Conference Proceedings of the Northeast Autonomous Vehicle Summit

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Report Number:
CT-2308-F-17-5

SPR 2308
May 24, 2017

Connecticut Transportation Safety Research Center
Connecticut Transportation Institute
School of Engineering
University of Connecticut

Submitted to:

Connecticut Department of Transportation
Bureau of Policy and Planning
Roadway Information Systems Unit
Research Section

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ACKNOWLEDGMENTS

This report was prepared by the University of Connecticut, in cooperation with the Connecticut Department of Transportation and the United States Department of Transportation, Federal Highway Administration. The opinions, findings and conclusions expressed in the publication are those of the authors and not necessarily those of the Connecticut Department of Transportation or the Federal Highway Administration. This publication is based upon publicly supported research and is copyrighted. It may be reproduced in part or in full, but it is requested that there be customary crediting of the source.

The authors wish to acknowledge the support of personnel from the Federal Highway Administration, the Connecticut Department of Transportation, and the University of Connecticut. In particular, the authors would like to thank and acknowledge: Amy Jackson-Grove: FHWA Connecticut Division Administrator; James Redeker: Commissioner, CTDOT; Robbin Cabelus: Transportation Planning Director, CTDOT; Kazem Kazerounian: UConn Dean School of Engineering; and Andrew Zehner: UConn Office of the Vice President for Research; for supporting this event.

SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
	NOTE: volumes greater than 1000 L shall be shown in m^3			
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
^oF	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	^oC
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	$candela/m^2$	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
^oC	Celsius	1.8C+32	Fahrenheit	^oF
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	$candela/m^2$	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.
(Revised March 2003)

TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No. CT-2308-F-17-5	2. Government Accession No. N/A	3. Recipients Catalog No.
4. Title and Subtitle Conference Proceedings of the Northeast Autonomous Vehicle Summit		5. Report Date May 24, 2017 6. Performing Organization Code SPR-2308
7. Author(s) Tara Simler, Eric D Jackson Ph.D., James Mahoney		8. Performing Organization Report No. CT-2308-F-17-5
9. Performing Organization Name and Address University of Connecticut Connecticut Transportation Institute 270 Middle Turnpike, U-5202 Storrs, Connecticut 06269-5202		10. Work Unit No. (TRIS) N/A 11. Contract or Grant No. SPR-2308 13. Type of Report and Period Covered Final Report March 2017-June 2017
12. Sponsoring Agency Name and Address Connecticut Department of Transportation 2800 Berlin Turnpike Newington, CT 06131-7546		14. Sponsoring Agency Code SPR-2308

15. Supplementary Notes
A peer exchange conducted in cooperation with the U.S. Department of Transportation , Federal Highway Administration

16. Abstract

The development of autonomous vehicle technology and potential adoption of autonomous vehicles is occurring at a rapid rate in the United States. As this technology evolves, there are many technical, logistical and legal issues that need to be addressed concerning the surface transportation system and policies. It is projected within the next five years fully autonomous vehicles will be available to the general public. Therefore, it is important that policy makers engage in active discussions to address the wide range of issues that autonomous vehicles will bring. The deployment of autonomous vehicles will result in a substantial shift in surface transportation priorities. Rules and regulations governing the use of this technology will need to be created or current regulations will need to be adapted to permit this technology, while preserving safety for the traveling public. The Northeast Autonomous Vehicle Summit provided an opportunity for the stakeholders to gather, learn, and discuss some of the issues that will need to be addressed as the technology is deployed. The resulting workshop provided an opportunity to document current perception and policy surrounding autonomous vehicle technology. The resulting action plans that were developed as part of this summit can be used to track and document progress, as well as an indicator of what the northeast states perceive as the most pressing issues for adoption of this technology. The overarching theme that emerged from this summit was that policy changes are needed to protect the public but should not discourage innovation and adoption.

17. Key Words Autonomous Vehicles, Highway Automated Vehicles, Self-driving Cars, AV Transportation Policy, Highway Safety, Conference, Workshop	18. Distribution Statement No restrictions. This document is available to the public through the National Technical Information Service, Springfield, VA. 22161 This report is available online from National Transportation Library at http://ntl.bts.gov

19. Security Classif. (Of this report) Unclassified	20. Security Classif.(Of this page) Unclassified	21. No. of Pages 25	22. Price N/A

TABLE OF CONTENTS

LIST OF TABLES

Chapter I Introduction and Background

The development and testing of autonomous vehicle technology is advancing at an exponential rate in the United States. As this technology continues to mature, there are many technical, logistical and legal issues that need to be addressed. Several automotive manufacturers have set target release dates of self-driving cars as soon as 2021. Autonomous vehicles (AV) are divided into six levels (0-5) as defined by the Society of Automotive Engineers International. Level 1 includes basic features such as lane assist, self-parking, blind spot monitoring, and brake assist. These features are becoming standard on new vehicle models. Levels 2 through 4 are vehicles that operate at an increasing level of autonomy, as the scales increases; however they still rely on human interaction. Level five is fully autonomous.

