Level 2, 3, and 4 AVs will have some features that make them "connected." This memo assumes that the manufacturer of the vehicles will install these connective features. As such, for these vehicles and even fully CVs the focus remains squarely on the manufacturer (as opposed to governmental entities).

The following discussion of the claims in the AV and CV context assumes that a plaintiff can allege a specific defect or a defect in general.

It also should be noted at the outset that the presence of software in AVs and CVs presents complications under all of the claims. To date, despite a large body of academic commentary suggesting they do so, courts have refused to subject software defects to strict liability.[161] Additionally, since it is nearly impossible to design software without errors, it follows that plaintiffs have tremendous difficulty in proving that software was negligently coded/created.[162] Despite this, this memo will, where applicable, assume that manufacturers can be held strictly liable for defects in their software.

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[157] *Id.* at 1268.

[158] *Id.* at 1268–69.

[159] *Id.* at 1270.

[160] *Id.*

[161] Polin, David. "Proof of Manufacturer's' Liability for Defective Software" *68 Am. Jur.Proof of Facts 3d § 333* (Updated April 2015) (West 2015) ("No cases have been found applying strict liability to software").

[162] *Id.*

AVs and CVs: Design Defect Claims

For design defects claims, the potential liability of manufacturers in Texas is unclear. Due to the complexity of these products, plaintiffs may have difficulty proving a design defect. For example, in a situation where an AV or CV's poorly designed software caused an accident, a plaintiff would have to hire a computer expert to examine the algorithm. The jury would then be subjected to a discussion of the algorithm in question, and allegedly safer algorithms, which would likely confuse them—the jury could plausibly throw up its hands and hold the manufacturer liable or could find that the algorithm in question was not defective.

Because of these difficulties, it has been suggested that plaintiffs will focus design defect claims on the tangible aspects of the car, such as when a car is designed with one laser sensor on the front of the vehicle instead of two.[163] Of course, these design defect claims can also involve a tremendous amount of complexity and will also necessitate the use of expert testimony, but these claims will likely be easier for a jury or judge to understand.

One potential problem for design defect claims in the AV and CV context is what would constitute a safer alternative design. In the short term, as AVs and CVs are implemented, it is conceivable that a court could rule that a safer alternative design would be one not having a particular feature of automation.[164] This is particularly true in the short term because people tend to be apprehensive of new or exotic technology.[165] In that instance, a chilling effect could likely result. On the other hand, as consumers become acquainted with the technology in the medium term, it is also conceivable that a court could rule more automation would have been a safer alternative, which, if more automation is more expensive, could chill the further implementation of the technology, or could actually spur its adoption, if alternatives are cheaper.[166] Furthermore, for Level 2 and 3 AVs, it is conceivable that a court could require a larger amount of warning time before an operator had to resume control over a vehicle.

In addition, even though Texas does not use the Consumer Expectations Test, consumer expectations are built into Texas's Risk-Utility Test as a factor. Consumers may have unrealistic expectations about the safety of automatic vehicles and their features, which could impact juries' risk-utility analyses in such a way as to find AVs and CVs unreasonably dangerous.[167]

The Risk-Utility Test presents other problems in the short term. Inevitably, as AVs and CVs are implemented in the short term, kinks and improvements will be discovered. Because one of the factors in the analysis is the availability of a substitute product that meets the same needs and y unsafe, juries may be inclined to that find non-autonomous vehicles are indeed substitute products that meet the same need. This problem could be avoided, however, during litigation if a defendant were to focus the inquiry more specifically, such as on an individual sensor or automatic feature.

Thus, the potential effect that design defect claims will have on AV and CV manufacturers is, at best, ambiguous in the short and medium terms.

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[163] Gurney, Jeffrey K. "Sue My Car, Not me: Products Liability and Accidents Involving Autonomous Vehicles." At 263-264 *U. Ill. JL Tech. & Pol'y* (2013).

[164] Marchant, Gary E. and Rachel A. Lindor, "The Coming Collision between Autonomous Vehicles and the Liability System," at 1335 Santa Clara Law Review, Vol.52 (2012)

[165] *See id.*

[166] Kalra, Nidhi, James M. Anderson, and Martin Wachs, "Liability and Regulation of Autonomous Vehicle Technologies," at 31 California PATH Research Report (2009)

[167] *Id* at 29.

AVs and CVs: Manufacturing Defects

As noted above, manufacturing defects represent a small proportion of products liability claims. Manufacturers have strong incentives to avoid producing defective products and have quality-control systems in place. Despite this, if an AV or a CV were to contain a manufacturing defect—for instance, if a sensor were manufactured defectively—the manufacturer would likely be held liable.

