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THESIS

**AUTONOMOUS VEHICLES: A POLICY ROADMAP
FOR LAW ENFORCEMENT**

by

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September 2015

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AUTONOMOUS VEHICLES: A POLICY ROADMAP FOR LAW ENFORCEMENT

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ABSTRACT

As of 2015, manufacturers and technology innovators are racing to perfect the autonomous vehicle for mainstream use. Advances in technology have proven that autonomous vehicles are no longer held back by engineering. Currently, there are hundreds being tested amongst us on California roadways with great results.

The positive impacts autonomous vehicles strive to provide include increased safety, decreased traffic congestion, increased fuel efficiency, reduced pollution, decreased impaired driving, and mobility for those unable to drive. Like any innovative technology, autonomous vehicles face challenges, such as regulatory tribulations, layers of safety testing, political and legal scrutiny, and public apprehension. They will also present challenges and opportunities for law enforcement as they are tested and eventually become mainstream.

This thesis provides an introduction to the key strategies the California Highway Patrol (CHP) should foster to support the safe introduction of autonomous vehicles while sustaining strategic relevance. Through scenario planning, the CHP can avoid long-term planning based on a single predicted outcome and identify commonalities in numerous scenarios and plan accordingly. Policy recommendations include collaboration with stakeholders, an increase in the presence in cyber investigations, an increase of high-tech workforce, expansion of high-tech collision investigation capability, and encouragement of the appropriate regulations without hindering the technology.

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LIST OF ACRONYMS AND ABBREVIATIONS

AMBER	America's Missing: Broadcast Emergency Response
AZ	Arizona
CA	California
CALTRANS	California Department of Transportation
CCIU	Computer Crimes Investigation Unit
CEO	chief executive officer
CFR	Code of Federal Regulations
CHP	California Highway Patrol
CiHP	California Information Highway Patrol
CIM	Collision Investigation Manual
CIPR	Center for Insurance Policy and Research
CLEMCC	Civilian Law Enforcement—Military Cooperation Committee
CT	Connecticut
DHS	Department of Homeland Security
DMV	Department of Motor Vehicles
DOT	United States Department of Transportation
DUI	driving under the influence
EDR	event data recorder
FAA	Federal Aviation Administration
FBI	Federal Bureau of Investigation
FFF	future freight flows
FHWA	Federal Highway Administration
FMVSS	Federal Motor Vehicle Safety Standards
GC	government code
GE	General Electric
GSM	Global System for Mobile
HSC	Highway Safety Committee
IACP	International Association of Chiefs of Police

IL	Illinois
LA	Louisiana
MADD	Mothers Against Drunk Driving
MAIT	Multidisciplinary Accident Investigation Team
MD	Maryland
MIT	Massachusetts Institute of Technology
MVA	motor vehicle account
NAIC	National Association of Insurance Commissioners
NHTSA	National Highway Traffic Safety Administration
NSA	National Security Agency
NTSB	National Transportation Safety Board
NV	Nevada
ODNI	Office of the Director of National Intelligence
OH	Ohio
ORi	Open Roboethics Initiative
PATH	Partners for Advanced Transportation Technology
SWITRS	Statewide Integrated Traffic Records System
UCLA	University of California, Los Angeles
U.K.	United Kingdom
US DOT	United States Department of Transportation
V2V	vehicle-to-vehicle communications
VA	Virginia
WY	Wyoming

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I. INTRODUCTION

It would be like an elevator. They used to have elevator operators, and then we developed some simple circuitry to have elevators just automatically come to the floor that you're at ... the car is going to be just like that. You can't have a person driving a two-ton death machine.

– Elon Musk, March 17, 2015¹

From early legends of magic carpets transporting kings to battle, to Leonardo da Vinci's horseless carriage, man has always been fascinated with autonomous travel. As soon as the automobile became the primary mode of transportation, inventors have been trying to automate it. For decades, autonomous vehicles seemed light years away and were only dreams of the future. Now the future has arrived and the technology is mature or at least close to maturation. Autonomous vehicles have improved to the point of testing on public roadways, in traffic, among us all, and appear to have the capability to outdrive human counterparts.

The essence of today's automotive experience is that people are terrible drivers. This becomes further complicated when we add the increasing amount of distractions and overall driver fatigue due to the ever increasing commute and time spent behind the wheel on congested roadways.² A study conducted by the U.S. Department of Transportation, National Highway Traffic Safety Administration (NHTSA) found that driver error was a component in 94 percent of the 2,189,000 collisions it evaluated.³ Of those driver errors, the NHTSA found that 41 percent were recognition errors, 33 percent were decision errors, 11 percent were performance errors, seven percent were non-

¹ Josh Lowensohn, "Elon Musk: Cars You Can Drive Will Eventually be Outlawed," *The Verge*, March 17, 2015, accessed June 5, 2015, <http://www.theverge.com/transportation/2015/3/17/8232187/elon-musk-human-drivers-are-dangerous>.

² Fernando Wilson, and Jim P. Stimpson, "Trends in Fatalities from Distracted Driving in the United States, 1999 to 2008," *American Journal of Public Health* 100, no. 11 (2010), accessed July 24, 2015, http://www.undistracteddrivingadvocacy.net/linked/wilson_trends_in_fatalities_from_distracted_driving_in_the_united_states_1999_to_2008.pdf.

³ U.S. Department of Transportation, National Highway Traffic Safety Administration, "Critical Reasons for Crashes Investigated in the National Motor Vehicle Crash Causation Survey-Traffic Safety Facts," February 2015, <http://www-nrd.nhtsa.dot.gov/pubs/812115.pdf>.

performance errors (such as sleep), and eight percent were other driver errors.⁴ Is Elon Musk correct when suggests humans will one day not be allowed to drive? Will the liability become too great to allow humans to drive?

The technology to allow vehicles to be driven by sensors and computers is already here. It is no longer an engineering problem. As of June 2015, the Google Self-Driving Car Project logged 1,057,962 miles in autonomous driving mode since the inception of the project in 2009 (i.e., the human driver gives up control of the vehicle and the computer does all of the driving).⁵ This is miles driven, in traffic, among us on our roadways. This is in addition to the billions of miles driven in simulation mode in Google's laboratory. As of June 2015, Google reported their self-driving test vehicles had only been involved in 14 minor collisions, all of which were NOT the fault of the autonomous vehicle.⁶ In other words, human error was the fault in all of the collisions and the self-driving car has NEVER caused a collision. Most of the collisions involved other vehicles whose drivers were inattentive and rear-ended the Google car.⁷ This data supports Elon Musk's prediction that someday humans will no longer be allowed to drive. The use of seat belts, air bags, and back-up sensors have proven to make vehicles safer and therefore have become mandatory. Thus, it is fairly probable that other sensor and self-driving technologies will also follow that trend.

The advent of autonomous vehicles could revolutionize the transportation industry and the way humans travel. This is why manufacturers are racing to build and produce their version of an autonomous vehicle. More importantly, this is why supporting entities need to gear up now and prepare for the possibility of the arrival of autonomous vehicles.

⁴ Ibid, 2.

⁵ "Google Self-Driving Car Project Monthly Report," June 2015, Google, accessed July 5, 2015, <http://static.googleusercontent.com/media/www.google.com/en/us/selfdrivingcar/files/reports/report-0615.pdf>.

⁶ "Google Self-Driving Car Project Monthly Report," May 2015, Google, accessed July 5, 2015, <http://static.googleusercontent.com/media/www.google.com/en/us/selfdrivingcar/files/reports/report-0515.pdf>.

⁷ Ibid.

As autonomous vehicles are phased into our everyday lives, much of the infrastructure that needs to support them will need to be updated, including law enforcement. As collisions become reduced by advanced technology, resources used to respond to and investigate collisions can be reduced. However, as the technology increases, so will the need for high-tech officers to investigate any autonomous vehicle involved collisions. Simultaneously, many of the nation's existing laws, regulations, and ordinances will need to be analyzed and updated to supplement this emerging technology.

Rachel Thompson from the Mind Tools Team stated,

Change is a common thread that runs through all businesses regardless of size, industry and age. Our world is changing fast and, as such, organizations must change quickly too. Organizations that handle change well thrive, whilst those that do not may struggle to survive.⁸

As a result of autonomous vehicles and their innovative emergence, many organizations that exist today may no longer be needed in their current form. Conversely, there will be many new opportunities for those organizations willing and able to change with the new technology, as well as those organizations geared to enter this new market. Nationwide, law enforcement will be one of those organizations that will need to shift many areas of its current operational environment, and the California Highway Patrol is in a position to lead this change.

A. RESEARCH QUESTION

This thesis answers the question: **“What should be the California Highway Patrol’s (CHP) strategy to foster the safe introduction of autonomous vehicles on California highways and sustain the strategic relevance of the CHP?”**

The CHP has a long tradition as one of the premiere law enforcement agencies in the world, especially when it comes to traffic management, collision investigation, and investigation of driving under the influence (DUI) violations. The CHP also has the distinct geographical advantage of residing and operating in California, the state where

⁸ Rachel Thompson, “Lewin’s Change Management Model,” Mind Tools, accessed June 6, 2015, http://www.mindtools.com/pages/article/newPPM_94.htm.

much of the technological advancements to make autonomous vehicles possible are being developed, manufactured, and tested. These two advantages should be used to help develop a solid policy roadmap for the CHP that it could share with the rest of the country's law enforcement to follow and in the end, to provide increased safety and service to the public.

B. PROBLEM STATEMENT

The arrival and testing of autonomous vehicles directly challenges the current operational environment of the CHP as well as that of any other law enforcement agency whose primary objective revolves around the education and enforcement of traffic regulations. This advancement in technology could drastically change the operational environment for traffic law enforcement and could even potentially spell the end for some soon-to-be-legacy institutions if they fail to recognize and adjust to the changing environment. It would be a failure to think about the possible futures of a traditional organization if autonomous vehicles come to fruition.

While this emerging technology has the potential of changing many facets of the operational environment of the CHP, some of those changes can be proactively managed as the technology develops. As a key regulatory body, CHP can be a catalyst for innovation and change, while remaining a viable institution.

Further complicating the matter will be the illicit use of autonomous vehicles by criminals. The future of crime in a world of autonomous vehicles is uncertain, but a trend is clear: traditionally, criminals are early adopters of technology and law enforcement institutions are not. Being late adopters deprives law enforcement agencies of the opportunity to discover new operational advantages and disadvantages, as well as understanding new security and safety threats posed by would be criminals. These weaknesses pose a significant threat. On the other hand, a proactive approach may help the CHP to be a positive stakeholder during the experimentation, implementation, and adoption of this emerging technology. As a key regulatory body that directly interacts with drivers and driverless cars, the CHP is an ideal institution to be the face of government when interacting with innovators to ensure the technology contains the

necessary security and safety features to be commercially viable. California highways are ground zero in a transportation revolution that is already here. Choosing to “wait and see” is not a prudent strategy; it is a death sentence. This thesis aims to aid the CHP in maintaining relevance in an era of autonomous vehicle research and potential adoption to ensure public safety. Much like the Ford chief executive officer (CEO) who challenged his company to be innovative toward autonomous vehicles when he stated, “we’re asking our people to challenge and question tradition.”⁹ The CHP needs to adopt a similar philosophy to adapt to a changing transportation environment.

Why is this important now? Technological advances, coupled with a marketplace eager to accept autonomous vehicles, has manufacturers racing to design, build, and test various autonomous systems and vehicles with hopes of capitalizing on something expected to revolutionize the auto-industry and the way we view ground transportation. Experts estimate the first fully autonomous vehicle will hit the marketplace within the next five years, much sooner than originally estimated.¹⁰ Tesla CEO, Elon Musk, recently predicted, “Maybe five or six years from now I think we’ll be able to achieve true autonomous driving where you could literally get in the car, go to sleep and wake up at your destination.”¹¹ Audi predicts full autonomous capabilities by 2017.¹² Google car project director, Chris Urmson, wants the technology to be present by 2019 so his now 11 year old son will not need to get a driver’s license when he turns 16.¹³ In contrast, skeptics have argued it will be more than a decade, and they believe it will happen

⁹ Verne Kopytoff, “Ford CEO Wants to Make a Self-Driving Car for the Masses,” *Fortune*, May 26, 2015, accessed May 26, 2015, www.fortune.com/2015/26/ford-ceo-wants-to-make-a-self-driving-car-for-the-masses.

¹⁰ Frederic Lardinois, “Autonomous Cars Are Closer Than You Think,” TechCrunch, January 18, 2015, accessed January 30, 2015, <http://techcrunch.com/2015/01/18/autonomous-cars-are-closer-than-you-think/>.

¹¹ Mike Ramsey, “Tesla CEO Musk Sees Fully Autonomous Car Ready in Five or Six Years,” *Wall Street Journal*, September 17, 2014, accessed October 30, 2014, <http://online.wsj.com/articles/tesla-ceo-sees-fully-autonomous-car-ready-in-five-or-six-years-1410990887>.

¹² Alexander Hars, “Category Archives: Automobile Manufacturers,” Driverless Car Market Watch, November 20, 2014, accessed January 30, 2015, <http://www.driverless-future.com/?cat=4>.

¹³ Chris Urmson, “How a Driverless Car Sees the Road,” Ted, March 2015, accessed July 5, 2015, https://www.ted.com/talks/chris_urmson_how_a_driverless_car_sees_the_road.

incrementally.¹⁴ Either way, both sides agree the technology will one day prevail and society will have autonomous vehicles.

In fact, the technology is already being placed in vehicles incrementally with great success, and autonomous vehicles are already being tested on California public roads today.¹⁵ As of October 31, 2014, the State of California approved testing permits for seven automotive manufacturers, each developing their own autonomous vehicle: Mercedes Benz, Volkswagen Group of America, Google, Tesla Motors, Delphi Automotive (whose technology is equipped on two Audi SQ5s), Bosch (whose technology is equipped on a BMW and a Tesla Model S), and Nissan.¹⁶

More approved testing permits will follow as additional manufacturers near their testing phase. Each approved participant in California's autonomous vehicle testing program is authorized to use the state's public roads to test their vehicles in a variety of conditions and situations. This demonstrates that we are no longer held back by technology and that the dream of autonomous driving is no longer a futuristic dream: autonomous vehicles are here now and on our roadways among us.

In addition to fully autonomous vehicles, automakers have added many of the autonomous technologies and sensors to existing automotive lines (e.g., parking assist, back-up braking, lane control, assisted cruise control, fetch the car) as building blocks toward full autonomous vehicle.¹⁷ Despite this fact, the CHP has not adapted training and/or equipment to properly investigate a collision in the context of autonomous capabilities. Policies and applicable training and equipment are also necessary to investigate not only collisions but also unique autonomous vehicle-related crimes,

¹⁴ Chuck Tannert, "10 Autonomous Driving Companies to Watch," *Fast Company*, January 8, 2014, accessed January 30, 2015, <http://www.fastcompany.com/3024362/innovation-agents/10-autonomous-driving-companies-to-watch>.

¹⁵ *Ibid.*

¹⁶ Verne Kopytoff, "Permits for Testing Self-driving Cars are a Hot Commodity in California," *Fortune*, November, 11, 2014, accessed May 26, 2015, <http://fortune.com/2014/11/11/california-permits-autonomous-vehicles/>; California Department of Motor Vehicles, "Application Requirements for Autonomous Vehicle Tester Program," accessed May 26, 2015, https://www.dmv.ca.gov/portal/dmv/?1dmy&urile=wcm:path:/dmv_content_en/dmv/vehindustry/ol/auton_veh_tester.

¹⁷ Kopytoff, "Ford CEO Wants to Make a Self-driving Car for the Masses,"

including cyber intrusions. The longer the CHP waits to enter this emerging market, the harder it will become.