The race to develop a fully autonomous vehicle has become the space race of this generation. These vehicles have the potential to revolutionize the way we travel. But the impacts go far beyond transportation. The proposed shift to a model of transportation as a service in place of individual vehicle ownership has the potential to impact numerous industries and sectors, including commercial transport, insurance, food service and hospitality, tax revenue at the state and local level, employment and most importantly safety. Therefore, it is important that policy makers engage early in active discussions to address the multitude of potential issues that could be impacted by successful implementation of autonomous vehicle technology.

In an effort to foster this discussion, a partnership was developed between the University of Connecticut, the Connecticut Department of Transportation (CTDOT) and the Federal Highway Administration (FHWA) to host a summit, where the technology and issues were presented by some of the country's leading experts in the field. The implications of this new technology were also discussed by a wide range of stakeholders from the northeast region of the United States. The summit concluded with a planning activity where stakeholders answered how this new technology would impact their state, and how they would respond to the issues that were raised by the presenters. In addition, this summit provided opportunities for researchers to learn about the current state-of-the-practice in autonomous vehicle technology and where additional research is needed.

The University of Connecticut's Transportation Safety Research Center (CTSRC) was able to obtain funding from the CTDOT, FHWA, UConn's Office of the Vice President for Research (OVPR), and the School of Engineering Dean's office to support speaker travel and recruitment for this event. A task team was formed, and work was initiated to secure a venue that would be centrally located to accommodate northeast states. CTSRC staff worked to navigate administrative issues, invite speakers, and organize the order of events for the summit. Bi-weekly meetings were set up with the Dean's office to report planning progress, as well as to discuss issues as they arose. CTSRC provided regular updates to the CTDOT with respect to the agenda and to receive feedback. CTSRC was in constant contact with CTDOT to review the invite list and to include a comprehensive and diverse list of attendees.

Stakeholders invited to participate in this summit included state policy makers, state DOT officials, university researchers, governmental officials, private industry, as well as the developers of autonomous vehicle technology. The invite list was extensive and included

Federal and State DOT and FHWA representatives from New Jersey to Maine. Along with government officials, members of law enforcement and private industry added a different perspective to the summit discussions. We had representation from all New England states, as well as New York and New Jersey. The summit agenda can be found in Appendix A.

Chapter II Presentations

The Northeast Autonomous Vehicle Summit was held at the Mystic Hilton in Mystic, CT on March 30 and 31, 2017. The agenda included a full day of presentations, with a question and answer period for each speaker on Day 1. Day 2 involved workgroup discussions and the formulation of action plans. The keynote speakers on the first day of the summit came from a variety of agencies and industries; notably Stanford University, Global Autonomous Vehicle Partnership, PolySync, United Technologies, Uber, Insurance Institute for Highway Safety, Toyota, American Automobile Association (AAA), Highway Safety North, as well as FHWA, CTDOT, and the New Jersey Department of Transportation (NJDOT).

The conference kicked off with a welcome from UConn's Dean of the School of Engineering, Kazem Kazerounian, and Tom Maziarz, Bureau of Policy and Planning, CTDOT. The first speaker was Chris Gerdes, PhD, former Chief Innovation Officer at the USDOT and currently a Professor in the Departments of Mechanical Engineering and Aeronautics and Astronautics at Stanford University. Dr. Gerdes presented a captivating glimpse into the future of automated vehicles. His presentation focused on:

- Opportunities autonomous vehicles will provide (reducing the 35,092 fatalities on our roads annually; providing accessible transportation at low cost per mile; and, making this mobility sustainable)
- Three basic needs for automation (actuation i.e. control of steering; propulsion and braking; sensing and perception; and, motion planning and control)
- Ethical considerations, which include respect for human life and the law, as well as resolving conflicts between safety, mobility, and legality
- Brief discussion on the drafting of the National Highway Traffic Safety Administration's (NHTSA) Federal Automated Vehicles Policy 15 Point Safety Assessment as presented by Dr. Gerdes:
    - Actuation
    - Control of steering, propulsion and braking (largely a solved problem for new cars)
    - Sensing and Perception (Sensing is here today, perception still developing)
    - Combinations of laser scanners, cameras and radar
    - Motion planning and control
    - Movement through required driving scenarios
    - Control of the car in emergency situations
    - Vehicle Cybersecurity
    - Object and Event Detection and Response
    - Post-Crash Behavior
    - Federal, State and Local Laws
    - Human Machine Interface

- Crashworthiness
- Registration and Certification

Dr. Gerdes closed with a discussion on how to frame the conversation of AV technology and policy.