There is, however, one area that presents complications, at least until the issue has been squarely decided: software malfunctions. In the products liability context, the Texas Supreme Court has held that a "product is something distributed or otherwise placed, for any commercial purpose, into the stream of commerce for use or consumption."[168] It is an open question whether software fits this definition. Alternatively, software could also be viewed as a component part of the product, which would not affect the products liability analysis. Since software is not "manufactured" in the regular sense of the word, if software is not a product or a component part, plaintiffs might not be able to bring a manufacturing defect claim in cases involving software malfunctions.[169]

Finally, because Texas does not recognize the malfunction doctrine, a plaintiff would have to rely either on direct evidence or on circumstantial evidence to demonstrate the existence of a manufacturing defect; plaintiffs could not simply point to an accident or failure of autonomous technology as evidence in and of itself of a defect.[170]

AVs and CVs: Failure to Warn Claims

The impact of failure to warn claims on AV and CV manufacturers is also ambiguous. Some scholars suggest that there is likely to be substantial ligation involving failure to warn claims in the AV and CV context.[171]

In the short term, because consumers will be unfamiliar with AV and CV technology, manufacturers could have a duty to safely instruct consumers on how to use the vehicles. This duty could conceivably be discharged by either having users read an instruction manual, undergo a tutorial in the vehicle or at the dealership, or be certified in some way.[172]

Because of the nature of the technology and its various uses, it is unclear when the law will require manufacturers to warn consumers and in what form a warning should be delivered. For example, in Level 2 and 3 AVs, in situations that necessitate a driver reengage manual control, will the manufacturer be required to warn users to pay attention to the road at all times, or for certain amounts of times, or in certain circumstances? Will manufacturers be required to deliver these warnings audibly, visually, or both? Will manufacturers be required to tailor warnings to certain classes of people, i.e., audible warnings for blind people or extra loud warnings for seniors? What type of information will be required to be included that would make a warning legally adequate? How intense should they be? The plaintiff will, of

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[168] *Fresh Coat, Inc. v. K-2, Inc.,* 318 S.W.3d 893, 897 (Tex. 2010)

[169] Gurney, Jeffrey K. "Sue My Car, Not Me: Products Liability and Accidents Involving Autonomous Vehicles." At 258-260 *U. Ill. JL Tech. & Pol'y* (2013)

[170] *See id* at 259-260 for the application of the malfunction doctrine to AVs and CVs in general.

[171] Kalra, Nidhi, James M. Anderson, and Martin Wachs, "Liability and Regulation of Autonomous Vehicle Technologies," at 32, California PATH Research Report (2009)

[172] Gurney, Jeffrey K. "Sue My Car, Not me: Products Liability and Accidents Involving Autonomous Vehicles." At 264-265 *U. Ill. JL Tech. & Pol'y* (2013)

course, argue that the manufacturer should always be required to warn, while the manufacturer will argue that the user or situation specific warnings are impossible if not impracticable.[173]

Of course, a user could ignore the warnings. Because AVs and CVs will have EDRs that ostensibly, will be able to record when a warning was ignored or, at the very least, not followed by an operator, manufacturers will be able to tell when a user did not follow a warning. Because of Texas's rule regarding the non-heeding of warnings, manufacturers could possibly avoid liability in cases involving ignored warnings. If the warnings are unclear or misleading, however, the heeding presumption would apply.

Furthermore, the Texan exceptions to the no-post-sale-duty-to-warn rule may also present complications for AV and CV manufacturers. At least one current company, Nissan, offers its CARWINGS software on a subscription basis.[174] It is plausible that other manufacturers will do the same, especially in the short term. While the Nissan CARWINGS software is used for remotely managing the car's electric battery and other features, some manufacturers could offer the entirety of their software on a subscription basis. This might cause manufacturers to face a continuing obligation to warn of product defects and issues under Texas law. Because Texas permits the use of subsequent remedial measures to prove control, plaintiffs might be able to use the existence of software updates, especially if the software is automatically updated, to demonstrate that the manufacturer had a substantial degree of control over the product sufficient to necessitate a post-sale warning. The reader should be aware that case law on the "substantial degree of control" exception is sparse. Because of this, it remains unclear, however, whether the evidentiary rule allowing "subsequent remedial measures" to be used as evidence would apply in the product's liability context.