Long-term transportation safety and passenger flow will still be a high priority in any future automotive scenario. As autonomous vehicles take much of the driver error out of collisions, they should make our roadways safer. They also have a promising potential to reduce or eliminate many of the needed traffic enforcement activities we are familiar with in today's transportation system: speeding, following too close, unsafe turning movement, failure to yield to a regulatory traffic signal, and driving under the influence (DUI). Any significant reduction in collisions, coupled with the reduced need for traffic enforcement, will challenge the current "business model" of the CHP. With drastically reduced responsibilities in these areas, the CHP will need to reinvent itself by embracing the new technology and learn where it will be most needed for public safety in the post-autonomous vehicle era. Failure to shift its mission to meet new public safety needs, could spell extinction for the CHP or at least a significant reduction in roles, responsibilities, and size. These are all long-term planning items the CHP should research and identify today. The CHP, based on its geographical location and close proximity to many of the innovators of autonomous vehicle technology in California, is positioned to use its outstanding reputation to collaborate with innovators, researchers, policymakers, and manufacturers to support the technology. These advantages will help them and emerge as a leader in law enforcement policy development throughout the transition to autonomous vehicles. Any technological advancement that improves driver and passenger safety should be strongly supported and embraced by the CHP, whose mission is to provide the highest level of safety, service, and security.¹⁸

C. LITERATURE REVIEW

Given the emerging nature of autonomous vehicle technology, some of the best sources of current information and data are derived from technology blogs, educational institution blogs, news reports, and opinion editorials from experts in the industry. As the

¹⁸ "California Highway Patrol Mission Statement," California Highway Patrol, accessed May 26, 2015, <https://www.chp.ca.gov/>.

technology matures, legislative efforts formalize, and policy is developed, the research material will become more refined and robust, and future research efforts should be able to draw from more scholarly sources. Every effort was made for this research to select material from scholarly sources; however, some material was obtained from other sources because it provided necessary and timely data for this topic.

1. Autonomous Vehicle Technology Status

From hands-free driving in a 2015 Mercedes-Benz S-500 equipped with Intelligent Drive¹⁹ or in a 2017 Cadillac,²⁰ to Volvo's Vision Zero Initiative,²¹ which is designed to reduce traffic deaths in its vehicles to zero by 2020, automotive manufacturers are turning to and announcing plans to incorporate technological advances into their vehicles in order to reduce and eliminate traffic collisions and ultimately accident related fatalities. In 2014, Tesla announced that its Model S being released in Australia in 2015 will come equipped with Autopilot that "combines a forward looking camera, radar, and 360 degree sonar sensors with real time traffic updates to automatically drive Model S on the open road and in dense stop and go traffic."²² Tesla has also incorporated features that will allow the vehicle to detect an available parking spot, park itself, and pick-up its driver when summoned.²³ The Google car, a fully autonomous vehicle prototype, has hit the streets in a testing capacity in many communities around the world, and Google reports successful test results over hundreds

¹⁹ "On the Way to Accident Free Driving," Mercedes-Benz, accessed January 8, 2015, <http://www.mercedes-benz-intelligent-drive.com/com/en/>.

²⁰ Keith Naughton, "GM to Introduce Hands-Free Driving in Cadillac Model," *Bloomberg*, September 7, 2014, accessed September 8, 2014, www.bloomberg.com/news/2014-09-07/gm-to-introduce-hands-free-driving-in-cadillac-model.html.

²¹ Doug Newcomb, "How Technology Can End Highway Fatalities," *PC Mag*, September 5, 2014, accessed September 8, 2014, www.pcmag.com/article2/0,2817,2467284,00.asp.

²² "Dual Motor Model S and Autopilot," Tesla Motors, accessed April 19, 2015, http://www.teslamotors.com/en_AU/models.

²³ Mike Ramsey, "Regulators Have Hands Full with Tesla's Plan for Hands-Free Driving," *The Wall Street Journal*, March 27, 2015, accessed April 1, 2015, <http://www.wsj.com/articles/regulators-have-hands-full-with-teslas-plan-for-hands-free-driving-1427484220>.

of thousands of accident free miles.²⁴ As this success continues, support for autonomous vehicles increases exponentially, and the technology is added in phases to vehicle lines as they hit the lots. With or without policy, the technology is coming. Will law enforcement be ready for it?

Researchers at the Polytechnic University of Bucharest, Romania have identified the need for an intelligent highway surveillance and safety system to work with the autonomous vehicle system to satisfy user needs and to adapt to traffic conditions.²⁵ The text, *Autonomous Vehicles: Intelligent Transport Systems and Smart Technologies*,²⁶ concludes that the objectives should include reduction of recurrent congestion and impact on traffic, reduced travel time, increased safety and efficiency, traveler interaction to provide improved travel experience through offered facilities, fast and efficient incident response by emergency services, reduced incident impact on traffic, decreased fuel consumption, and decreased air pollution. Interaction with the highway system will provide first responders prioritization in traffic and allow for faster responses.

The U.S. government has begun to take notice and is slowly introducing proposals to require automakers to ensure vehicles communicate with each other to avoid collisions in order to save lives by reducing or eliminating automobile collisions.²⁷ Their proposals are based on a report published by the National Highway Traffic Safety Administration. In the report, the administration estimates technology could be used to prevent some 592,000 left-turn and intersection collisions per year by ensuring future cars and light trucks are equipped with technology that enables them to talk to one another and warn of

²⁴ Evan Ackerman, "Google's Autonomous Car Takes to the Streets," *IEEE Spectrum*, October 13, 2010, accessed January 9, 2015, <http://spectrum.ieee.org/automaton/robotics/artificial-intelligence/googles-autonomous-car-takes-to-the-streets>.

²⁵ Nicu Bizon, Lucian Dascalescu, and Naser Mahdavi Tabatabaei, eds., *Autonomous Vehicles: Intelligent Transport Systems and Smart Technologies* (New York: Nova Science Publishers, 2014), 148–150.

²⁶ Ibid.

²⁷ Associated Press, "U.S. Government Moves toward Requiring Cars to 'Talk' to Each Other," *CBS News*, August 18, 2014, accessed August 29, 2014, <http://www.cbsnews.com/news/us-government-may-require-cars-to-talk-to-each-other/>.

potential hazards.²⁸ The report also states a car would have the ability to “see” other vehicles around it and know speed, distance, heading, etc., and use that information to determine if a vehicle was going to run a red light. As communities catch on, roadway and traffic signals could also start talking the cars, sending signals and warnings of traffic hazards and/or congestion to allow drivers to take alternate routes.

Think consumers are not ready? CISCO completed a study and surveyed over 1,500 customers about emerging technology. According to CISCO, “half of the world’s consumers would trust a car that can operate without a human driver.”²⁹

2. Benefits of Autonomous Vehicles

According to California Partners for Advanced Transportation Technology (PATH), a research partnership at U.C. Berkeley, the examples of the designed benefits of autonomous vehicles will be increased safety, decreased traffic congestion, increased fuel efficiency, reduced emissions, maximized resources, and increased productivity.³⁰ They also state the autonomous vehicle technology may have uses in delivery mechanisms, such as truck platooning, a system that uses forward collision avoidance technology to allow two or more commercial vehicles to communicate with one another in order to travel close together, saving fuel, and reducing drag.³¹

Research also indicates the technology has military uses. According to the Israel Inside, the Israeli army has deployed a new generation of unmanned jeeps.³² The article

²⁸ National Highway Traffic Safety Administration [(NHTSA)], “Preliminary Statement of Policy Concerning Automated Vehicles,” May 2013, accessed March 30, 2015, http://www.nhtsa.gov/.staticfiles/rulemaking/pdf/Automated_Vehicles_Policy.pdf.

²⁹ Marc Carter, “Half of the World’s Consumers Trust Autonomous Cars, According to a New Study,” CISCO, May 20, 2013, accessed August 29, 2014, <http://inhabitat.com/half-of-the-worlds-consumers-trust-autonomous-cars-according-to-a-new-study/>.

³⁰ “Automated and Connected Vehicles,” California Partners for Advanced Transportation Technology, accessed August 28, 2014, <http://www.path.berkeley.edu/research/automated-and-connected-vehicles>.

³¹ Ibid.

³² David Shamah, “As Google Dreams of Driverless Cars, IDF Deploys Them: Self Driving Vehicles Are not New for the Israeli Army, and a New Generation of Unmanned Jeeps is Set to Debut,” *The Times of Israel*, June 3, 2014, accessed August 28, 2014, <http://www.timesofisrael.com/as-google-dreams-of-driverless-cars-idf-deploys-them/#>.

relates that the Israeli army hopes the vehicles will provide lifesaving benefits, transport supplies into war zones without risking additional lives, summoned to transport wounded out, and be used to clear hot zones prior to troop arrival with advanced scanning systems.³³

According to 2014 poll by ORi (Open Roboethics Initiative), a majority of those polled believe the blind should be allowed to ride in an autonomous vehicle without any restrictions, and seniors and children should be allowed to ride in them with limited restrictions based on safety.³⁴ A second ORi poll (2014), revealed that 94 percent of those polled said, “Yes, an adult under the influence of a performance impairing substance (e.g., drugs or alcohol) should be allowed to ride alone in an autonomous vehicle which does not require human input.”³⁵

In an article written for How Stuff Works, authors Deaton and Hall-Geisler write that the future is now and relate that some predictors envision a day when no one owns a vehicle.³⁶ They write that vehicles will be summoned to a person’s location and drive the person to her or his destination. No need for parking stalls, parking lots, garages, etc. It will free up real estate while reducing the number of vehicles on the road and maximizing their use.³⁷

The *International Weekly Journal of Science* predicts that during the 2020 decade:

- A. Driverless cars (autonomous vehicles) will become widespread,
- B. Vehicles will drive together in train formations to save fuel and become more efficient,
- C. Vehicles will use technology to improve traffic flow,

³³ Ibid.

³⁴ *Io9*, “Should People without Licenses Be Allowed To ‘Drive’ Autonomous Cars?” blog entry by George Dvorsky, May 27, 2014, accessed January 10, 2015. <http://io9.com/should-people-without-licenses-be-allowed-to-drive-auto-1582118998>.

³⁵ “Results: Should an Autonomous Car be Able Drive around Itself?,” Ori—Open Roboethics Initiative, accessed January 1, 2015, <http://www.openroboethics.org/results-should-an-autonomous-car-be-able-to-drive-around-itself/>.

³⁶ Jamie Page Deaton, and Kristen Hall-Geisler, “How Driverless Cars Will Work,” How Stuff Works, accessed August 29, 2014, <http://auto.howstuffworks.com/under-the-hood/trends-innovations/driverless-car.htm>.

³⁷ Ibid.

- D. Vehicles will use technology to avoid collisions,
- E. Autonomous vehicles will improve land use by reducing areas needed for parking because people will no longer need to own their own vehicle.³⁸

Another potential stated benefit to the motoring public, as well as law enforcement community, will be the possible reduction and/or deletion of driving under the influence (DUI) traffic deaths. The nonprofit organization Mothers Against Drunk Driving® (MADD) has even publicly backed advanced technological measures of preventing DUI related accidents and deaths and believes autonomous vehicles could be the answer.³⁹

3. Challenges of Autonomous Vehicles for Law Enforcement

There will be a transition period for the nation, as well as law enforcement. Fagnant and Kockelman discuss some of the benefits autonomous vehicles and some of the key barriers to implementation. Among the stated benefits are: safety, reduced traffic congestion, improved fuel efficiency, reduced brake wear, improved lane use efficiency, travel behavior improvements (e.g., ride sharing improvements, ease of transportation for the elderly and immobile, and less parking space needs), freight transportation, and economic benefits.⁴⁰

On the other hand, some of the key barriers as they stand today are issues related to vehicle cost, licensing, litigation, liability, perception, security, privacy, and research gaps.⁴¹ High costs for autonomous vehicles and their related technology is thought to be a large barrier because autonomous vehicles are very technology driven and the costs for the sensors, communication equipment, safety equipment, and software to run each car is very high. An example of this high cost is given by the Center for Automotive Research

³⁸ M. Mitchell Waldrop, "Autonomous Vehicles: No Drivers Required," *International Weekly Journal of Science* 518, no. 7537, February 4, 2015, accessed July 18, 2015, <http://www.nature.com/news/autonomous-vehicles-no-drivers-required-1.16832>.

³⁹ "Secure the Future," MADD, accessed August 8, 2014, www.madd.org/drunken-driving/advanced-technology/.

⁴⁰ Daniel J. Fagnant, and Kara Kockelman, *Preparing a Nation for Autonomous Vehicles: Opportunities, Barriers and Policy Recommendations* (Washington, DC: Eno Center for Transportation, 2013), accessed July 31, 2015, <https://www.enotrans.org/wp-content/uploads/wpsc/downloadables/AV-paper.pdf>, 167–81.

⁴¹ *Ibid.*, 10–13.

in its publication, *Self-Driving Cars: The Next Revolution*.⁴² The center reported that the light detection and ranging (LIDAR) system used in the Google car costs an estimated \$70,000 for each vehicle.⁴³

However, costs for technology can change as technologies evolve and the cost to manufacturer these technologies declines. In October 2014, Tesla announced that it will allow buyers to choose to add on the Tech Package with Autopilot for \$4,250 to the cost of a new Model S.⁴⁴ Although not fully autonomous, the autopilot feature uses many of the same technologies to safely navigate roadways as the Google car at a fraction of the cost.

Fagnant, and Kockelman report licensing is a barrier due to the various state laws and policies and conflicts that exist or will exist if each state is left patching policy to meet consumer needs.⁴⁵ Furthermore, Fagnant and Kockelman write about the licensing for testing autonomous vehicles, driving them, and registering them. In addition, they discuss the issues that could arise if each state has differing laws. In the security and privacy section, they dissect the need to secure access to the technology in the vehicles as well as the data the vehicles will be able to access and retain.⁴⁶

4. Costs and Acquisition

Budgetary constraints could prove to be a major challenge for law enforcement. According to Colin Neagle, “State and local governments will need to account for a drastic reduction in fines from traffic violations as autonomous cars stick to the speed

⁴² The Center for Automotive Research and KPMG, “Self-Driving Cars: The Next Revolution,” 2012, accessed June 1, 2015, <https://www.kpmg.com/US/en/IssuesAndInsights/ArticlesPublications/Documents/self-driving-cars-next-revolution.pdf>.

⁴³ *Ibid.*, 12.

⁴⁴ John Voelcker, “Tesla Reveals ‘D’ All-Wheel-Drive Model S, ‘Autopilot’ Feature,” Green Car Reports, October 10, 2014, accessed August 2015, http://www.greencarreports.com/news/1094879_tesla-reveals-d-all-wheel-drive-model-s-autopilot-feature.

⁴⁵ Fagnant, and Kockelman, *Preparing a Nation for Autonomous Vehicles*, 11.

⁴⁶ *Ibid.*, 12–14.

limit.”⁴⁷ The National Highway Traffic Safety Administration (NHTSA) reported, “Approximately 41 million people receive speeding tickets in the U.S. every year, paying out more than \$6.2 billion per year.”⁴⁸ For government organizations that rely heavily on these fines and fees to support portions of their funding, they will be forced to downsize, reorganize, or shutdown. Neagle’s report centralizes around the possible impact autonomous vehicles could have on a revenue stream as a result of a significant decrease or elimination of fines resulting from traffic violations.⁴⁹

Another major hurdle for law enforcement will be the cost to purchase and maintain a high-tech fleet. Consider radio systems and in-car cameras. A person does not have to search far for agencies still trying to purchase these technologies and get them in service.⁵⁰ Budgets, training, and maintenance costs are cited as many of the hurdles law enforcement face when purchasing new technology.⁵¹

5. Collision Investigation

Although autonomous vehicles appear to be much safer than human drivers, collisions will more than likely continue to be a part of vehicle travel for some time.⁵² The answer of who will investigate these collisions is yet to be addressed and will prove to be both an opportunity and challenge for law enforcement. According to First Sergeant Charles L. Cohen of the Indiana State Police, training and equipping law enforcement to

⁴⁷ Colin Neagle, “Driverless Cars Could Cripple Law Enforcement Budgets,” *Network World*, May 20, 2014, accessed January 10, 2015, <http://www.networkworld.com/article/2226966/opensource-subnet/driverless-cars-could-cripple-law-enforcement-budgets.htm.l>.