Next, Art Shulman, Executive Director at Global Autonomous Vehicle Partnership (GAVP) gave a presentation titled, "Creating Municipal Autonomous Vehicle Districts". Mr. Shulman's presentation included discussion of the three main challenges ahead for AVs; technology, regulation, and societal impacts. Art also described how the GAVP is advancing a strategy to make autonomous vehicle implementation happen sooner. He outlined how his organization plans to engage sponsors and a targeted municipality to fund an initiative to set up a city or cities to pilot AV implementation.

At this point in the program, the conference was broken into two groups. Group one focused on technology issues while the second group of presentations focused on infrastructure impacts.

Josh Hartung, CEO and Co-Founder of PolySync focused his presentation on vehicle technology. Mr. Hartung discussed "What is safe enough?" and proceeded to discuss the safety gap between prototype and production-model autonomous vehicles.

Shridhar Duggirala, PhD, Assistant Professor of Computer Science and Engineering at the University of Connecticut, spoke of how formal verification can help in certifying autonomous vehicles. Dr. Duggirala discussed high level traffic rules using temporal logic, motion primitives using hybrid systems verification tools, and real time correctness using Worst Case Execution Time (WCET) tools.

For the Infrastructure session, Dale Thompson, Lead Research Engineer, FHWA; Carol Atkinson-Palombo, PhD, Associate Professor, University of Connecticut; and, Nino Manes, PhD, Project Leader at United Technologies Research Center, focused their individual presentations on the infrastructure impacts and needs of autonomous vehicles.

Dr. Atkinson-Palombo's presentation, titled "Society & Self-Driving Vehicles: A Framework for Understanding Transitions", focused on how society will handle the inevitable changes of this new technology. Dr. Atkinson-Palombo discussed affective and cognitive evaluations of major and minor innovations. She raised questions such as:

- Will 'auto'-autos (i.e., AVs) change how much driving is done on US roads and hence GHG emissions?
- How will self-driving vehicles affect employment in the transportation sector?
- What are the implications of auto-autos for jobs?
- How equitable will the impacts be?
- Are auto-autos feasible in every location?
- How should government (at all scales) regulate emerging transportation technology?
- How will the public learn to interact with self-driving cars?
- How willing are people to give up control of their vehicle to machines?
- How will any transition to shared ownership of self-driving vehicles affect automobile ownership levels, and ultimately the auto industry?

Dr. Atkinson-Palombo concluded her presentation by stating that this emerging technology needs to be implemented into society in a way that maximizes positive impacts and minimizes cost.

Dr. Nino Manes presented on how United Technologies (UT) and their subsidiaries are researching and developing integrated technologies to improve an automated lifestyle. One of the most interesting aspects of his presentation was the fact they are looking into how a person could call for a car, have it arrive, and take them to their destinations. Meanwhile, the integrated systems could prepare for their arrival by automatically calling the elevator. Once on the elevator, it will already know the floor they are traveling to, based on history or preprogramming. Meanwhile, the HVAC systems will have already started to adjust the temperature in the destination to the preferred conditions. This type of automation will reduce the need to wait for manual input to activate systems that historically need to respond to human requests.

Finally, Dale Thompson's presentation provided detailed information on the "Smart City Challenge", which included twelve vision elements designed to provide a framework for cities to consider in their development of a proposed AV demonstration. These elements were broken down into three categories: technology, innovative approaches to urban transportation elements, and smart city elements. The Smart City Challenge provided a roadmap for cities looking to revolutionize their transportation systems. The USDOT received 78 applications-one from nearly every mid-sized city in America. The USDOT committed up to $40 million for this effort, and, in response, the seven Smart City finalists leveraged over $500 million to help make their Smart City vision a reality. Mr. Thompson also discussed FHWA's Exploratory Advanced Research efforts where the focus areas are:

- Connected highway systems
- Human behavior and travel choices
- Breakthrough concepts in material science
- Technology for assessing performance
- New technology and advanced policies for energy and resource conservation

This program has awarded 75 projects, 31 of which are currently active. Finally, Mr. Thompson informed us of current research initiatives at FHWA.