Additionally, because offering updates to consumers is similar to the defendant's blade replacement program in *Bradshaw*, doing so would also likely constitute a manufacturer's voluntary assumption of a post-sale duty to warn. Manufacturers could foreseeably discharge this duty by alerting the driver via the car that an update was needed or by using more traditional means, i.e., the use of regular mail or telephone.

In cases where an accident reveals to manufacturers the need for a software update, the update is likely going to be considered a "subsequent remedial measure" within the meaning of Texas law (Tex. R. Evid. § 407(a) (West 2015). Such an update is both "subsequent" temporally and is "remedial" in that it corrects the cause of the accident. As such, plaintiffs would be barred from using the existence of the update to prove the need for warning or instruction in the first place. Updates that are not automatic, i.e., updates that prompt the user to "accept" the update will likely constitute notice of a defect in the product, assuming the update's prompt describes the reasons why the update is necessary.

Thus, failure to warn claims could potentially have a large impact on AV and CV manufacturers.

AVs and CVs: Breach of Warranty Claims

Breach of warranty claims are likely to have little or no impact on AV and CV manufacturers.[175] Car manufacturers are sophisticated sellers who will likely disclaim or narrowly tailor any warranties attached to their products.

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[173] Kalra, Nidhi, James M. Anderson, and Martin Wachs, "Liability and Regulation of Autonomous Vehicle Technologies," at 32, California PATH Research Report (2009)

[174] Svarcas, Francesca. "Turning a new LEAF: A Privacy Analysis of CARWINGS Electric Vehicle Data Collection and Transmission." 165 Santa Clara High Technology Law Journal (2012)

[175] Kalra, Nidhi, James M. Anderson, and Martin Wachs, "Liability and Regulation of Autonomous Vehicle Technologies," 26. California PATH Research Report (2009)

In terms of implied warranties for fitness, the ordinary purpose of AVs and CVs will be for transportation. It is unlikely that manufacturers will face liability in the AVs and CVs unless the cars are purchased for a particular purpose other than transportation.

Finally, courts around the nation are split as to whether software qualifies as a "good" under the Uniform Commercial Code's provisions; software must be considered a "good" for breach of warranty claims alleging only non-properly-functioning software.[176]

Thus, breach of warranty claims are not likely to have a significant impact on AV and CV manufacturers in Texas.

AVs and CVs: Other Relevant Elements of Texas Law

The Federal government is likely to develop its own regulations and guidelines for AVs and CVs. As such, assuming a manufacturer complies with these regulations, they may benefit from Texas's rebuttable presumption that they are not liable in products liability cases.

Component part manufacturers will face the same amount of liability that they currently face under Texas law.

AVs and CVs: Defenses to Products Liability Claims in Texas

Operators will likely face less liability over time as the vehicles become more and more automated. As a result, the burden of this liability will shift onto manufacturers over time.

In the short term, operators will still face liability, particularly in Level 2 and 3 AVs, which require operator control in certain circumstances. Manufacturers will therefore be able to shield themselves by pointing to the comparative negligence of operators, which, given the amount of data stored in the vehicles and available to manufacturer-defendants, should be relatively easy to prove.

Thus, Texas's comparative negligence regime will still play in a role in products liability litigation involving AVs and CVs but will likely be diminished or completely negated as fully autonomous and connected vehicles hit the road.

AVs and CVs: No Defect?

It is entirely possible that an AV or a CV would be involved in an accident where neither the plaintiff nor the manufacturer would be able to identify what exactly went wrong. Indeed, this has already occurred at least once in the context of a conventional vehicle. Beginning in 2009, numerous Toyota vehicles began to suddenly accelerate. Toyota's engineers were able to formulate several theories as to why certain vehicles would accelerate but were not able to conclusively identify a cause.[177]

It is unclear how the law would treat an inexplicable accident that occurred while a vehicle was in autonomous mode or who would be liable. Professor David Vladeck has suggested that courts apply strict liability principles to these cases.[178] Under his proposed system, the law would treat manufacturers and

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[176] Andresen, Kathryn A. "The Law and Business of Computer Software" § 18:3 (West 2007)

[177] *See* Douglas, Danielle and Michael Fletcher, "*Toyota Reaches $1.2 Billion Settlement to End Probe of Accelerator Problem"* The Washington Post. (March 19 2014) (available at http://www.washingtonpost.com/business/economy/toyota-reaches-12-billion-settlement-to-end-criminal-probe/2014/03/19/5738a3c4-af69-11e3-9627-c65021d6d572_story.html).