⁴⁸ “Driving Citation Statistics,” *Statistic Brain*, accessed July 8, 2014, <http://www.statisticbrain.com/driving-citation-statistics/>.

⁴⁹ Neagle, “Driverless Cars Could Cripple Law Enforcement Budgets.”

⁵⁰ Paul Schultz, “The Future Is Here: Technology in Police Departments,” *Police Chief Magazine*, June 1, 2008, accessed January 10, 2015, http://www.policechiefmagazine.org/magazine/index.cfm?fuseaction=display_arch&article_id=1527&issue_id=62008.

⁵¹ *Ibid.*

⁵² John Villassenor, “Products Liability and Driverless Cars: Issues and Guiding Principles for Legislation,” *The Brookings Institution*, April 24, 2014, accessed January 16, 2015, <http://www.brookings.edu/research/papers/2014/04/products-liability-driverless-cars-villasenor>.

properly handle computer forensics has been a challenge for many years.⁵³ He cites the speed of emerging technology and the increase of types of electronic devices and increasing storage space, which has law enforcement continually trying to learn on the fly and playing catch-up.⁵⁴ He also points out that both statutory and case law have failed to keep pace with changes in technology, making enforcement more difficult.⁵⁵

6. Legal Environment (Laws, Pending Legislation, Regulations, Fault Concerns, Insurance Requirements)

Legislation is beginning to surface to allow testing in various states and each law is independent of the next.⁵⁶ The U.S. Congress has discussed these issues in subcommittee meetings and pointed out that the potential benefits of autonomous vehicles cannot be overlooked.⁵⁷ At the state level, the California legislature and several other states have passed legislation allowing testing and/or licensing.⁵⁸ Finally, many other states have not yet enacted any specific legislation and are relying on other statutes to guide them.

A patchwork of legislation in each state could leave gaps in the law and confuse consumers, manufacturers, and regulators. The U.S. Constitution is guided by the legal premise that everything that is not forbidden is allowed.⁵⁹ This legal premise is what provides U.S. citizens their freedom and could create a legal loophole or gap that allows

⁵³ Charles L. Cohen, "Growing Challenge of Computer Forensics," *Police Chief Magazine*, March 1, 2007, http://www.policechiefmagazine.org/magazine/index.cfm?fuseaction=display_arch&article_id=1136&issue_id=32007.

⁵⁴ *Ibid.*

⁵⁵ *Ibid.*

⁵⁶ "Automated Driving: Legislative and Regulatory Action," Stanford Center for Internet Society, *CyberWiki*, accessed January 15, 2015, http://cyberlaw.stanford.edu/wiki/index.php/Automated_Driving:_Legislative_and_Regulatory_Action.

⁵⁷ *Hearing before the Subcommittee on Highways and Transit of the Committee on Transportation and Infrastructure, How Autonomous Vehicles Will Shape the Future of Surface Transportation, House of Representatives*, 113 Cong., (2013), accessed August 29, 2014, <http://www.gpo.gov/fdsys/pkg/CHRG-113hhrg85609/pdf/CHRG-113hhrg85609.pdf>.

⁵⁸ "Autonomous Vehicles in California," California Department of Motor Vehicles, accessed January 9, 2015, <https://www.dmv.ca.gov/portal/dmv/detail/vr/autonomous/auto>.

⁵⁹ Gordon Hadley, *Judicial Review in International Perspective*, Vol. 2 (The Hague: Kluwer Law International, 2000), 256.

autonomous vehicles to be driven legally on public roadways. Currently, legislation only allows testing in a handful of states. Because many states do not have legislation at all, testing may be considered legal.

Anderson et al. have produced one of the most comprehensive autonomous vehicle research studies to date.⁶⁰ The authors have identified what autonomous and automated vehicles are; listed some advantages and disadvantages the technology could bring; the current state and legislative efforts, activity, standards and regulations, general liability implications; and general guidance for policymakers.⁶¹

The NHTSA issued its *Preliminary Statement Concerning Automated Vehicles* in 2013.⁶² This preliminary policy directive posits that autonomous vehicles are likely to significantly change automobile travel more than it has changed in the last 100 years. It notes, “improving highway safety, increasing environmental benefits, expanding mobility, and creating new economic opportunities,” as some of the potential benefits. It also expanded the list by detailing how the elimination of a large number of collisions will save fuel, reduce traffic congestion, and reduce greenhouse gases.⁶³ The documents stated purpose is to provide a description of developments in autonomous vehicle, an overview of NHTSA’s automated research program, and “recommend principles that States may wish to apply as part of their considerations for driverless vehicle operation, especially with respect to testing and licensing.”⁶⁴ Although this preliminary policy statement acknowledges that the NHTSA is aware of autonomous vehicles and their potential benefits, it fails to address or even mention any potential safety hazards or concerns, privacy issues, cybersecurity concerns, or physical security concerns. In 2015, the new NHTSA chief, Mark Rosekind, was quoted as being very interested in promoting

⁶⁰ James M. Anderson et al., *Autonomous Vehicle Technology: A Guide for Policymakers* (Washington DC: RAND Corporation, 2014).

⁶¹ Ibid.

⁶² NHTSA, “Preliminary Statement of Policy Concerning Automated Vehicles,”

⁶³ Ibid., 1.

⁶⁴ Ibid., 2.

the technology as it holds the potential for great societal benefit, from reducing crashes to smoothing out traffic congestion and enabling driving for elderly or infirm people.⁶⁵

To compare an alternative approach to the U.S.'s model for testing and adopting autonomous vehicles, this thesis will briefly explore a case study between the U.S. and the U.K. In February 2015, the U.K. released its official policy regarding autonomous vehicles, autonomous vehicle technology, and autonomous vehicle testing.⁶⁶ Claire Perry, Parliamentary Under Secretary, Department of Transport in the United Kingdom (U.K.)⁶⁷ wrote:

This review concludes that our legal and regulatory framework is not a barrier to the testing of automated vehicles on public roads. This creates a tremendous opportunity for the whole country to share in shaping the future of these exciting developments and the Government, working with the devolved administrations, wants to play its part in making that happen.⁶⁸

The U.K. policy creates national level definitions for key terms, such as “driverless car” and “fully autonomous,” as well as identifies ways to navigate licensing, testing, liability, etc.⁶⁹

7. Cybersecurity/ Physical Security Measures

In today's homeland security environment, cybersecurity is a growing concern for many entities, both public and private. Given that the autonomous vehicles utilize and communicate with numerous advanced systems, cybersecurity will play a large role in securing them from nefarious activity.⁷⁰ In *America the Vulnerable*,⁷¹ Joel Brenner draws

⁶⁵ Ramsey, “Regulators Have Hands Full.”

⁶⁶ British Department for Transport, *The Pathway to Driverless Cars: Summary Report and Action Plan* (London: Crown Publishing, 2015).

⁶⁷ The Parliamentary Department of Transport is the U.S. equivalent of the head of the U.S. Department of Transportation (USDOT).

⁶⁸ British Department for Transport, *The Pathway to Driverless Cars*, I.

⁶⁹ NHTSA, *The Pathway to Driverless Cars*, 16.

⁷⁰ Anderson et al., *Autonomous Vehicle Technology*, 75–95.

⁷¹ Joel Brenner, *America the Vulnerable: Inside the New Threat Matrix of Digital Espionage, Crime, and Warfare* (New York: Penguin Press, 2011).

from his past experience and expertise at the National Security Agency (NSA) and the Office of the Director of National Intelligence (ODNI) to point out cyber related vulnerabilities and hurdles for the U.S. He hits on privacy concerns, as well as advancing technology in crime and warfare. If our current policies and technology are leaving us vulnerable to adversarial exploitation, then how will we be when our technology has doubled or tripled in power and our policies are still lagging behind? In order to support this technology and the benefits it brings, we need to lay the foundation for its existence.

During a breakout session of a cybersecurity and resiliency workshop regarding autonomous vehicle design at Stanford, experts notes, “cybersecurity attacks against automated vehicle systems could result in the loss of assets and an increased risk to life,” thus “a highly interactive, diverse and distributed approach to the design and operation of automated vehicle systems is desirable.”⁷² The workshop focused on the potential impact cyber-related failures or lack of availability can have on an autonomous vehicle.⁷³ In fact, Dieter Zetsche, Daimler chief executive, warned, “Defending car systems against such attacks has already become essential.”⁷⁴

D. METHODOLOGY

This research seeks to begin a conversation for what the CHP and other law enforcement entities will need to look like should the emergence of autonomous vehicles and autonomous vehicle technology succeed. The CHP and much of law enforcement is based on rich traditions and a militaristic approach to problem solving. These organizations can be slow at adapting to new technologies for a variety of reasons. Nevertheless, the CHP will need to adapt in order to pivot its roles and responsibilities to emerge as a leader in law enforcement in a world with autonomous vehicles and autonomous driving.

⁷² Jim Misener, “Cybersecurity and Resiliency,” Vehicle Automation: TRB@Stanford, 2013, accessed January 10, 2015, <http://2013.vehicleautomation.org/program/breakouts/cybersecurity>.

⁷³ Ibid.

⁷⁴ Chris Bryant, “Daimler Chief Warns on Potential for Cyber Attacks on Cars,” *Financial Times*, July 23, 2014, accessed January 10, 2015, <http://www.ft.com/intl/cms/s/0/2037dac6-1264-11e4-a581-00144feabdc0.htm.1#axzz3H5KTxjMX>.

1. Selection

The topic of autonomous vehicles was selected because they are already being driven and tested in traffic on California roadways—even at the time this thesis was written. The need for law enforcement input will arise as more autonomous vehicles hit the streets and potential incidents occur. The CHP has a unique opportunity to help identify potential policy needs and help develop those policies based on its reputation and its geographic location in California where much of this technology is emerging as well as being tested.

This topic of discussion is important because autonomous vehicles could be the next disruptive technology that causes a spike in our predictive strategic plans. They have the potential to affect the lives of every citizen who relies on motor vehicles for transportation. Other parties of interest are vehicle and component manufacturers, researchers, innovators, CHP, law enforcement, homeland security entities, licensing and registration departments, insurance companies, legislatures (state and national), commercial vehicle transportation companies, MADD, etc. The sheer size of the list indicates that this emerging technology, no longer being held back by engineering gaps, could potentially be a game changer for the transportation industry and all those entities that rely on or support that industry.

2. Limits

This thesis will not attempt to dissect the technology and explain how it works or how it might work. That will be left for scientists, engineers, subject matter experts, researchers, and designers. In addition, it will also not recommend or draft policy or legislation for the introduction and testing of the technology. The technology is still too new to have a one-size fits all law that may hinder its evolution. The federal government, as well as state governments, will have to continue to work with manufactures and the various stakeholders collaboratively throughout the project to ensure a balance between innovation and security. This thesis will outline what some states have done and what others have not done to merely show the need for national consistency coupled with additional research and collaboration. This research will provide an overview of scenario

planning, how it may help law enforcement, the CHP to get away from its traditional methods for long range planning, and use scenario planning to be better prepared, long term—for the many possible outcomes autonomous vehicles may present.

3. Type and Mode of Analysis

In order to answer the research question, this study will first examine the challenges the CHP will face as a result of emerging autonomous vehicle technology will present to the CHP. Next, this study will examine a case study between the policies the U.K. are adopting and those being adopted the U.S. Finally, this study will use a variant of the scenario planning method to recommend planning methods the CHP can use to prepare for the technological changes, as well as limit challenges and identify opportunities.

To examine the possible challenges the CHP will face as autonomous vehicles and autonomous vehicle technology becomes prevalent, research will be gathered and analyzed in a variety of areas that could affect law enforcement. The most notable areas that affect law enforcement are those that affect funding, revenue streams, and the CHP's mission and area of responsibility, as well as the need for advanced accident investigation tools and abilities. Other areas of potential need for study include autonomous vehicles as a weapon, cybersecurity, and high-tech forensic investigators.

After identifying the challenges posed to the CHP, this study will examine and compare the U.S. strategy efforts to the U.K. efforts. This case study will be used to help identify strengths, weaknesses, opportunities, and potential threats, if they exist, and help direct future studies and policy development. This case study will show the advantages to a national, top-down strategy and compare it to a state-to-state patchwork system.

Finally, a variant of scenario planning will be used to guide the CHP toward a method to help identify commonalities in future predictions and varied outcomes based on specified conditions. To properly introduce scenario planning, an overview of what it is and why it will benefit the CHP in future planning is needed. Once the groundwork is set, this study will present as examples three possible scenarios the CHP could face:

1. Wait and see (continue to operate using traditional methods and planning),

2. Collaborative effort,
3. Strict government rule.

These scenario examples will not be all encompassing but will provide examples on how scenario planning could be a useful tool for the CHP as well as open the door for further research in this area. By thinking about numerous possible future scenarios, this study will help identify any common elements that are present in each scenario and assist in identifying any potential opportunities or threats. From these scenarios, the CHP can begin to develop plans to capitalize on those opportunities while mitigating any threats. This type of planning casts a wider net and helps get an organization to think, rather than simply follow the current path assuming, it will remain constant.

The above three scenarios were selected because they are all plausible and indicate three different outcomes for the adoption and regulation of autonomous vehicles. As stated above, these are not the only possible outcomes, just the most obvious.

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II. CHALLENGES FOR THE CALIFORNIA HIGHWAY PATROL

As RAND's study of *Autonomous Vehicle Technology: A Guide for Policymakers* points out,

In the field of [autonomous vehicle] technology, law and policy will play a critical role in shaping the paths of technological development and deployment. An early case, regulation, or other policy (or lack thereof) could permanently shape the development of this technology. These pathways may influence the course of development in this field for a long time. It is therefore important that policymakers get it as right as possible.⁷⁵

This influence they identify is a concept dubbed, path dependence—"the tendency of a past or traditional practice or preference to continue even if better alternatives are available."⁷⁶ Essentially, we often lock-in incorrect choices even though the knowledge exists that these choices are incorrect. This can happen in many forms, including, policy, law, technology adoption, etc.

Laws and court decisions become especially difficult to change once they are enacted or ruled on. Yale legal professor, Oona Hathaway stated,

It reveals, for example, that courts' early resolutions of legal issues can become locked-in and resistant to change. This inflexibility can lead to inefficiency when legal rules fail to respond to changing underlying conditions...opportunities for significant legal change in a common law system are brief and intermittent, occurring during critical junctures when new legal issues arise or higher courts or legislatures intercede.⁷⁷

Because significant legal change needs to occur when new legal issues arise, the time to coordinate, strategize, and enact regulations for the adoption and use of autonomous vehicles is now. The CHP can and should play a major role in this endeavor to ensure the technology meets the needs of the consumer and that law enforcement helps molds those

⁷⁵ Anderson et al., *Autonomous Vehicles Technology*, 149.

⁷⁶ *Business Dictionary*, s.v. "path dependency," accessed July 7, 2015, <http://www.businessdictionary.com/definition/path-dependency.htm.l#ixzz3fLNE3Vbj>.