This infrastructure track inspired many discussions, particularly the USDOT Smart City Challenge, in which the USDOT challenged mid-sized American cities to use emerging transportation technologies to address their most pressing problems.

During the lunch period, Jason Post from Uber delivered a presentation on "The Future of Urban Mobility." Mr. Post started by saying that there are more than 1,200,000,000 cars in the world and that 22% of all carbon emissions come from transportation. Uber's focus is to help cities make data-driven transportation policy, planning, and operational decisions. He gave an example of a deal between Uber and a New Jersey city, where the city would pay Uber instead of spending millions of dollars to build additional parking at a transit station. Currently, 10% of millennial Uber riders in the U.S. say they have either given up a car or not bought one, and that by 2030, 25% of all miles driven globally will be by ride hailing. He concluded by saying that shared self-driving cars would reduce the number of cars on the road by 90%.

Peter Calcaterra, a Transportation Planner at CTDOT, delivered an overview of the Federal Autonomous Vehicle Policy as well as Model State Guidelines for implementing autonomous vehicles. He also mentioned that Connecticut has formed an inter-agency workgroup to discuss what is needed for testing and deployment of autonomous vehicles.

Jim Hedlund, PhD, Principal, Highway Safety North, spoke of traffic safety policy issues that states will face. This included current state laws, autonomous vehicle testing and operations. Mr. Hedlund provided more information and answered questions on how the new NHTSA model policy will impact states. The key takeaway from this session is that AV is still an evolving technology and the impacts are highly variable and difficult to predict at this point.

David Kidd, PhD, Research Scientist, Insurance Institute for Highway Safety (IIHS), discussed policy considerations for driving automation technology. Dr. Kidd, on behalf of IIHS, commented on the Federal Automated Vehicles Policy, stating where NHTSA should focus their policy. He identified five areas:

- NHTSA should give more guidance about the contents of the Safety Assessment Letter (a report submitted by AV manufacturers outlining how they are meeting the Safety Assessment areas)
- Vehicle performance guidance should be explicitly applied to Level 2 systems. Dr. Kidd presented videos of drivers doing a wide range of activities, other than driving, while in a Level 2 automobile (i.e. playing games, sleeping, reading, etc.). All of which are not appropriate for this level of technology.
- Guidance should recommend that driving automation systems not rely on users to limit their use within the operational design domain. Dr. Kidd once again showed footage of some of their testing that shows issues with car following in rural areas.
- NHTSA should collect information about which vehicles are equipped with driving automation systems.
- Guidance should encourage addressing possible misuse errors primarily through intuitive design.

Dr. Kidd also recounted a study done by IIHS with their employees and vehicles with advanced AV technology. As a result of this study, he noted that the technology itself may not be as valuable as how it was implemented. He showed results on driving experience where high end cars with the same features (i.e. adaptive cruise control) were rated lower than more common models with the same technology. Results were also presented on manufacturer's guidance on when and where the advanced features varied (i.e. free flow interstates vs stop and go traffic). Finally, Dr. Kidd showed a video of how this technology can fail in unexpected ways. One of the vehicles they were testing malfunctioned such that all warning lights illuminated, and the only way to reset the car was to remove the battery. However, driver safety was not impacted by this failure, but it has been reported as a non-unique experience for that make and model of the vehicle.

Cathy Rossi, AAA Mid-Atlantic Vice President of Public and Government Affairs, discussed the policy, insurance, privacy, cyber security, and consumer understanding of autonomous vehicles. Ms. Rossi spoke about what AAA is doing to better understand autonomous technologies, like automatic emergency braking and adaptive cruise control. AAA's role is to continue ongoing discussions with federal and state policy makers, consumer

education, monitor technology's impact on overall safety, and consumer perspective. Ms. Rossi presented survey findings where they asked drivers how soon they could imagine routinely riding in a fully autonomous or self-driving vehicle; 58 percent said within 10 years. However, 25 percent said never. Furthermore, the AAA study reported that more than 80 percent of those surveyed think that local and state governments should inform the public about when and where that testing will occur. Ms. Rossi concluded with the AAA's "Road Forward" which would include:

- Keep safety a priority
- Respect motorists' rights
- Consumer education & acceptance
- Harmonization & standardization
- Ongoing research
- Continued investment

The last session of the day was a panel discussion on AV policy moderated by CTDOT Commissioner, James Redeker. Bill Kingsland, Assistant Commissioner, NJDOT, gave insight to New Jersey's autonomous vehicle initiatives. He discussed the working groups they have established, New Jersey's current legislative actions, and who they are partnering with to evaluate and deploy pilot autonomous vehicles.