[178] Vladeck, David. "Machines Without Principles: Liability Rules and Artificial Intelligence." 89 Wash. L. Rev. 117 2014, at 146.

component part manufacturers as jointly liable.[179] In the alternative, Professor Vladeck also proposed that the law treat the car as a legal entity in and of itself; under this proposal, the car would have its own insurance (paid for by either the manufacturer or the owner or both).[180]

Professors Sophia Duffy and Jamie Patrick Hopkins have also suggested that, in these cases, owners of AVs and CVs be held strictly liable and forced to cover extra insurance.[181] They suggest that given the potentially low rate of accidents involving AVs and CVs and the low rate of inexplicable accidents in general, the extra insurance costs will deter neither implementation by manufacturers nor use by consumers.[182]

Thus, it is clear that the possibility for unexplained accidents exists and that sometime in the future courts will have to address this problem by either re-crafting existing doctrine to fit AVs and CVs or by creating new legal theories or regimes.

Conclusion

While the full impact of Texas's products liability regime cannot be fully ascertained at this time, it appears that the manufacturers of AVs and CVs could face increased liability in certain cases and less liability in others. This conclusion is limited in that consumer understanding of the technology could impact how juries rule in certain cases. The products liability system in Texas seems robust enough to be able to capture the various proposed forms of AV and CV technology. Finally, it does appear that, over time, manufacturers will shoulder more liability as the vehicles become more automated.

In this technical memorandum, we conducted expert interview and performed B/C analysis, to understand the impacts of smart driving technologies on transportation management and operations strategies. The expert interview is meant to gather the firsthand opinion on technology trends, applications, barriers and challenges anticipated, as well as recommended solutions. The B/C analysis is meant to quantify the potential of different TSM&O strategies when market penetration of C/AVs varies from low to high. Based on the B/C values and expert interview results, the most promising technologies are recommended.

In conclusion, the top strategies should be further considered include the traffic signal control, ramp metering, dynamic route guidance, and intersection collision avoidance (at high C/AV market penetration). These strategies will bring both congestion reduction and safety benefits at freeways and arterials. This is based on not only the B/C ratio across all stages, but also the expert evaluation of technology maturity timeline, their anticipated benefits and impacts on transportation management and operations strategies. In the next step, it is recommended that these strategies are examined with more in-depth, through simulation modeling, policy analysis and field tests, to better characterize their effectiveness.

[179] *Id* at 149.

[180] *Id* at 150.

[181] Duffy, Sophia and Jamie Patrick Hopkins. "Sit, Stay, Drive: The Future of Autonomous Car Liability." 16 SMU Sci. & Tech L. Rev 453 (2013) at 118-122.

[182] *Id.*

Appendix I. Expert Survey Questionnaire

Expert Interview on Smart Transportation Technologies

Introduction:

The University of Texas at Austin has developed this Expert Interview as part of a research project with the Texas Department of Transportation (TxDOT), "**Bringing Smart Transport to Texans: Ensuring the Benefits of a Connected and Automated Transport System in Texas.**" This project will develop and demonstrate a variety of smart transportation technologies and strategies for Texas using connected vehicle (CV), automated vehicle (AV), smartphone, and related technologies. The purpose of this interview is to develop a composite understanding from ***technology experts*** and ***thought leaders*** in the areas of **smart transportation technologies** and **intelligent transportation systems**. Your insights on the latest developments and evaluation of emerging transportation technologies will help us formulate a comprehensive synthesis of smart transportation technologies and transportation operations and management strategies.

If you have any question about this interview, please feel free to contact the following investigators:

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Acronyms

- V2V: vehicle-to-vehicle
- V2I: vehicle-to-infrastructure
- L2 Automation: Level 2 combined function automation
- L3 Automation: Level 3 limited self-driving automation
- L4 Automation: Level 4 full self-driving automation
- V2V/V2I integrated with L2-L4 Automation: L2 through L4 automation and V2V or V2I communication working in unison

Section 1: Questions on Smart Driving Technologies

1. When do you think the following technologies will be sufficiently developed for mainstream adoption (i.e. market penetration reaches 20% or more)? Please give your estimate of the most probable time period.

Technology	**Most Probable Time Period (e.g. 2020-2025)**
DSRC-based V2V Communication	
DSRC-based V2I Communication	
Cellular-based V2V Communication	
Cellular-based V2I Communication	
Level 2 (Combined Function) Automation	
Level 3 (Limited Self-Driving) Automation	
Level 4 (Full Self-Driving) Automation	
V2V/V2I integrated with L2-L4 Automation	

2. Please rate the anticipated benefits of the following **smart transportation technology packages** if they are fully developed on a scale of 1-5, where 1=least significant or no impact and 5=most significant.