⁷⁷ Oona A. Hathaway, "Path Dependence in the Law: The Course and Pattern of Legal Change in a Common Law System" (working papers, John M. Olin Center for Studies in Law, Economics, and Public Policy, Paper 270, 2003), http://digitalcommons.law.yale.edu/lepp_papers/270.

needs from a safety and response vantage point. If the CHP can help avoid path dependent policies, strategies, laws, court decisions, etc., all involved parties will benefit.

This can be done through examining the various elements that autonomous vehicle technology intersects with law enforcement and creates unique challenges, not immediately recognized by the masses. The areas to further dissect that may challenge the CHP are: revenue/funding,

A. REVENUE/FUNDING

In California, vehicles are required to be registered annually with the state, and money obtained from those registered vehicles is placed into the California Motor Vehicle Account (MVA) along with revenue received for state driver's licenses, identification cards, and special permit fees. Approximately 71 percent of the MVA is distributed to the CHP, and the rest is distributed to the California Department of Motor Vehicles and the California Air Resources Board.⁷⁸ The MVA is the CHP's largest funding source.

Because the CHP is almost entirely funded by the MVA, it is vulnerable to any decline in funding or changes in distribution. Should legislation redistribute duties relating to autonomous vehicle collision investigation or decide the CHP does not need as much money from the MVA each year because collisions have declined, the CHP could find itself in a financial crisis. Furthermore, if futurists are right, vehicle sharing programs will dominate the market and people will no longer seek to own their own cars, possibly reducing the total number of registered vehicles. This decline in vehicle registrations could impact the CHP's primary funding stream, ultimately impacting the CHP's operations.

The CHP's reliance on the MVA as its funding source can also be a strength. The more vehicles registered in California, the more revenue the state collects into the MVA. Therefore, the CHP is not exposed to many of the revenue spikes other entities observe.

⁷⁸ "Motor Vehicle Account Overview," California Legislative Analyst's Office, January 26, 2011, accessed July 7, 2015, http://www.lao.ca.gov/handouts/transportation/2011/motor_vehicle_account_overview_012611.pdf.

Unlike local law enforcement agencies, the CHP does not financially benefit from any enforcement action it takes (e.g., DUI fines, traffic infractions). Most of the related fines and fees generated as a result of CHP law enforcement action are distributed to the city or county jurisdiction in which the violation occurred.⁷⁹

Conversely, fines and fees generated by law enforcement action of local law enforcement agencies generate significant funds for the issuing city or county.⁸⁰ For example, the City of Los Angeles generated nearly \$161 million in revenue from parking violations alone in 2014.⁸¹ California had an average of 189,378 arrests per year between 2009 and 2012 for driving under the influence (DUI) with an average conviction rate of 75 percent.⁸² Each conviction resulted in court imposed fines, cost recovery fees, court fees, attorney's fees, and increased insurance rates.⁸³ The average total cost of a DUI in California now exceeds \$16,000.⁸⁴ The fines and fees resulting from DUI convictions equated to hundreds of millions of dollars that go to support local governments and programs.⁸⁵ Speeding tickets in California averaged 1.6 million convictions between 2009 and 2014, resulting in approximately \$810 million per year in revenue from fines.⁸⁶ Each citation written, regardless of the offense, upon conviction results in revenue that helps fund local municipal agencies and programs.⁸⁷ As technology improves and autonomous vehicles begin to phase in, traffic infractions and DUI arrests will drop each year because the computers will be doing the driving, and they have the ability to take

⁷⁹ "Fact Check: Anatomy of a Traffic Ticket in California," California Courts, Judicial Branch of California, accessed August 20, 2015, <http://www.courts.ca.gov/.23715.htm>.

⁸⁰ Ibid.

⁸¹ Emily Alpert Reyes, "Group Wants to Revamp How L.A. Collects Parking Ticket Revenue," *L.A. Times*, June 13, 2014, accessed July 7, 2015, <http://www.latimes.com/local/cityhall/la-me-parking-fine-cap-20140613-story.html>.

⁸² California Office of Traffic Safety, *California's Annual Performance Report, 2014* (Elk Grove, CA: California Office of Traffic Safety, 2014), accessed July 5, 2015, http://www.ots.ca.gov/Media_and_Research/Publications_and_Reports/hsp14/2014_Annual_Performance_Report.pdf.

⁸³ Ibid.

⁸⁴ Ibid.

⁸⁵ Ibid.

⁸⁶ California Office of Traffic Safety, *California's Annual Performance Report, 2014*, 20.

⁸⁷ "Fact Check: Anatomy of a Traffic Ticket in California."

human choice out of the equation. When this happens, revenue used to fund local municipalities will begin to decline, creating pressure on local and county agencies.

When they begin to feel the economic pressure, local municipalities will be forced to cut costs or find ways to increase funding. The MVA could be one such funding stream. Should the CHP fail to rebrand itself and prove its relevance in the future, the MVA would be ripe for the taking.

Another unforeseen challenge for the CHP when it comes to revenue and funding, is the need for additional funding to cover costs related to recruiting, hiring, training, and equipping the future's high-tech, CHP workforce. Technology comes at a cost and traditionally, law enforcement, CHP included, operates in a reactive means and purchases technology late in the adoption cycle when it becomes cheaper. Further hindering the CHP is the bureaucratic rules for budgeting and purchase acquisition they are required to follow. Even if the CHP identified a piece of technology they needed to do their job, it would take years to get funding for and permission to acquire the technology. This will definitely create a hurdle for the agency that they will have to account for, further justifying an early start.

B. REDUCED MISSION / RESPONSIBILITIES

Whether collision avoidance technology and vehicle-to-vehicle communications (V2V) become the norm or autonomous driving becomes the standard, technology to make our vehicles safer and avoid collisions is improving at record speeds. This will be a great thing for society as less people are injured and killed each year—a goal the CHP shares. Either way, the reduction in traffic collisions and plausible reduction in moving violations and DUI offences should be of great concern to the CHP. These are their core strategies and missions for increasing the safety, service, and security of the people of California. Assuming motorist services, such as flat tires and mechanical failures, remain constant, the CHP will be left with a main objective that matches that of a motorist service company. The old adage “AAA with a badge” (a joking insult that other California law enforcement agency's use when describing CHP officers) will be one step closer to becoming a reality.

The CHP will need to rebrand itself and re-strategize its relevance in the future, and it will be easier to start now before economic battles hit the forefront. Law enforcement, especially traffic law enforcement, is changing drastically before our eyes, and the CHP must change with it or risk obsolescence. It cannot afford to rest on its past reputation and past performance. It must continue to provide indispensable services to the public, and it must find new ways to do it. Autonomous vehicles may naturally present new challenges that require law enforcement oversight, but the CHP should not wait to find out what those new needs are.

C. ADVANCED ACCIDENT INVESTIGATION

The CHP has long been recognized as a leader in accident investigation, by both law enforcement and the insurance industry. In California, the CHP's, *Collision Investigation Manual* (CIM) has become the bible of accident investigation for California law enforcement agencies having responsibilities for traffic enforcement. Both the manual and the CHP's forms are used to document traffic accidents. This skillset and reputation will be one it should build upon to use as vehicles and collision investigation becomes more high-tech.

Since 1978, the CHP has also led the way in advance accident investigation when it created its Multidisciplinary Accident Investigation Team (MAIT) program. The CHP created MAIT because:

The severity and intricacy of traffic collisions dictated the need for more intensive investigations to determine subtle collision and injury causes. The objective of the MAIT Program is to provide the CHP with the means to conduct in-depth investigations and analyses of major traffic collisions throughout the state. Investigations include the reconstruction of an incident and a study of the factors that may have contributed to the incident. The factors include environmental, human and mechanical and are associated with the three phases of a collision which are pre-collision, at-collision and post-collision. The ultimate objective of the program is the utilization of these identified causation factors to prevent collisions of a similar nature from recurring.⁸⁸

⁸⁸ "Multidisciplinary Accident Investigation Team (MAIT)," California Highway Patrol, accessed July 7, 2015, [https://www.chp.ca.gov/programs-services/for-law-enforcement/multidisciplinary-accident-investigation-teams-\(mait\)](https://www.chp.ca.gov/programs-services/for-law-enforcement/multidisciplinary-accident-investigation-teams-(mait)).

Each MAIT team the CHP operates consists of investigators with specialized training in traffic collision reconstruction and consist of a CHP sergeant, two or more CHP officers, one non-uniformed motor carrier specialist I (an expert in vehicle inspection), and one non-uniformed senior transportation engineer from California Department of Transportation (CALTRANS). The CHP currently operates eight MAIT teams statewide, and they are used for those collisions that are advanced in nature and require a high degree of technical investigation. Each team maintains a cache of high-tech equipment to analyze collisions from an investigatory manner, as well as an engineering perspective. The CHP's MAIT team model is truly an out of the box, collaborative team assembled to handle the most difficult of tasks.

The MAIT teams may be undoubtedly called upon should an autonomous vehicle crash and cause injury or death in California, as they will be the only entity the CHP has to retrieve data from the event data recorder. If an autonomous vehicle crashes in autonomous mode, everyone from the involved parties to the manufacturer will be interested in knowing the cause of the collision. By adding autonomous mode as an element in a collision, it will be much more difficult to determine who was in control of the vehicle at the time of the collision. Having the manufacturer report this data adds a biased element to the investigation. For example, if the Google car was involved in a traffic collision, which resulted in a fatality of a passenger in another vehicle, an investigation performed by non-biased, uninvolved, third party would be better received from most parties as opposed to having Google report who it determined to be at fault in the collision. Autonomous vehicle collisions could be investigated similar to how the aviation industry uses the National Transportation Safety Board (NTSB). The NTSB was established in 1967 to independently investigate all civil aviation accidents in the U.S., as well as any major accidents involving the other modes of transportation.⁸⁹ This is where law enforcement and the CHP's MAIT teams will come in handy.

However, what will the CHP do when there are thousands of autonomous vehicles on California roadways and there are only eight MAIT teams to investigate those

⁸⁹ "Major Investigations," National Transportation Safety Board, accessed July 5, 2015, <http://www.nts.gov/.investigations/Pages/default.asp.x>.

autonomous collisions? Or is eight teams too many if autonomous vehicles are extremely successful, and there is less than one collision per day throughout the state? What will the CHP do when a driver claims his or her car's computer swerved to miss something and collided with something else? How will CHP verify this statement without evaluating the vehicles event data? The high-tech collision investigator needed for the not so distant future will need additional skills, training, and tools to meet those emerging needs.

D. EVENT DATA RECORDERS (EDR)

The Code of Federal Regulations (CFR), under Title 49, Part 563, last amended in 2014 (49 CFR Part 563), contains the regulations for vehicle event data recorders (EDR). As of 2004, an estimated 40 million passenger vehicles were equipped with EDRs voluntarily by manufacturers.⁹⁰ The Transportation Research Safety Board believes that approximately 96 percent of 2013 model, passenger cars and light trucks sold were equipped with an EDR voluntarily by the manufacturer.⁹¹

The current regulation does not require manufacturers to install EDRs; they are only voluntarily installed.⁹² The regulation standardizes what data is required, how it is formatted, and its survivability in a collision.⁹³ The regulation also mandates that automakers that install EDRs provide a commercially available tool for copying the data and provide consumers with a notification statement in their vehicle owner's manual.⁹⁴ In essence, if a manufacturer chooses to install an EDR in a vehicle, it is required to

⁹⁰ Hampton C. Gabler et al., *Use of Event Data Recorder (EDR) Technology for Highway Crash Data Analysis* (Washington, DC: Transportation Research Board for the National Academies, 2004), accessed July 7, 2015, http://www.nhtsa.gov/.DOT/NHTSA/NRD/Articles/EDR/PDF./Research/EDR_Technology.pdf.

⁹¹ Ibid.

⁹² "49 CFR, vol. 16, Part 563," accessed July 8, 2015, <http://www.gpo.gov/.fdsys/pkg/CFR-2011-title49-vol16/pdf/CFR-2011-title49-vol16-part563.pdf>.

⁹³ Ibid.

⁹⁴ "49 CFR, vol. 16, Part 563;" "U.S. DOT Proposes Broader Use of Event Data Recorders to Help Improve Vehicle Safety," National Highway Traffic Safety Administration, December 7, 2012, accessed July 7, 2015, <http://www.nhtsa.gov/.About+NHTSA/Press+Releases/U.S.+DOT+Proposes+Broader+Use+of+Event+Data+Recorders+to+Help+Improve+Vehicle+Safety;>

program the EDR to collect data in a specified format, ensure it is able to survive the crash, and ensure entities other than the manufacture can access the data.

In 2012, the NHTSA released a proposed safety regulation to apply as of September 1, 2014, requiring manufacturers to install EDRs in all passenger cars and light trucks weighing less than 8,500 pounds.⁹⁵ The proposal aimed to add the EDR requirement to the Federal Motor Vehicle Safety Standards and Regulations, § 405; however, this never occurred.⁹⁶ As a result, EDRs remain a voluntarily installed piece of equipment.

Under 49 CFR Part 563, the stated scope is: “This part specifies uniform, national requirements for vehicles equipped with event data recorders (EDRs) concerning the collection, storage, and retrievability of onboard motor vehicle crash event data.”⁹⁷ The code also requires manufacturers to ensure collision investigators and researchers are able to retrieve the data from EDRs with a commercially available product.⁹⁸ It further states under § 563.3 Application that “This part applies to the following vehicles manufactured on or after September 1, 2012, if they are equipped with an event data recorder: passenger cars, multipurpose passenger vehicles, trucks, and buses with a GVWR of 3,855 kg (8,500 pounds) or less...”⁹⁹ Once an EDR is installed in a vehicle, the requirement of 49 CFR Part 563 then becomes mandatory.

Data ownership is another area regarding EDRs that many have questioned. To help answer this question, the NHTSA released an advisement recommending EDR data be treated as the property of the vehicle owner and thus, not available for use or access without the owner’s consent.¹⁰⁰

⁹⁵ Ibid.

⁹⁶ Federal Motor Vehicle Safety Standard, 49 CFR, Part 571; Event Data Recorders, *Federal Register*, 77, no. 240, 74144-74159; Office of the Federal Register, “National Highway Traffic Safety Administration—Notice of Proposed Rulemaking, Docket no. NHTSA-2012-0177,” 2012, accessed July 8, 2015, http://www.nhtsa.gov/.staticfiles/rulemaking/pdf/EDR_NPRM_2012-12-07.pdf.

⁹⁷ “49 CFR, vol. 16, Part 563.”

⁹⁸ Ibid.

⁹⁹ Ibid.

¹⁰⁰ “U.S. DOT Proposes Broader Use of Event Data.”

Accessing and using the data to reconstruct collision factors and causes then becomes the next main focus. Although most cars on our roadways have EDRs today, the data is rarely captured by law enforcement when investigating a collision. There are several reasons it is not routinely collected. The first is that it is not always needed. Determining who is driving each vehicle can be determined by driver and witness statements. When a vehicle is operated in autonomous mode, determining who or what was in control of the vehicle at the time the collision occurred will become a very important fact needed. This piece of evidence will only truly be collected by accessing a vehicle's onboard computer or EDR.

Another reason EDR data is not routinely collected is that it takes additional training and equipment to access, collect, and decipher the data. Another reason is the increases the investigatory time frame for law enforcement. In today's environment, time is a scarce resource for law enforcement; therefore, any activities that cost more and increase investigative time without adding value to the investigation are not performed. As vehicles become more reliant on technology, the value of the data may change and become necessary step in the investigatory process.

A third reason EDR data is not routinely collected is due to data privacy concerns. Under current standards, the data belongs to the owner; therefore, law enforcement would need to follow all search and seizure laws to collect and analyze EDR data (i.e., obtain a search warrant). This adds significant time and costs to complete.