Tom Maziarz, Bureau of Policy and Planning, CTDOT, sat on this panel to assist in answering any questions that may arise in how the CTDOT may address the policy implications of autonomous vehicles.

Jane Lappin, Director of Public and Government Affairs, Toyota Research Institute, informed attendees at the summit of Toyota's research initiative for using artificial intelligence to develop automated vehicles, assistive indoor robotics, and materials discovery.

The PowerPoint presentations from each of the presenters can be found on the CTSRC website http://ctsrc.uconn.edu/ under the NE Autonomous Vehicle Summit tab.

Chapter III Workshops

Day 2 of the Summit featured comprehensive workgroups that were comprised of representatives from government, law enforcement, and private industry. The purpose of the workgroups was to document current progress, plans, vision, state concerns and challenges and to share experiences and best practices. A survey with questions regarding policy, technology and safety was created to guide the discussion. Questions were posed regarding licensing and registration of AVs; enacting and enforcing traffic laws and regulations; communicating with and educating the public about motor vehicle safety issues; training of law enforcement and first responders; infrastructure; vehicle testing; and, liability and insurance. Once the survey was completed, the groups were then asked to formulate potential action plans for states to use.

The workshop results are summarized below. The results can also be found on the CTSRC website http://ctsrc.uconn.edu/ under NE Autonomous Vehicle Summit.

The lead agency in Connecticut is the Office of Policy and Management. There is proposed legislation under consideration to create a task force to study AV/pilot testing programs. Various levels of groups are involved in all states; most states are still in the process of forming lead groups.

In regard to vehicle/driver issues, the workgroup participants were divided on NHTSA's policy that SAE Levels 4 (an automated system can conduct the driving task and monitor the environment, and the human does not need to take back control; however, the automated system can only operate in certain environments and conditions) and level 5 (the automated system can perform all driving tasks under all conditions that a human driver could perform them) require a driver's license. Some felt that a license should be required for Level 4 but not 5. Others felt that a license should not be required for Level 4 or 5. The question of requiring a driving test or license for highly automated vehicles (HAV's) also sparked conversation and differing views. Some groups believe that states should not require a driving test or license for HAVs. However, even though no license would be required, there may need to be limitations on those who can be in the vehicle alone; it may be too soon to be determined. Discussion indicated that states should provide training to include emergency and safety procedures, as well as testing occupant ability and competence on operations of the vehicle. States in attendance currently do not have the ability to identify a vehicle as being enabled for autonomous use on its registration. CT would like to have an extra box on the registration forms for AV status, but not including SAE level. Maine would like to include that on the registration. The group was consistent in their opinion that there should be some sort of standardization across states so that officers or state DMVs could quickly recognize AVs by their registrations. If each state takes a different approach it could/would be difficult to enforce laws consistently across state lines. However, it was agreed that the regulations governing the labeling and identification of HAVs should be NHTSA's responsibility because they already regulate vehicle classes. Some states are looking to follow NHTSA guidance.

With respect to law enforcement issues, all agreed that law enforcement representatives need to be part of HAV committees. Although groups were unsure how law enforcement and first responders should be trained in the handling of HAV crashes/violations, it was mentioned that HAV Manufacturer's should have input on training requirements. The groups agreed that knowledge of how to disable the vehicle, emergency systems and a specific protocol were imperative. This could lead to the need for an "emergency stop or shut off" for AVs, which

vehicle manufactures may not already have in place. Groups discussed how States can work together to develop methodologies for enforcement to discourage risk taking behaviors and vehicle operation (i.e. distracted driving). Responses included the encouragement of national and regional forums to share information and develop regional solutions and also to restrict/not allow Level 3 vehicles, and to continue to improve coordination and communication.

It was agreed that law enforcement will face many challenges with regard to HAVs. Some challenges include determining responsibility in crashes; education and training of officers; whether warrants will be needed to get data from the vehicle; and identifying who the driver is and what the vehicle responsibility is. It was mentioned multiple times that manufacturers need to be involved in solutions to these problems. It was also agreed that the states should modify their crash report form in the future to specifically collect information about HAV ability and operation at the time of a crash. However, it was unclear how that data would be collected and if current vehicles would log that information in their crash data recorders. Another challenge law enforcement faces is identifying HAVs in a crash, during a traffic stop, or routine enforcement activity. Some suggestions discussed were special number plates or designation on registrations in accordance with NHTSA recommendations. Crash Data Recorder (CDR) readers (a device installed in a motor vehicle to record technical vehicle and occupant information for a brief period of time before, during, and after a crash) were mentioned as a way for law enforcement to know if HAV systems were engaged and in control at the time of a crash.