Technology	**Benefits**					
	Safety	Mobility	Driver Comfort	Environment	Social Equity	Other*
DSRC-Based V2V						
DSRC-Based V2I						
Cellular-Based V2V						
Cellular-Based V2I						
L2 Automation						
L3 Automation						
L4 Automation						
V2V/V2I integrated with L2-L4 Automation						
* Please specify:						

3. Please **rate the anticipated barriers** for the mainstream adoption of the following smart driving technology packages, on a scale of 1-5, where 1=least significant barrier and 5=most significant barrier.

Technology	**Barriers**							
	Cyber Security	Reliability	Liability	Price	Infrastructure Preparedness	Policy & Regulation	Public Acceptance	Other*
DSRC-Based V2V								
DSRC-Based V2I								
Cellular-Based V2V								
Cellular-Based V2I								
L2 Automation								
L3 Automation								
L4 Automation								
V2V/V2I integrated with L2-L4 Automation								
* Please Specify:								

4. Please recommend the **top 5 smart transportation technologies** (e.g. emergency braking, blind spot detection, auto-pilot, etc.) that you envision will bring the most benefits to **drivers and the system** in **next 10 years**. Note that we are **not** talking about **strategies**, e.g. smart traffic signals & connected vehicle message propagation.

	Technology	**Reason (Optional)**
1		
2		
3		
4		
5		

5. Are there any **complications/risks** that you envision during the **transition phase** (i.e. when not all vehicles are automated and/or connected and/or not all infrastructures are connected)?

6. What solutions do you envision being implemented during the transition phase?

Section 2: Questions on Intelligent Transportation System (ITS) Applications

1. What levels of technology adoption (i.e. **"critical mass/threshold"** in terms of market penetration, %) do you see necessary to realize different levels of impact in **transportation operations and design**?

	Threshold of Adoption (%)		
Technology Area	**Any Impact**	**Modest Impact**	**Significant Impact**
DSRC-Based V2V			
DSRC-Based V2I			
Cellular-Based V2V			
Cellular-Based V2I			
L2 Automation			
L3 Automation			
L4 Automation			
V2V/V2I integrated with L2-L4 Automation			

2. Please recommend **top 5 smart transportation based operations or design strategies** (e.g. queue warning, smart signal control, etc.) that you envision are achievable in the **next 10 years**?

	Strategy	**Reason (Optional)**
1		
2		
3		
4		
5		

3. How will the following **ITS applications** be influenced by smart driving technologies when they enter **mainstream adoption phase** (ownership between 16-84% of the market)? Please rate on a scale of 1 to 5, where 1=no or minimal impacts, and 5=most significant impacts.

Strategy Area	**Overall Impact of Smart Driving Technologies (1-5)**
Traffic Signal Control	
Freeway Operations	
Incident Management	
Work Zone Management	
Dynamic Managed Lanes	
Data Collection & Archiving	
Traveler Information	
Public Transit	
Ridesharing	
Road Weather Management	
Tolling & Pricing	
Infrastructure Monitoring And Maintenance	
Asset Management	
Incentive-Based Demand Management	
Dynamic Parking	
Eco-Routing	
Driver Situational Awareness	
Vehicle And Driver Monitoring	
Port Operations	
Freight Transportation	
Other (Please Specify)	

4. What **public agency actions** do you recommend to accelerate the adoption of smart driving technologies and corresponding transportation operations and design strategies?

5. Do you have any **other thoughts or comments**?

6. Can we contact you by phone within the following weeks for some additional questions? If so, what would the most convenient time be for you? **Thank you very much!**

Appendix J. Expert Interview Questions

1. In general, what do you envision are the biggest challenges facing large-scale CAV deployment? (Institutional and policy, legislation, security, operations and design, etc.)
2. What are the ongoing efforts of your agency on CAV research and development to address the challenges?
3. What TxDOT (or your state DOT) can do to harness the CAV technologies in next 10 to 15 years? (e.g. Pilot program, open data platform, PPP, etc.)
4. [Customized, TBD] (This question will be based on the survey feedback and/or answers to the last three questions)

Case Law

American Tobacco v. Grinnell, 951 S.W.2d 420 (Tex. 1997)

Barton v. State, 882 S.W.2d 456 (Tex.App.-Dallas 1994)

Bell Helicopter Co. v. Bradshaw, 594 S.W.2nd 519 (Tex.App—Corpus Christi, 1979)

Bituminous Cas. Corp. v. Black & Decker Mfg. Co., 518 S.W.2d 868, (Tex.App—Dallas, 1974).

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