For the CHP, cost is going to be a huge hurdle to overcome regarding EDRs and data capture. Although the law states manufacturers shall provide a commercially available tool for copying the data, it does not require them to buy the tool and provide it to law enforcement. It also does not require any standardized communications port, thus requiring the CHP to purchase proprietary cables to connect to each make of vehicle (i.e., one cable for Ford, another for Audi, another for Honda, etc.). Currently, the data is accessed through the vehicle's diagnostic port, the same port mechanics use to access the vehicle's diagnostic system. Manufacturers want these ports to be unique to give them an advantage during repairs. Thus, accessing the vehicle's onboard computer is currently very expensive for law enforcement to perform and maintain fluency in.

By revisiting the standardization efforts of NHTSA, the CHP may be able to convince it the mandates are needed to standardize how the data is accessed, either physically or virtually. By performing additional research in this area, the NHTSA and the CHP may be able to collectively develop a standardized method for law enforcement to access and retrieve the data without hindering the manufacturer's diagnostic advantage. Having to continually buy and maintain a cache of cables will be expensive and cumbersome for the CHP and other law enforcement agencies nationwide. By standardizing these early, it could help avoid a patchwork model. Also, it will revisit the need to track and maintain this data for collision investigation and further safety evaluation.

Finally, accessing the data could be revisited by the courts and streamlined. The National Academies study contains an in depth analysis on whether or not law enforcement can access the EDR data post collision without a warrant.¹⁰¹ The study concluded that under the "Special Needs" exception and "Exigent Circumstance" exception, accessing and collecting the data is legal without a warrant. Researchers stated:

While prompt discovery of an accident's origin is not necessary to prevent its reoccurrence, a prompt seizure of the EDR may be required to prevent loss of the EDRs critical data. This may be especially true where vehicles are only slightly damaged, and may be driven from the scene by their owners. Where a driver may remove a vehicle from the accident scene there exists the possibility that critical evidence may be lost, thus creating a 'compelling need for official action.'

Alternatively, police officers may seize EDRs without a warrant during accident investigations because the EDR contains critical evidence of the accident's potential causes, and may furnish other evidence used to prosecute drivers from criminal offenses. It is well settled that warrantless searches of automobiles are permitted by the Fourth Amendment if the officers have probable cause to believe that the vehicle contains contraband or other evidence of a crime.¹⁰²

¹⁰¹ Gabler et al., *Use of Event Data Recorder*, 148–155.

¹⁰² *Ibid.*, 152.

However, the study did not evaluate if the two exceptions would hold up if there was no driver, like in the autonomous vehicle case. One would think they would probably apply, but when it comes to the courts, it would be better to spell out in a legal opinion before the need arose. That way law enforcement could get a warrant when necessary or rely on one of the stated exceptions to the warrantless search. Either way, the evidence could be secured and remain untainted, thus usable in court. Preferably, the data could be obtained by law enforcement in the most expedient manner; thus, it will not further delay an involved party or the investigation of the collision. Because this is a futuristic technology, some virtual data collection method seems to be the answer to expedite data recovery and eliminate hardware extraction tools.

E. INCREASED NEED FOR CYBER INVESTIGATIONS

The digital revolution has become a considerable shift from the traditional industrial environments of the past to one based significantly on computerized information and processes. This shift has lowered many of the traditional operational boundaries and created a high-tech, global economy almost overnight. This growth and advancement has not evolved without its challenges. Cyber related threats and attacks have become a significant portion of these new challenges, and they bring with them a lot of complex variables that seem to evolve in tandem with the technological advances.

As threats are identified, new threats emerge. Individually, personal identifying information is placed at risk and/or compromised at an alarming rate. According to Symantec, in 2013 there were eight mega breaches, breaches which exposed more than 10 million identities, compared to just one in 2012.¹⁰³ In these breaches, infiltrators gained unauthorized access to real names, dates of birth, social security numbers, and other personal identifying information. Each mega breach leaves millions of individuals susceptible to identity theft and a variety of other cyber related crimes. These breaches are occurring in both the public and private sector. In 2013, 552 million identities were

¹⁰³ Symantec Corporation, *Internet Security Threat Report*, Vol. 19 (Mountain View, CA: Symantec Corporation, 2014), http://www.symantec.com/content/en/us/enterprise/other_resources/b-istr_main_report_v19_21291018.en-us.pdf, 12.

exposed, a 493 percent increase from 2012.¹⁰⁴ These thefts lead to a myriad of other crimes.

Not only is this a concern for law enforcement, but is a national security concern that creates economic and physical threats to our country and its prosperity. During testimony before the Senate Judiciary Committee, Subcommittee on Crime and Terrorism, Federal Bureau of Investigation (FBI) Assistant Director of Cyber Division, Gordon Snow, stated:

Countering efforts by foreign countries to steal our nation's secrets, evaluating the capabilities of terrorists in a digital age, and fighting cyber-crime are the FBI's highest priorities. It is difficult to overstate the potential impact these threats pose to our economy, our national security, and the critical infrastructure upon which our country relies.¹⁰⁵

In 2012, an estimated 8.7 billion devices were connected to the Internet, and it is believed this number will grow to 40 billion by 2020.¹⁰⁶ The first "website" was created in 1991. Now, there are more than 30 trillion individual web pages.¹⁰⁷ With the addition of so many different types of devices linking to the outside world, cybersecurity and cyber investigations will be forced to constantly play catch-up to the next greatest threat.

FBI Assistant Director Snow stated:

U.S. critical infrastructure faces a growing cyber threat due to advancements in the availability and sophistication of malicious software tools and the fact that the new technologies raise new security issues that cannot always be addressed prior to adoption. The increasing automation of our critical infrastructures provides more cyber points for adversaries to exploit.¹⁰⁸

¹⁰⁴ Ibid.

¹⁰⁵ Gordon M. Snow, "Statement before the Senate Judiciary Committee, Subcommittee on Crime and Terrorism," April 12, 2011, accessed July 2014, www.fbi.gov/news/testimony/cybersecurity-responding-to-the-threat-of-cyber-crime-and-terrorism.

¹⁰⁶ Peter W. Singer and Allan Friedman, *Cybersecurity and Cyberwar: What Everyone Needs to Know* (New York: Oxford University Press, 2014), 2.

¹⁰⁷ Ibid., 2–3.

¹⁰⁸ Snow, "Statement before the Senate Judiciary Committee,"

President Obama declared, the “cyber threat is one of the most serious economic and national security challenges we face as a nation” and that “America’s economic prosperity in the 21st century will depend on cybersecurity.”¹⁰⁹ The threats and crimes are occurring daily, and it only looks like it will get worse.

Pursuant to California Government Code (GC) § 14613.7(a) and Title 13, of the California Code of Regulations, Division 2, Chapter 12, § 1875, the CHP is the lead agency tasked with the investigation and tracking of computer crimes involving state computer resources in the State of California. All other California state agencies are required to notify the CHP when they learn of a computer related crime occurring to one of their state owned systems or state resource. The CHP maintains a small investigative unit that handles these cyber investigations. The CHP also has “jurisdiction over those matters related to the security of state officers, property, and occupants of state property,” pursuant to GC § 14615 (b). These two responsibilities, coupled with the fact that the CHP is a statewide resource, makes it an ideal agency to handle high-tech, investigations within the state.

F. AUTONOMOUS VEHICLES AS A WEAPON

The FBI released an executive analytic report in May 2014, indicating if autonomous vehicles “will have a high impact on transforming what both law enforcement and its adversaries can do operationally with a car.”¹¹⁰ The FBI pointed out that criminal actors will be able do things that require both hands and taking one’s eyes off the road while driving, things like firing a weapon.

Using technology for methods they were not originally intended is nothing new; however, with autonomous vehicles, the stakes could be very high. The lives autonomous vehicles could save may be placed in jeopardy by criminal actors. If not secured, autonomous vehicles could be hacked and possibly be sent misguided signals to force a

¹⁰⁹ Barack Obama, “Cyber Security,” accessed July 2014, www.whitehouse.gov/issues/foreign-policy/cybersecurity.

¹¹⁰ Mark Harris, “FBI Warns Driverless Cars Could be Used as ‘Lethal Weapons,’” *The Guardian*, July 16, 2014, accessed July 8, 2015, <http://www.theguardian.com/technology/2014/jul/16/google-fbi-driverless-cars-lethal-weapons-autonomous>.

collision. Or, another possibility is that a system the vehicle interacts with, such as a traffic signal, could be hacked and forced to emit the wrong signal, causing an autonomous vehicle to crash unwittingly. Or worse, an autonomous vehicle could be loaded with explosives and programmed to drive to a location for detonation—an advanced vehicle borne smart bomb. Advanced safety and security standards will be a must and may prove to be the greatest challenge for manufacturers, law enforcement, and legislators.

III. COMPARING THE U.S. MODEL FOR ADOPTION OF AUTONOMOUS VEHICLES TO THE U.K.'S POLICY STRATEGY

To date, the U.S. has slowly entered the regulatory and policy arena regarding autonomous vehicles and autonomous vehicle testing. It has slowly begun to test the water and begin to look at autonomous vehicle technology. However, as we will address later, the U.S. is still following a “wait and see” approach, forcing each state to address autonomous vehicles separately. Conversely, the United Kingdom (U.K.) recently produced a policy strategy that is vastly different than any other in an attempt to embrace the technology and ensure its success in the U.K. Before comparing the new U.K. strategy, this research will outline the U.S. climate for autonomous vehicle then seek to overlay the U.K. approach.

A. THE CURRENT U.S. CLIMATE FOR AUTONOMOUS VEHICLES

Emerging technology regularly outpaces government policy, regulations, laws, and oversight in part because the need for evaluation. Whether a product is discovered by accident, like penicillin or the microwave oven, or it is painstakingly designed and redesigned over decades, government evaluation and eventual regulation occurs much later in the process. In fact, it often occurs out of cause for concern by consumers from accidents or unintended consequences, such as the regulations for baby cribs. Beginning June 28, 2011, all baby cribs sold in the U.S. were required to meet new federal regulations for safety, such as no longer allowing drop sides.¹¹¹ These regulations resulted from unforeseen accidents and are the government’s means to correct poor safety standards.

There is no question that autonomous vehicle technology is progressing at speeds that policymakers are unable to keep up with. Carl Tobias, a product liability law professor at the University of Richmond, stated, “Technology is always running ahead of

¹¹¹ “A Safer Generation of Cribs,” United States Consumer Product Safety Commission, accessed August 29, 2015, <http://www.cpsc.gov/en/Safety-Education/Neighborhood-Safety-Network/Posters/Crib-Rules/>.

the law, but in this case running way ahead of the law.”¹¹² Whether one believes fully autonomous driving is just around the corner or light years away, manufacturers are racing to design their versions of autonomous vehicles. Each year, they add new computerized functions to existing automobiles lines. Today, adaptive cruise control, blind spot monitoring, parking assist, assisted braking systems, steering assist, traffic sign assist, collision prevention assist, lane keeping assist, attention assist, crosswind assist, lighting assist, and even a fully autonomous “fetch” system for private property (Tesla S with software update 7.0 allows the car to be summoned to a driver’s location for pickup, like in a parking garage), are all in vehicles leaving assembly lines. Each year these technologies become more prevalent, smaller in size, and less costly, making them more common. At the same time, manufacturers are working to build and test their version of a fully autonomous vehicle, which is considered a new technology rather a new model of vehicle. Because the technology has progressed rapidly and the new technology is not predictable, policymakers have struggled to overcome many of the related challenges and barriers. These barriers could create significant vulnerabilities to law enforcement, especially in areas of response, collision investigation, cybersecurity, privacy rights, data retrieval, and physical security.

The desire to see autonomous vehicles succeed is very strong. They could prove to be far safer than human operators, thus saving thousands of lives each year. Additionally, they could provide the U.S. with significant economic gains and could maximize resources and reduce waste. Moreover, they could revolutionize the automobile and our way of life. Because the gains are high and consumers have grown up with idea that one day computers will drive them around, the U.S. consumer is eager to see autonomous vehicles succeed. However, this desire to succeed should not prevent sound policy from guiding manufacturers toward a product that is safe for consumers and minimizes potential threats. Threats involving cybersecurity, data privacy, and physical security all need to be minimized in order to provide the safest product to the motoring public.

¹¹² Ramsey, “Regulators Have Hands Full.”

B. U.S. POLICY—A PATCHWORK STATE-TO-STATE

Before advancing to what the U.S. is doing to regulate autonomous vehicles currently, one must understand briefly who the U.S. policymakers surrounding autonomous vehicles, autonomous vehicle technology, and the infrastructure needed to communicate with autonomous vehicles are.

The U.S. Constitution establishes a government based on federalism—“the sharing of power between the national and state governments.”¹¹³ Conversely, other countries, such as the U.K., follow a centralized system where the national government maintains total power. Under the U.S. system, law making is a power shared by both the federal government and state governments. For the most part, states are able to make laws that best suit their need. Traditionally, the federal government prefers to handle policies that affect the entire nation, such as national defense or currency/monetary, while leaving most criminal matters and divorce matters to the states; however, transportation usually gets its regulations from both. The federal government handles the regulation of commerce between states, while the states regulate commerce within their borders. Both are responsible for building and maintaining highways.

Who regulates transportation in the federal government? Established on October 16, 1966, the U.S. Department of Transportation (US DOT) was delegated with the responsibility of developing and coordinating policies to create a national transportation system for the U.S. and ensure it was based on “need, the environment, and national defense.”¹¹⁴ Therefore, the U.S. DOT is the primary federal department responsible for guiding and administering policies designed to “enhance safety, adequacy, and efficiency of the [US] transportation system and service.”¹¹⁵ The U.S. DOT has direct oversight over 13 federal agencies covering all modes of transportation, from automobiles, to rail, to aviation, to maritime. The U.S. DOT’s stated mission is to:

¹¹³ “Federalism,” U.S. History, accessed July 6, 2015, <http://www.ushistory.org/gov/.3.asp>.

¹¹⁴ U.S. Department of Transportation, Office of the Historian, “The United States Department of Transportation: A Brief History,” accessed March 31, 2015, <http://ntl.bts.gov/.historian/history.htm>.

¹¹⁵ Ibid.

Serve the United States by ensuring a fast, safe, efficient, accessible and convenient transportation system that meets our vital national interests and enhances the quality of life of the American people, today and into the future.¹¹⁶

Officials at U.S. DOT listed the department's top priorities as to keep the traveling public safe and secure, increase their mobility, and have our transportation system contribute to the nation's economic growth."¹¹⁷

Safety is the highest priority of the U.S. DOT, as indicated by its purpose, mission statement, and listed priorities. As new technology is developed and introduced to the marketplace, U.S. DOT is the regulatory department that evaluates it, regulates it, and provides policy guidance around its use. The department also controls and allocates federal transportation funding to states. This makes U.S. DOT the primary influential entity in the U.S. over the successful or unsuccessful future of autonomous vehicles in the U.S. Its mission of "...fast, safe, efficient, accessible and convenient transportation system that meets our vital national interests and enhances the quality of life," coupled with the many possible benefits of autonomous vehicles, shows that it has a vested interest in the technology's success. It also has a vested interest in ensuring the autonomous vehicles are safe and secure.

The two main agencies under the U.S. DOT that can also influence autonomous vehicles and related infrastructure are the Federal Highway Administration (FHWA) and the National Highway Traffic Safety Administration (NHTSA). The FHWA oversees construction, maintenance, and preservation of U.S. bridges and tunnels.¹¹⁸ The FHWA also researches and provides "technical assistance to state and local agencies in an effort to improve safety, mobility, and livability, and to encourage innovation."¹¹⁹ As autonomous vehicles evolve, most predict they will need to communicate or "talk" to the environment through sensors and other technological means to read roadway hazards,

¹¹⁶ "About DOT," U.S. Department of Transportation, accessed March 30, 2015, www.dot.gov/about.