Concerning liability and insurance issues, no state present at the workshop has started reviewing or drafting rules for who is liable in the event of an HAV crash. In discussing how the officer will determine if the crash was caused by driver behavior or HAV malfunction, it was suggested that the Officer review the black box and/or interview human drivers. Challenges on this topic include who the liability resides with when there is no driver and determining who is at fault. It is imperative that the vehicle manufacturers create a way for third party review and access to data recorded at the time of the crash. Without this information law enforcement and insurance groups would rely on the statement of the driver, which would be seen as not a reliable source of information.

States have started discussions on whether HAVs will be required to carry motor vehicle insurance. Groups maintain some of the challenges with regard to insurance include answering who needs to maintain the insurance -- the driver/owner or the manufacturer. There was also a concern on what would be the limits of such insurance.

When infrastructure is concerned, it was asked how States can work together to standardize and maintain road infrastructure including signs, traffic signals and lights, and pavement markings. It was deliberated that the FHWA's Manual of Uniform Traffic Control Devices (MUTCD) might be appropriate to address this responsibility, and to also work with AASHTO. There was a concern of how states would be able to meet new or emerging standards that AVs might require. States identified a potential need for more federal dollars for maintenance and repair of infrastructure in order to prevent liability to the State for failure of AV technology due to infrastructure limitations or failures. States should work with municipalities and national organizations to establish uniformity.

Chapter IV Action Plans

After answering and discussing the survey questions, the groups began to formulate action plans with regard to the topics discussed. Outlines of the responses are tabulated in Tables 1 through 5 below:

Table 1: Law Enforcement

Problem	Proposed Strategy	Targeted Project Performance	Agency Responsible	Action Items & Timeframe
How do I pull over an AV?	Require vehicle-to-vehicle (V2V) technology preemption with visual indicators		NHTSA Law enforcement officers	ASAP
Determine if it's an AV or if the AV system is engaged. Updating crash reporting so that relevant data is collected regarding AVs to determine their involvement (did it cause or contribute to the crash).				
Being able to determine fault and liability in the event of a crash or violation.	Require Federal regulations address the need for AVs be able to communicate with law enforcement.	Coordinate with other states (through AASHTO) and Congressional delegations to influence Federal policy, regulations and/or laws.	Coordination among state agencies.	Respond to proposed regulations when they are published.
Training law enforcement to recognize an AV; investigations of accidents and enforcement of violations	The International Association of Chiefs of Police IACP should develop standards/train the trainer model and operate it	Goals, milestones	Police Officer Standards and Training Council (POST), Fire Academy	Assign project manager

Table 2: Liability & Insurance

Problem	Proposed Strategy	Targeted Project Performance	Agency Responsible	Action Items & Timeframe
How and who do we cover?	Hybridized policy that covers product liability as well as individual negligence.	Early, consistent universal implementation. It would take years to see how it makes sense financially.	State insurance regulator	Engage the insurers in the state, ASAP
Determining premium costs to insure AVs. Addressing the mixed use environment of AVs and non-AVs.			Private insurers. Dept. of Insurance.	
Determining who needs to carry insurance, the requirements for liability and limits.	Coordinate with other states to develop common approach.	Coordinate with other states to develop common approach.	Insurance Department, in coordination with sister agencies on technical committee.	As soon as legislative authority is established (but before implemented) for AVs to be tested and/or operated on public roads.
What new issues are presented with the introduction of AVs	Data gap analysis, researching other jurisdictions	Above might indicate necessary legislative changes	Insurance Department	Legislation Framework

Table 3: Vehicle & Safety Issues

Problem	Proposed Strategy	Targeted Project Performance	Agency Responsible	Action Items & Timeframe
How does a state manage safety inspections? How do we ensure that a car's safety is maintained (after a crash, etc.)?	Implement a national standard			
Regulating the cohabitation of AVs and non-AVs on the roadway system	Driver training and endorsements necessary for drivers that become dependent on the new technologies.			
Concerns regarding safe fallback procedures, including warnings to human driver. Timeframe is a big concern.	Prohibit level 3 vehicles from operating on public roads.	Work with state legislature, other states, congressional delegation, NHTSA and private sector to prohibit level 3 vehicles from being sold and operating on public roads.	Coordination among state agencies to coordinate with other states through AASHTO, American Association of Motor Vehicle Administrators (AAMVA), etc.	Sooner rather than later.
Federal motor vehicle safety standards	Enforce NHTSA's recommended standards	Performance measures	NHTSA	TBD