¹¹⁷ "Our Administrations," U.S. Department of Transportation, accessed March 31, 2015, www.dot.gov/administrations.

¹¹⁸ "What We Do," Federal Highway Administration, accessed March 31, 2015, www.ftwa.dot.gov/about/.

¹¹⁹ Ibid.

road and environmental conditions, speed limits, traffic signals, congestion, etc. The FHWA will have a direct research responsibility and regulatory influence on most of these entities.

In fact, the push for using technology to solve vehicle safety issues is so great both the NHTSA and President Obama have called for a plan to place vehicle-to-vehicle (V2V) communication systems in all new cars and trucks as a way to help reduce, and ultimately prevent, traffic accidents, and fatalities.¹²⁰ According to *Daily Tech* writer Tiffany Kaiser,

Automakers like Audi, Volkswagen, BMW, Ford, General Motors, Honda and Toyota have all started developing some type of V2V technology, but NHTSA's new push for making such technology required in new vehicles will likely put forward some sort of standard to ensure that everyone is on the same page and that vehicles from different automakers can communicate with one another effectively.¹²¹

In support of the V2V technology, U.S. Transportation Secretary Anthony Foxx stated,

Vehicle-to-vehicle technology represents the next generation of auto safety improvements, building on the life-saving achievements we've already seen with safety belts and airbags. By helping drivers avoid crashes, this technology will play a key role in improving the way people get where they need to go while ensuring that the U.S. remains the leader in the global automotive industry.¹²²

President Obama related in his speech at the Turner-Fairbank Highway Research Center, that V2V technology could reduce up to 80 percent of the 32,000 road deaths each year in America, significantly reduce the two million non-fatal injuries per year, and

¹²⁰ Brandon Hill, "President Obama Extols the Safety, Cost Benefits of Vehicle-to-Vehicle Communications Tech," *Daily Tech*, July 15, 2014, accessed July 6, 2015, <http://www.dailytech.com/President+Obama+Extols+the+Safety+Cost+Benefits+of+Vehicle+to+Vehicle+Communications+Tech+/article36219c.htm>.

¹²¹ Tiffany Kaiser, "NHTSA Will Require Vehicle to Vehicle Communications in All New Cars, Trucks," *Daily Tech*, February 3, 2014, accessed July 6, 2015, <http://www.dailytech.com/NHTSA+Will+Require+Vehicle+to+Vehicle+Communications+in+All+New+Cars+Trucks/article34255.htm>.

¹²² Ibid.

save society \$800 billion annually in costs.¹²³ This V2V technology is coming and it will only be one element in autonomous vehicles.

The autonomous vehicles themselves and their ultimate success lie with the NHTSA. Its primary responsibility is to reduce “deaths, injuries, and economic losses resulting from motor vehicle crashes.”¹²⁴ It accomplishes this by setting and enforcing safety performance standards for motor vehicles and motor vehicle equipment, as well through grant funding to state and local entities for local safety programs.¹²⁵ Additionally, among other motor vehicle related duties, the agency investigates safety defects, sets and enforces fuel economy standards, helps state and local entities reduce drunk drivers, promotes safety belt usage, child car seat usage, and air bags.¹²⁶ Finally, it is a research arm for the federal government for driver behavior and traffic safety.¹²⁷ Therefore, NHTSA is going to play a huge part in the regulations and policy decisions for the security and safety of autonomous vehicles and autonomous vehicle technology within the U.S. Is it already involved and if so, what is it doing?

In May 2013, the NHTSA issued its, *Preliminary Statement Concerning Automated Vehicles*.¹²⁸ In this preliminary policy directive, the NHTSA posits that autonomous vehicles are likely to significantly change automobile travel more than it has changed in the last 100 years. It lists “improving highway safety, increasing environmental benefits, expanding mobility, and creating new economic opportunities,” as some of the potential benefits.¹²⁹ Furthermore, it expands this list by detailing how the elimination of a large number of collisions will save fuel, reduce traffic congestion, and reduce greenhouse gases.¹³⁰ This statement also outlines the NHTSA’s role and the

¹²³ Hill, “President Obama Extols the Safety,”

¹²⁴ “Who We Are and What We Do,” National Highway Traffic Safety Administration, accessed April 1, 2015, www.nhtsa.gov/About+NHTSA/Who+We+Are+and+What+We+Do.

¹²⁵ Ibid.

¹²⁶ Ibid.

¹²⁷ Ibid.

¹²⁸ NHTSA, “Preliminary Statement of Policy Concerning Automated Vehicles,”

¹²⁹ Ibid., 1–2.

¹³⁰ Ibid., 1.

purpose of the document. It explains, “NHTSA is responsible for developing, setting, and enforcing Federal motor vehicle safety standards (FMVSSs) and regulation for motor vehicles and motor vehicle equipment.”¹³¹ It also asserts the document is designed to provide a description of developments in autonomous vehicle, an overview of NHTSA’s automated research program, and “recommend principles that states may wish to apply as part of their considerations for driverless vehicle operation, especially with respect to testing and licensing.”¹³²

Although this preliminary policy statement outlines that the NHTSA is aware of autonomous vehicles and their potential benefits, it fails to address or even mention any potential safety hazards or concerns, privacy issues, cybersecurity concerns, standardization, or physical security concerns. Maybe it failed to recognize them or intend to address them at a later date. Either way, it provides guidance to states to help implement its policies and regulations without any mention of these possible concerns, thus allowing the states to continue without all of the necessary information to make an informed policy. It explains:

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 the innovations in automated driving and their potential to transform our roadways.¹³³

The guidance by no means restricts a state from allowing more. In 2015, the technology has far surpassed what it was in 2013 when this policy statement was drafted. In 2015, the new NHTSA chief, Mark Rosekind, declared he is very interested in promoting the technology and believes it holds the potential for great societal benefit, such as reducing crashes to reducing traffic congestion and enabling driving for elderly or infirmed people.¹³⁴ Clearly, U.S. policymakers want to see the technology succeed and thus have chosen the current hands off, tread lightly approach by merely guiding states. The NHTSA does hold the power to recall vehicles should they prove unsafe. In fact, this

¹³¹ Ibid., 2.

¹³² Ibid., 2.

¹³³ Ibid., 10.

¹³⁴ Ramsey, “Regulators Have Hands Full.”

was repeated in an official statement from the agency, “Like all vehicles on our roads, it must meet the applicable federal safety standards and must not present an unreasonable risk to safety.”¹³⁵

Further complicating matters are the state legislative efforts toward autonomous vehicles. Because each state decides independently how to govern themselves in areas not addressed by the federal system, each state is left to research and institute its own policies, regulations and laws. Because no federal laws prohibit the use of autonomous vehicles, and many current state laws do not address autonomous vehicles or autonomous vehicle technology, they are said to be legal. This potential loophole forced many states to research the issue independently and draft their own autonomous vehicle legislation. Figure 1 shows state legislatures who are considering or have considered bills related to automated driving as of July 2015.

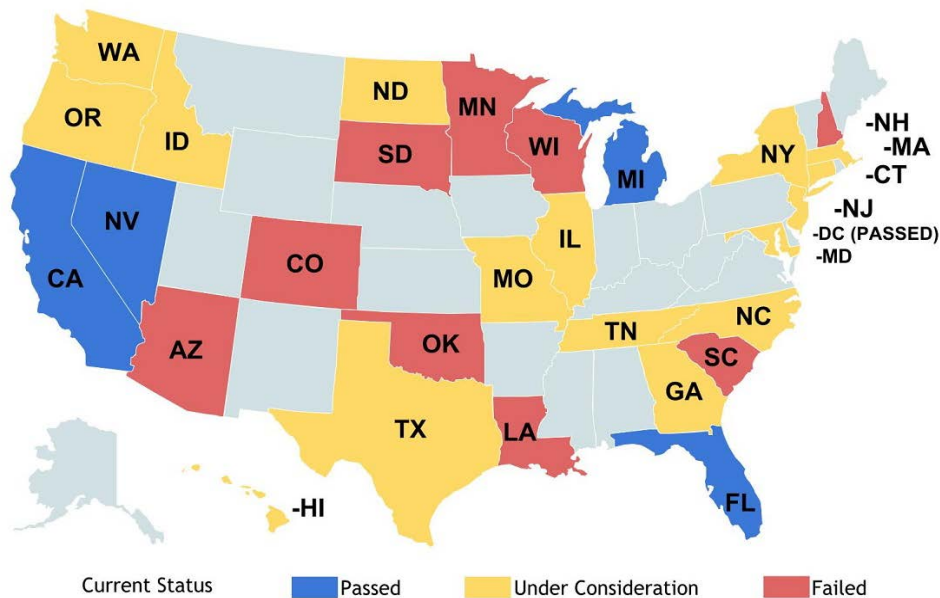


Figure 1. State legislatures That Have Considered a Bill on Autonomous Driving as of July 2015¹³⁶

¹³⁵ Ibid.

¹³⁶ “Automated Driving: Legislative and Regulatory Action.”

Most of the legislation is centered on defining autonomous vehicles, licensing autonomous vehicles, and testing autonomous vehicles. One can imagine how many similar, but differing, definitions have been developed. As it stands, the U.S. does not have a centralized definition, nor does it have any policy that can be used nationwide to address any law enforcement concerns that may arise as autonomous vehicles hit the streets. What safeguards are going to prevent an attacker from intentionally hacking the autonomous vehicle and sending it misinformation to cause it to crash? Or placing an improvised explosive device into a Tesla Model S and programming it to fetch to an intended target for detonation? Or even sharing a driver's location, routes of preferred travel, favorite tunes, or daily patterns with an unauthorized user?

The slow, wait and see approach the U.S. is following has created a patchwork of definitions, laws, regulations, and opinions regarding autonomous vehicle operation on U.S. roadways. To date, many questions still remain unanswered. Federally, the U.S. has only released statements of intent to complete further research and allow states to regulate as they see fit. This has created varying definitions, licensing requirements, testing requirements, and operating rules and equipment requirements. Many states have not passed any legislation, choosing to rely on existing legislation that may, or may not, apply. The U.S. law enforcement community has not yet weighed in any potential concerns like cybersecurity, privacy rights, or physical security. In the end, the U.S. patchwork of policy is just that, a bunch of temporary, reactive Band-Aids that provide manufacturers and state policymakers little guidance or direction.

Even manufacturers have serious concerns over the current patchwork of regulations. Jörg Schlinkheider, head of driver assistance systems for VW of America (owner of Audi), stated, "Audi is hoping the laws will become clearer when federal agencies eventually step in."¹³⁷ Schlinkheider further stated, "We can't deal with 50 different states and 50 different sets of regulations. Right now we have to take special

¹³⁷ Jason H. Harper, "Self Driving Cars are No Longer a Thing of the Future," *Time*, January 9, 2015, accessed July 7, 2015, <http://time.com/3661446/self-driving-driverless-cars-ces/>.

steps for drivers in California, but anyone with a driver’s license can pilot a prototype in Michigan.”¹³⁸

C. THE U.K. AUTONOMOUS VEHICLE STRATEGY

Differing significantly from the patchwork of rules the U.S. has attempted to enact state-to-state, the U.K. recognized what it considers a tremendous opportunity to become the leader in autonomous vehicle development. In February 2015, the U.K. drafted and released its official policy regarding autonomous vehicles, autonomous vehicle technology, and autonomous vehicle testing.¹³⁹ Claire Perry, Parliamentary Under Secretary, U.K. Department of Transport (the U.S. equivalent of the head of the U.S. DOT), wrote:

This review concludes that our legal and regulatory framework is not a barrier to the testing of automated vehicles on public roads. This creates a tremendous opportunity for the whole country to share in shaping the future of these exciting developments and the Government, working with the devolved administrations, wants to play its part in making that happen.¹⁴⁰

The U.K. approach has been to address the issue from a national level, embrace the process, and work with developers throughout the process in an attempt to become the lead country in autonomous vehicles—a significant economic motivator. The U.K. policy creates national level definitions for key terms, such as “driverless car” and “fully autonomous.”¹⁴¹ The policy then lays out the action plan of steps to follow to ensure the technology is allowed to progress within the U.K. while ensuring it is done in a safe, effective manner (See Figure 2). The U.K. plan includes:

- The identified need to allow testing on public roads,
- Outline of the potential benefits the technology could bring,
- Provides a review of the regulations and legislation that allow for the development and testing in the U.K.

¹³⁸ Ibid.

¹³⁹ British Department for Transport, *The Pathway to Driverless Cars*.

¹⁴⁰ Ibid, 5.

¹⁴¹ Ibid., 16.

- An outline of the potential regulations that need to be reviewed and/or revised,
- Definitions for the various levels of automation,
- Regulations for ensuring a test driver is able to take over a test a vehicle when needed during all testing (in compliance with the Vienna Convention),
- Defines the driver, test driver, and vehicle user,
- Addresses liability and insurance concerns,
- Outlines autonomous vehicle policy internationally (North America, Europe, and Asia),
- Designates a “code of practice,” which guides testers toward a clear set of safety standards and spells out what constitutes negligence on their part,
 - Trained, test driver required,
 - Data recorder required,
 - Vehicle technology must pass tests on closed roads and test tracks prior to allowing it on public roads,
 - Test driver must be ready and able to take control.
- Cybersecurity:
 - High level of computer technology required in autonomous vehicles in order to connect to the Internet, other vehicles, and their surroundings, as a result, the U.K. requires that cybersecurity issues be carefully considered.
 - Fail safe conventional mechanisms need to be installed to overcome a cybersecurity attack on the electronic systems.
 - All systems in autonomous vehicles or connecting to autonomous vehicles shall have appropriate security measures built into them.¹⁴²
 - “The Government and industry bodies will continue to work closely together on protecting these technologies against any potential cybersecurity issues.”¹⁴³
 - Action Item: “Liaise with manufacturers and stakeholders to ensure an appropriate level of protection from unauthorized access,

¹⁴² Ibid., 28.

¹⁴³ Ibid.

control or interference for automated vehicles engaged in testing.”¹⁴⁴

- Road infrastructure standards addressed and local stakeholders required to be informed,
- Public education materials about testing required.

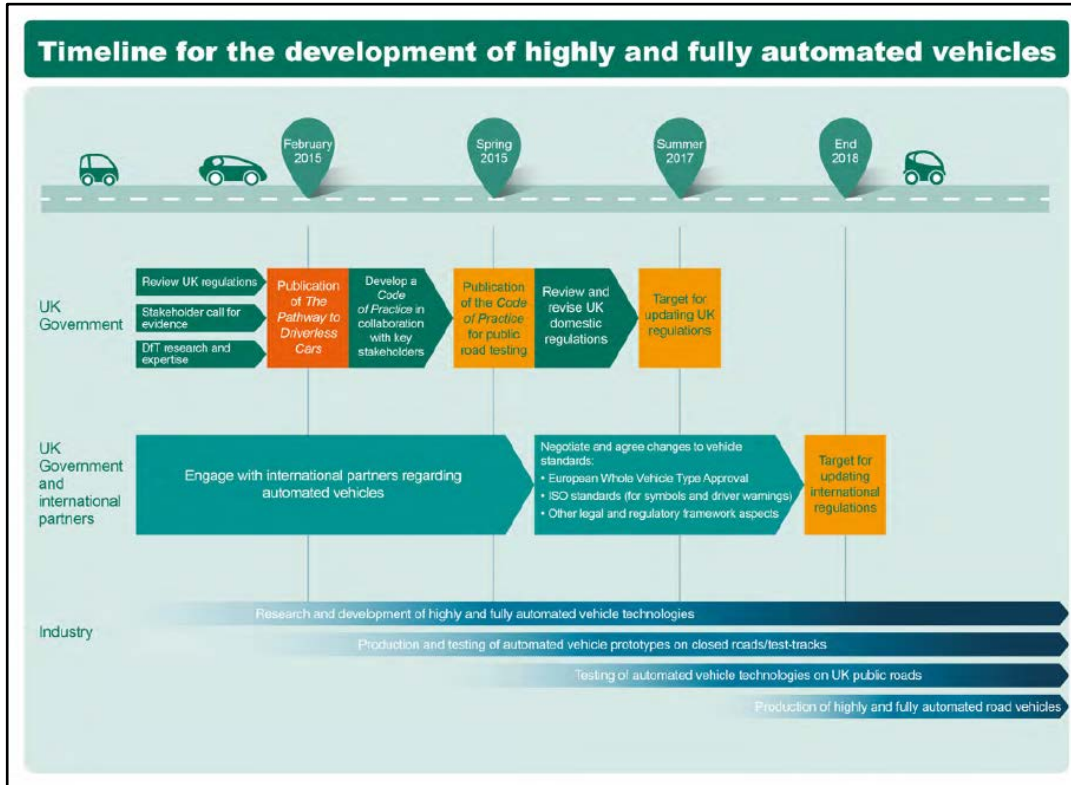


Figure 2. U.K.’s Timeline for Autonomous Vehicle Development¹⁴⁵

The U.K. plan has not fully addressed homeland security threats and vulnerabilities, but it has touched on cybersecurity and opened the door for future collaboration with manufacturers and stakeholders. It has also spelled out its plan for the near term and the long term, as well as pointed out the difficulties other countries like the U.S. are having with a piecemeal approach. Additionally, the U.K. believes its plan provides clearer understanding of how autonomous vehicle development should occur within the U.K. and its goal of becoming the global leader in autonomous vehicle

¹⁴⁴ Ibid.

¹⁴⁵ Ibid., 31.

technology. Moreover, its “light touch,” non-regulatory approach to testing and development through a code of practice will undoubtedly draw manufacturers to the U.K. and places it in a good position to work directly with those manufacturers toward a common goal: safe, automated driving. The U.K. approach to this innovation is highlighted in Figure 3. It involves collaboration with private companies, subject matter experts, universities, and research labs working in coordination with the government and policymakers early in the process to overcome challenges prior to market entry. This formula could prove to be critical to the successful introduction of autonomous vehicles, and the U.K. could emerge as the market leader (see Figure 3).

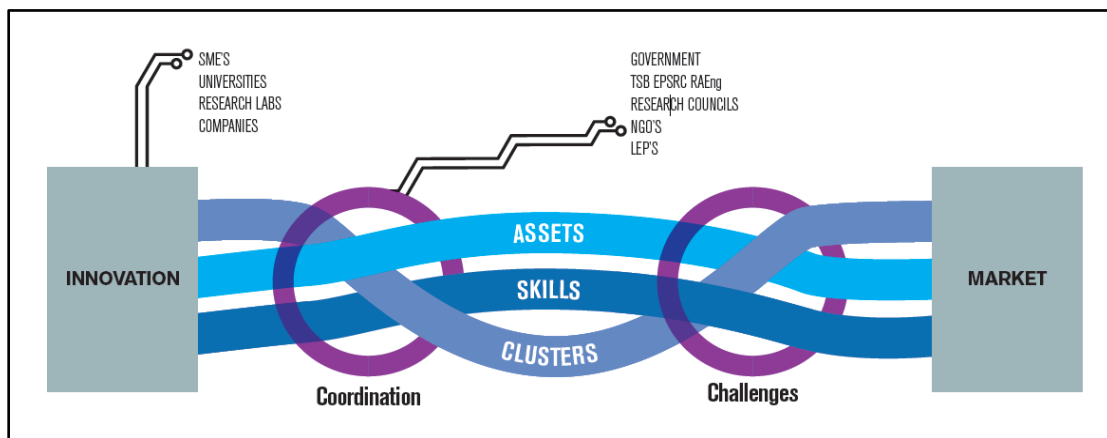


Figure 3. RAS 2020 Strategic Theme, Five Areas of Strategic Activity to Ensure RAS Innovation¹⁴⁶

D. POLICY CONSIDERATIONS FOR THE U.S.

There are four main policy areas the U.S. can strengthen based on the U.K.’s policies: defining key terms for consistency, establishing clear guidelines for autonomous vehicle testing and licensing, spell out liability concerns in the beginning to establish a baseline and identify any gaps, and ensure cybersecurity measures are implemented and researched. Additionally, the U.S. could expand on the U.K.’s strategy by adding in policy related to privacy concerns, as well as some form of physical security measures.

¹⁴⁶ “RAS 2020: Robotics and Autonomous Systems, The Knowledge Transfer Network,” Robotics and Autonomous System Special Interest Group, July 2014, accessed April 2015, <https://connect.innovateuk.org/documents/2903012/16074728/RAS%20UK%20Strategy?version=1.0>.

The U.S. DOT could work collaboratively to draft and release a national strategy that addresses the simple, known aspects of autonomous vehicle technology, such as definitions, testing, and licensing. Once the U.S. DOT issues regulatory definitions and policies, states could use them to develop any necessary state level policy. Those states that have failed to enact regulations would also be covered by the federal regulations. By leading the way, the U.S. DOT and the NHTSA could provide the consistency that is currently lacking in our state-to-state patchwork.

Next, the U.S. should follow the U.K.'s soft approach in handling cybersecurity concerns in autonomous vehicles by having the U.S. DOT draft language that requires manufacturers to consider cybersecurity in autonomous vehicles and all autonomous vehicle technologies, as well as require a failsafe, mechanical measure to counter any electronically controlled autonomous technology, such as steering, braking, and accelerating. These measures, coupled with advanced cybersecurity measures, will help reduce the possibility that an autonomous vehicle could be programmed to crash or taken over by an adversary.

Cybersecurity will be an ongoing hurdle for any technology, but it is one that needs to be addressed early and often when it involves motor vehicles. Thus, ongoing research by universities, private companies, research institutions, military research entities, and subject matter experts needs to occur now. Manufacturers and/or the NHTSA should hold competitions to “crack” or “hack” emerging autonomous vehicles and autonomous vehicle technologies in an effort to identify and close any vulnerabilities in a positive manner before an adversary does. Rewards and incentives could help encourage this and ensure vulnerabilities are brought to the attention of manufacturers.

Advanced cybersecurity measures developed by the military and government should be shared with manufacturers in order to help secure autonomous vehicles and possibly standardize cybersecurity measures. Efforts in cybersecurity cost taxpayers billions each year; therefore, if an advanced technology is invented by a government source, it should be cleared for dissemination in an expedient manner. This will be a difficult hurdle to cross; however, autonomous vehicle technology is worth the investment due to its potential benefits.

Liability and insurance requirements need to be addressed as well, even in the testing phase. Again a top-down approach will best suit the nation to help guide states through the potential scenarios. Once a baseline is established, any dispute outside of the baseline could be handled in the court of law. Without a baseline, the courts would be left to establish decisions post incident—a much lengthier process. The U.S. DOT should work with the National Association of Insurance Commissioners (NAIC), the Center for Insurance Policy and Research (CIPR), and the U.S. Department of Justice (US DOJ) to ensure policy is consistent with current legislation, case law, and practice. This joint opinion would help state departments implement their own guidelines. It will essentially provide loose interpretation to states.

The last two policy recommendations for U.S. are privacy rights and physical security measures. These have not been addressed by the U.K. or any other nation to date; however, they could be considered a high priority for the U.S. With more and more sensor technology added each year, vehicles become smarter and more connected to the world. They also have begun to collect more and more data on their drivers and passengers. This data will be necessary to ensure autonomous vehicles are able to successfully navigate the advanced environments and interact with their users. This data also should be secure to prevent unauthorized access and/or use by any non-stakeholder. For example, a driver's routes of travel, whereabouts, or travel patterns may be necessary to improve autonomous vehicle efficiency, but they are not necessary for others to access and/or use. The data should be protected much like financial data or telephone data. If a legitimate need arose outside of its intended purpose, courts should decide if the need is actually legitimate, through the current search warrant process.

To accomplish this, any data that links to personal identifying information should be restricted. Manufacturers will need to be involved in this process as they develop the technology and the technology that communicates with it. Any communications that emit from an autonomous vehicle should be restricted much like a cell phone. Entities should not be allowed under the law to attach technologies near roadways that capture information from passing vehicles without some type of authorization. For example, McDonald's should be able to see a person vehicle coming and know her or his

favorite meal from past orders so it can change its billboard sign to entice the person to stop. Although this may sound like good marketing, the technology could be used to detonate a roadside bomb when a person drives by or do some other nefarious activity. The point is that it needs to be regulated in order to balance privacy rights with technology innovation.

Finally, the U.S. needs to work with research entities, public and private, to identify potential vulnerabilities and improper uses. By “red teaming” the technology early and often, the U.S. can work with manufacturers to incorporate safeguards to overcome any potential vulnerabilities. For example, an adversary should not be able to simply place a bomb in an autonomous vehicle, program it to drive to a target, and then detonate it. Some type of safeguard will need to be designed to prevent such an inconceivable act.

Simple research grants and awards to overcome some physical vulnerability will drive many research entities into action. Further action will need to be accomplished through collaborative efforts and solidified by regulations. Obviously, all vulnerabilities cannot be overcome or identified, but the U.S. will at least be heading in the right direction by beginning to identify some and working to overcome them.

If the U.S. continues down its current path of allowing the states to decide how to handle autonomous vehicles, the nation will face inconsistent policies that will impact on our national highway system. We will also miss a potential opportunity to work collaboratively with manufacturers to design and install the necessary safety features to address homeland security and passenger safety concerns. Without early involvement from law enforcement, the U.S. may miss vulnerabilities that are cheaper and easier to address early in the process. We cannot afford to be a sedentary customer of what other nations and/or manufacturers develop.

IV. SCENARIO PLANNING

Innovations are not adopted by individuals or society at the same time. Instead, they are adopted sequentially in a bell curve fashion, as hypothesized by Everett Rogers.¹⁴⁷ Rogers argues that innovations are adopted at varying times based on four main influences: the innovation itself, communication channels, time, and a social system.¹⁴⁸

Humans have been obsessed with self-driving driving cars for decades, only held back by engineering. Now that technology is no longer a barrier, self-driving cars have become a reality. The desire for safer vehicles, capable of overcoming human error, has further increased the desire for self-driving cars. In Figure 4, the innovation adoption curve for autonomous driving is placed next to its hype cycle. This graphical representation shows that the autonomous driving is moving toward its peak of visibility and expectations on the hype cycle, indicating it is ripe for adoption by the public. Experts predict that the autonomous vehicle will be such a disruptive technology that it will not simply be the release of a new model of vehicle, but the development of the next wave to technology, much like cloud computing, 3D printing, and the Internet of Things (see Figure 4).¹⁴⁹

¹⁴⁷ Everett M. Rogers, *Diffusion of Innovation* (New York: Free the Press, 2003), 1–35.

¹⁴⁸ Ibid.

¹⁴⁹ Michael Bartl, “The Future of Autonomous Driving: Introducing the Foresight Matrix to Support Strategic Planning,” *The Making of Innovation, E-journal* (April 2015), accessed July 2015, http://www.michaelbartl.com/co-creation/wp-content/uploads/Autonomous-Driving-pdf._bartl.pdf.

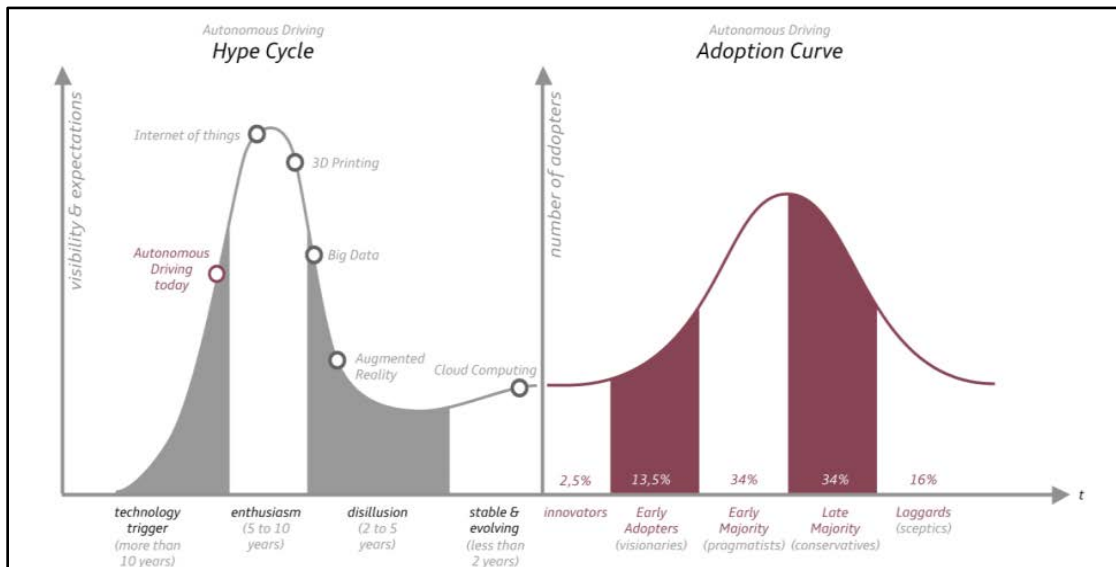


Figure 4. Innovation Path for Autonomous Driving¹⁵⁰

Each wave of new technologies has produced new challenges and opportunities for organizations. Determining the possible alternatives becomes difficult. Rogers stated:

An innovation presents an individual or an organization with a new alternative or alternatives, with new means of solving problems. But the probabilities of the new alternatives being superior to previous practice are not exactly known by the individual problem solvers. Thus, they are motivated to seek further information about the innovation to cope with the uncertainty that it creates.¹⁵¹

Scenario planning is one method for determining some of the possibilities and starting an organization toward becoming a thinking organization.

A. SCENARIO PLANNING AS A PREPAREDNESS TOOL

Through the use of scenario planning, the CHP can better prepare for the future of its organization, as well as the safety and service it can provide to the public. To better understand why this method is appropriate, this section discusses scenario planning and compares it to traditional strategic planning methods, thus proving a justification of why the tool would be useful for the CHP as autonomous vehicles develop.

¹⁵⁰ Ibid., 3.

¹⁵¹ Rogers, *Diffusion of Innovation*, Preface.

According to strategic management strategists at the Balanced Scorecard Institute:

Strategic planning is an organizational management activity that is used to set priorities, focus energy and resources, strengthen operations, ensure that employees and other stakeholders are working toward common goals, establish agreement around intended outcomes/results, and assess and adjust the organization’s direction in response to a changing environment.¹⁵²

This is an important activity for any organization to perform and follow. Where the waters get murky, is when an organization performs strategic planning based on prior results and they are not properly prepared for the future or they miss important signals in the business environment that could have led to big opportunities. Table 1 shows several of these peripheral signals and which organizations missed the opportunities and which organizations saw the opportunities and capitalized on them.

Table 1. Opportunities in Weak Signals¹⁵³

Domain	Opportunities in the Periphery	Who Saw It	Who Missed It
Technological	Digital Revolution	Apple (iPod)	Music Industry
	White LED Lighting	LED Companies	Light Bulb Manufacturers
	Open-Source Software	Linux, IBM	Microsoft and Sun Microsystems
	CD-ROM Encyclopedias	Microsoft	Encyclopedia Britannica
	Rapid Spread of GSM (Global System for Mobile)	Nokia	Iridium
Economic	Overnight Package Delivery	FedEX, UPS	USPS, United Airlines
	Search Engine Potential	Google	Microsoft

¹⁵² “The Basics of Strategic Management,” Balanced Scorecard Institute, accessed July 5, 2015, <http://balancedscorecard.org/Resources/Strategic-Planning-Basics>.