Table 4: Infrastructure & Environmental Impact

Problem	Proposed Strategy	Targeted Project Performance	Agency Responsible	Action Items & Timeframe
Determine short term highway infrastructure needed by the states.	Determine short term highway infrastructure needed by the states.	Ensure that transportation professionals are involved with the original equipment manufacturers.		
What do HAVs need and how to maintain that effectively (markings & signing, pavement conditions, other infrastructure)?	What do HAVs need and how to maintain that effectively (markings & signing, pavement conditions, other infrastructure)?	Need to pilot test in areas with existing markings, signing, and pavement. Determine what's effective & target needs appropriately. Identify how HAVs react to environmental changes both long term & temporary (temporary work zone, speed limit changes in school zones/work zones, shoulder closers, etc.).		Evaluate results of pilot programs. Increased maintenance requirements of states and municipalities.
Identifying what infrastructure requirements are necessary for AVs and the resources needed to meet those requirements.	Identifying what infrastructure requirements are necessary for AVs and the resources needed to meet those requirements.	MUTCD should take lead through AASHTO, state work groups and private sector to identify modifications to current practices. Encourage additional Federal and private sector dollars to help provide resources, especially on local system.	Unknown, until we better understand what the AV requirements will be to safely operate on the roadway. Begin/continue dialogue with private sector through TRB, AASHTO, AAMVA, etc. to better know what the requirements will be.	Multiple agencies, including DOT, DMV, FHWA, NHTSA, etc. Sooner rather than later.
Funding resources, training	Full engagement	Performance measures	States/towns	TBD

Table 5: Vehicle Testing

Problem	Proposed Strategy	Targeted Project Performance	Agency Responsible	Action Items & Timeframe
No regulatory scheme for vehicle testing	Draft regulations based on NHTSA guidelines. Efficient optimization of staff/resources	Draft, promulgate regulation	Multi-agency effort	Research other state's regulations; consult with UConn; TBD

The Action Plan results can also be found on CTSRC website http://ctsrc.uconn.edu/ under NE Autonomous Vehicle Summit.

Chapter V Findings

The objective of the Northeast Autonomous Vehicle Summit, held in Mystic Connecticut on March 30 and 31st, 2017, was to provide an introduction to autonomous vehicle technology while also providing a forum for discussion regarding autonomous vehicle policy. Through discussions, presentations and workshop groups, the effects of this technology were identified to be widespread, far beyond just simply transportation. Even with representation from state, federal, law enforcement and private industry, it is difficult to comprehend just how far reaching this technology goes. It is agreed that once autonomous vehicles are fully implemented, the benefits will be numerous. This technology could result in a significant decrease of costs (labor, fuel, insurance, capital), and most importantly decrease fatalities on our roadways. While 94 percent of crashes can be attributed to human error, this technology is projected to be a major driving force to allow states to meet their goal of significantly reducing traffic fatalities.

There are valid concerns that this technology will have a negative impact on some industries. The primary impact will be occupations where human labor will be replaced with automation. These fields would include commercial vehicle drivers, service drivers (taxi drivers, school bus drivers, transit bus drivers, Uber drivers), and transit employees, just to name a few. The hotel, hospitality and foodservice industries can expect to face changes, as well. The demand for single night hotel stays during ground transportation could disappear since vehicles would be able to drive while operators sleep, read or perform other activities. As car travel becomes less demanding and more convenient, air travel for trips that are less than 500 miles may also significantly decrease. Automated vehicles which are predicted to be primarily electric vehicles, will expedite a shift away from gasoline. This will affect not only the oil industry, but state revenue, as the state's gas tax is the primary source of revenue for transportation improvements. The need for insurance, car repair/auto parts, and medical services will be reduced as the number and severity of crashes decrease. Cities and towns will see a reduction in traffic violations, as well as the need for traffic enforcement officers. The demand for parking will decrease as the transportation model shifts from individual vehicle ownership to a ride share or transportation service model. Autonomous vehicles have the potential to completely change the way cities and their suburbs are built and are currently structured.

States must continue to move forward with discussions on forming HAV lead agencies (if they haven't already). There are many questions to be answered and further research needed, as well as potential guidance from NHTSA, industry, or other state and federal agencies. Long and short term issues will continue to arise and be handled. However, safety is still the main priority and focus. While there are still many questions regarding the topics discussed above, it is imperative to continue this dialog among state agencies, law enforcement and private industry. This Summit provided stakeholders the opportunity to discuss issues associated with autonomous vehicles and provide connections for these discussions to continue beyond the event that may potentially turn into research opportunities for CTSRC and UConn. If there was a common theme for this conference it would be that policy changes and research are needed. But care should be taken to not restrict the development and implementation of this technology. Any potential impediment to the use of these vehicles could result in investments, testing, and adoption of this technology to be shifted to other states or regions, or even worse, the loss of interstate commerce, revenue

and potential transportation system efficiencies as a result of automation-based businesses that might avoid operations in your state.

Appendix A


NORTHEAST
AUTONOMOUS
VEHICLE SUMMIT
MYSTIC HILTON, MYSTIC, CT
MARCH 30-31, 2017
FEATURING:
3.30 VEHICLE FORUM
3.31 STATE WORKSHOPS
UCONN
UNIVERSITY OF CONNECTICUT
CTI
Connecticut
Transportation
Institute
U.S. Department of Transportation
Federal Highway
Administration
CTSRC
Connecticut
Transportation Safety
Research Center

Mystic Hilton
20 Cogan Boulevard
Mystic, Connecticut 06355

Thursday, March 30, 2017

7:30 am to 8:00 am	Continental Breakfast
8:00 am to 8:30 am	**Welcome and Opening Remarks (Schooner Ballroom)** **Kazem Kazerounian:** UConn Dean **Andrew Zehner:** UConn OVPR **Tom Maziarz**: CTDOT
8:30 am to 10:15 am	**Introduction to Automation (Schooner Ballroom)** **Chris Gerdes, PhD:** Stanford University **Art Shulman:** Global Autonomous Vehicle Partnership (GAVP) *"Creating Municipal Autonomous Vehicle Districts"*
10:15 am to 10:30 am	Break
10:30 am to 12:00 pm	**Town Hall Panel Discussions** **Track 1: Vehicle Technology (Schooner Ballroom)** **Moderator: John Ivan, PhD:** UConn **Dan Galves: Moblieye Inc.** **Josh Hartung:** PolySync *"What is safe enough? Assessing the safety gap between prototype and production of autonomous vehicles."* **Sridhar Duggirala: UConn Computer Science** **Track 2: Infrastructure (Clipper Ballroom)** **Moderator: Chuck Harlow:** CTDOT **Dale Thompson: Federal Highway Administration (FHWA)** ***"U.S. DOT Smart City Challenge"*** **Nino Manes, PhD: United Technologies Research Center** **Carol Atkinson-Palombo PhD: UConn Geography**
12:00 pm to 1:30 pm	**Lunch (Schooner Ballroom)** **Jason Post:** Uber Public Affairs Northeast *"The Future of Urban Mobility"*
1:30 pm to 2:15 pm	**Policy Implications of Automation: Part 1 (Schooner Ballroom)** **Moderator: Amy Jackson-Grove: Federal Highway Administration (FHWA)** **Peter Calcaterra:** CTDOT *"Federal Automated Vehicles Policy-Model State Guidelines"* **Jim Hedlund, PhD:** Highway Safety North *"Autonomous Vehicles Meet Human Drivers: Traffic Safety Policy Issues for States"*
2:15 pm to 2:20 pm	Break
2:20 pm to 3:15 pm	**Policy Implications of Automation: Part 2 (Schooner Ballroom)**

	David Kidd, PhD: Insurance Institute for Highway Safety ***"Considerations for Driving Automation Technology Policy"***
	Cathy Rossi: AAA Mid-Atlantic
3:15 pm to 3:30 pm	Break
3:30 pm to 4:45 pm	**Northeast Policy Roundtable: (Schooner Ballroom)** **Moderator: James Redeker:** CTDOT Commissioner **Bill Kingsland:** NJ DOT, Assistant Commissioner **Jane Lappin:** Toyota Research Institute **Tom Maziarz:** CTDOT, Bureau Chief Policy and Planning
4:45 pm to 5:00 pm	**Day 1 Closing Remarks: James Redeker:** CTDOT Commissioner

Friday, March 31, 2017

7:30 am to 8:00 am	Continental Breakfast
8:00 am to 8:15 am	**Introduction to the Workshop sessions (Schooner Ballroom)**
8:15 am to 9:45 am	**Workshop Part 1: Policy, Technology, and Safety**
9:45 am to 10:00 am	Break
10:00 am to 11:30 am	**Workshop Part 2: Potential Action Plans**
11:30 am to 11:45 am	Break
11:45 am to 12:00 pm	**Conference Takeaways and Closing Remarks**