¹⁵³ Paul J. H. Schoemaker, “Strategic Thinking and Decision Making,” DSI: Decision Strategies International, 2011, accessed July 2015, <https://www.youtube.com/watch?v=6aLvCVL6bGw>.

Domain	Opportunities in the Periphery	Who Saw It	Who Missed It
	Discount Point-to-Point Airlines	Southwest, Ryanair, and EasyJet	United, Delta, Lufthansa
Societal	Sports and New Age Drinks	Snapple, Gatorade	Coke, Pepsi (Initially)
	Popularity of Reality Shows	Reality Show Producers	Game Shows
	Age Compression and Demand for more Sophisticated Dolls	Bratz	Mattel (Barbie)
Political	Generic AIDS Drugs in Africa	Indian Pharmaceutical Companies	Major Global Pharmaceutical Companies
	Social Discontent in Venezuela	Hugo Chavez	Establishment (PDVSA)
	Role of ‘Exurbs’ in Changing U.S. Voter Patterns	George Bush and Karl Rove	John Kerry

It does not matter which domain an organization resides in, there are signals that will present opportunities and threats to that organization. Many of the organizations in the Table 1 who observed these signals and pounced on the opportunities presented and emerged as a market leader. Most began as the little guy on the block, completely overshadowed by the organizations that missed the signals. This shows that organizations need to be constantly self-evaluating and preparing for a variety of future possibilities. By doing so, they hope to remain competitive and hear those signals in the periphery. Scenario planning is one tool that can help organizations see possible futures and prepare accordingly for the commonalities found in each scenario. Figure 5 depicts the reinforcing benefits of scenario planning.

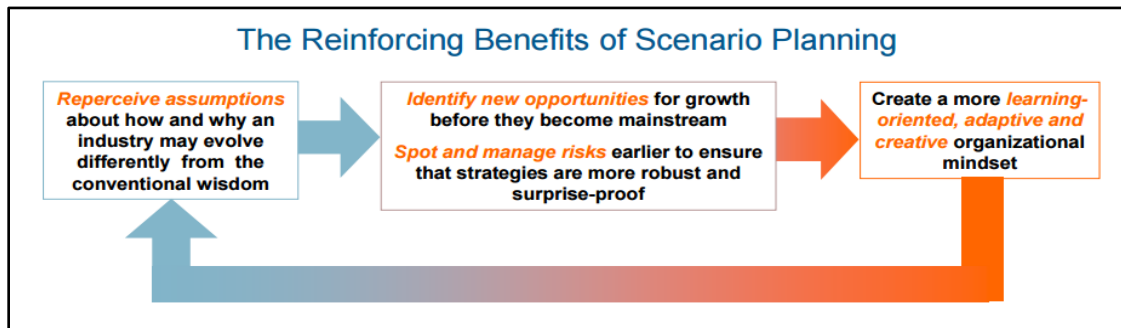


Figure 5. Benefits of Scenario Planning¹⁵⁴

Scenario planning offers an organization a glimpse of how the future may turn out in order to help the organization make strategic decisions today to prepare to meet those future needs.¹⁵⁵ It helps the organization consider a wide range of possibilities, resulting in a more innovative view of the future and any potential opportunities or threats.¹⁵⁶ In the *Scenarios: The Art of the Strategic Conversation*, author Kees van der Heijden relates how the Shell corporation used scenario planning based on the Kehn philosophy: “...planning must be based on the assumption that something is predictable. If the future is 100% uncertain planning is obviously a waste of time. The primary task therefore is to separate what is predictable from what is fundamentally uncertain.”¹⁵⁷ Van der Heijden notes that the predictable elements become known as predetermined elements and would be used in all scenarios. The point is not to predict the most plausible future or single possible future, but to develop and test strategies under a variety of plausible futures.¹⁵⁸ As represented in Figure 6, scenarios overlap an organization’s competencies and vision in order to help the organization create a strategy. If an organization only used competencies and vision, it could find itself clearly outside of a plausible future and not see potential threats, weaknesses, or opportunities (see Figure 6).

¹⁵⁴ Monitor Group, *Introduction to Scenario Planning* (Cambridge: Monitor Company Group, 2007), accessed July 2015, <http://www.mwcog.org/uploads/committee-documents/aV5eWFtX20080731094534.pdf>.

¹⁵⁵ Kees van der Heijden, *Scenarios: The Art of Strategic Conversation* (Hoboken, NJ: John Wiley & Sons, 2005), 150–162.

¹⁵⁶ Monitor Group, *Introduction to Scenario Planning*, 2.

¹⁵⁷ van der Heijden, *Scenarios: The Art of Strategic Conversation*, 4.

¹⁵⁸ Monitor Group, *Introduction to Scenario Planning*, 2.

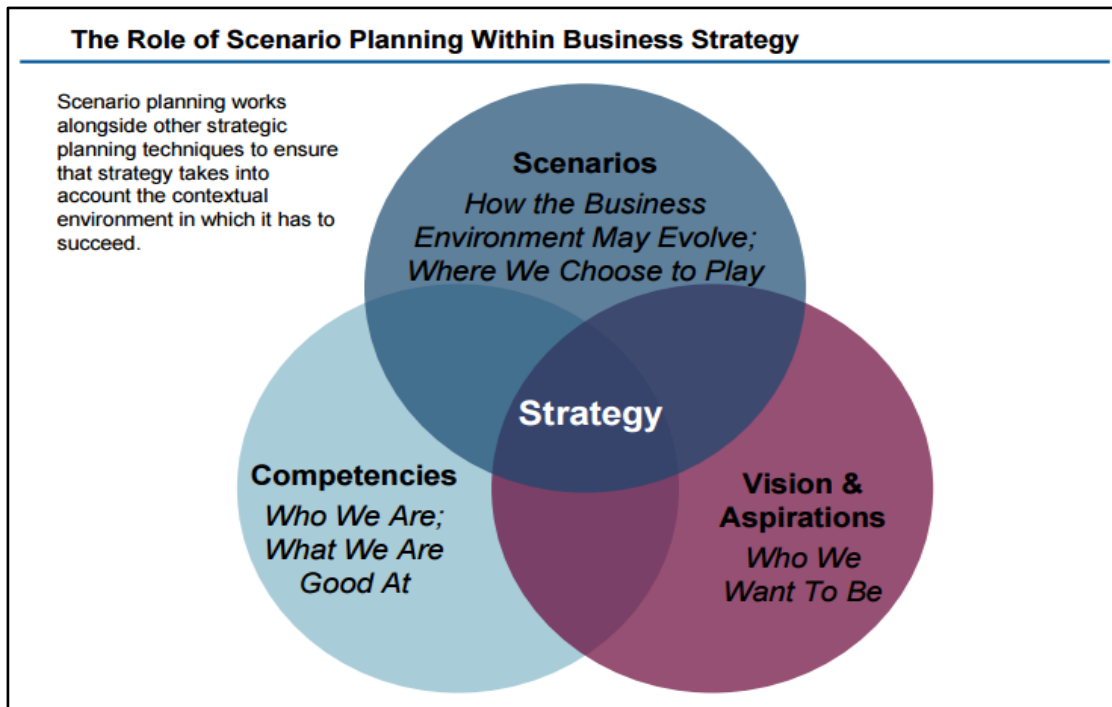


Figure 6. Role of Scenario Planning¹⁵⁹

Figures 7–9 help depict the value of scenario planning compared to traditional forecasting. Figure 7 shows the where an organization is right now and using past data to attempt to predict the future outcomes. This method relies on trends and conditions to continue into the foreseeable future.¹⁶⁰ Furthermore, this method usually works for short periods of time; however, it does not perform as well when looking out 10 years or more.¹⁶¹

¹⁵⁹ Ibid., 3.

¹⁶⁰ “Introduction to Scenario Planning Video,” posted by Future Freight Flows Project at MIT, December 15, 2011, accessed July 2015, <https://www.youtube.com/watch?v=yVgxZnRT54E>.

¹⁶¹ Ibid.

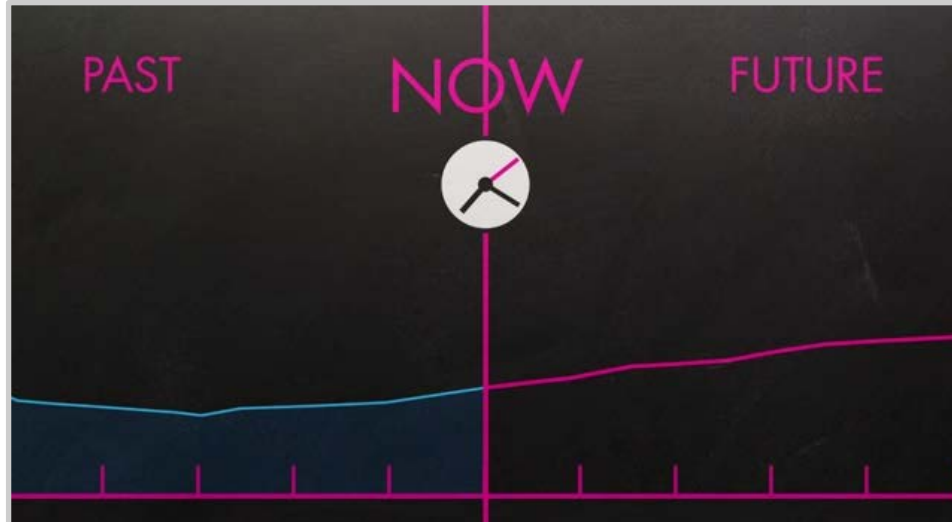


Figure 7. Projecting the Future Using Past Data (Projection Line)¹⁶²

The traditional methods for forecasting future needs also do not plan for or account for step changes and unforeseen events, such as natural disasters, terrorist attacks, political unrest, economic upheaval, or technological innovation.¹⁶³ Any of these can cause unforeseen changes in an organization’s operating environment and create a spike, or step change, in the organization’s strategic planning.

Using a prior example from Table 1, white LED lights were significantly overlooked by traditional incandescent and fluorescent bulb manufacturers. LED lights, consisting of red diodes, were invented by General Electric (GE) in 1962.¹⁶⁴ They were used in the 1970s for indicator lights and not much more. It was not until 2006 that Professor Shuji Nakamura of the University of California, Santa Barbara transformed the once dim light source into a bright: blue, green, or white light-emitting diodes.¹⁶⁵ Professor Nakamura was awarded the 2006 Millennium Technology Prize for his work

¹⁶² Ibid.

¹⁶³ Ibid.

¹⁶⁴ “The History of the Light Bulb,” Energy, November 22, 2013, accessed July 6, 2015, <http://energy.gov/articles/history-light-bulb>.

¹⁶⁵ “2006 Millennium Technology Prize Awarded to UCSB’s Shuji Nakamura,” University of California, Santa Barbara, June 15, 2006, accessed July 6, 2015, <http://www.news.ucsb.edu/2006/012148/2006-millennium-technology-prize>.

on the LED lights and received \$1.3 million dollars as a prize.¹⁶⁶ Due to increased concerns over energy shortages, coupled with the high efficiency of LED lighting and longevity of life, the LED industry rapidly accelerated.¹⁶⁷ Since 2008, the costs of the LED bulbs has fallen 85 percent, making them highly affordable by the masses. According to Energy.gov,

In 2012 alone, more than 49 million LEDs were installed in the U.S.—saving about \$675 million in annual energy costs—and as prices continue to drop, LEDs are expected to become a common feature in homes across the country.¹⁶⁸

LEDs became a step change in the lighting industry and many businesses were not ready for the change. As a result, the lighting industry has become a highly competitive marketplace with relatively new entrants doing very well, further eroding the market share of traditional companies like GE, Osram, and Philips.¹⁶⁹ Figure 8 shows the effect a step change can have on an organization's trend line. LEDs are an example of this and had General Electric keyed in on possibility of improving the technology in LEDs to meet consumer needs, it may have emerged with the market share in LEDs while reducing its output of standard lighting products.

¹⁶⁶ Ibid.

¹⁶⁷ "History of the Light Bulb"

¹⁶⁸ Ibid.

¹⁶⁹ Stephen Lacey, "The Path to 80 Percent Market Share for LED Lights," GreenTech Efficiency, April 30, 2013, accessed July 6, 2015, <http://www.greentechmedia.com/articles/read/The-Path-to-an-80-Percent-Market-Share-for-LED-Lights>.



Figure 8. Step Change Due to Unpredictable Event¹⁷⁰

Scenario planning has proven to be a useful tool in helping an organization reduce the chaos and uncertainty of unforeseen events and eventual step changes. By developing scenarios of future possibilities, organizations start to think about a variety of possible future outcomes, as depicted in Figure 9.

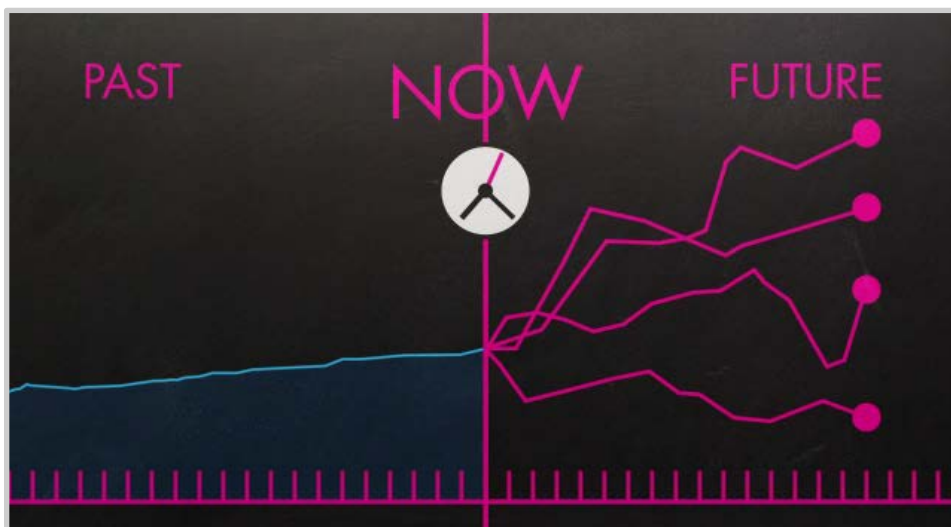


Figure 9. Scenario Planning for Future Preparation¹⁷¹

¹⁷⁰ "Introduction to Scenario Planning Video,"

¹⁷¹ Ibid.

Once an organization works through the many possible scenarios, it can begin to look for those commonalities in each scenario. Commonalities are then used to help get the organization thinking and planning toward the future. This preparation of going through scenarios also helps the adaptability of the organization, even if none of the scenarios come to fruition.¹⁷²

B. SCENARIO PLANNING INTO PRACTICE FOR THE CHP

Below are three potential scenarios for the year 2030, briefly outlined based on research for this thesis. They include perceivable and theoretical elements, such as speed of transformation of autonomous vehicle and sensor technology, cybersecurity, public policy, existing and proposed legislation, public opinion, the Internet of things, law enforcement strategy, extensive resources devoted to automobile travel, and the increasing time spent behind the wheel.

1. Wait and See Scenario

The CHP maintains its status quo of striving to reduce the mileage death rate each year using traditional methods of education, enforcement, and engineering (roadway repairs and reporting of unsafe roadway conditions). The CHP continues to hire and train based on traditional needs of a professional, paramilitary, enforcement trained workforce capable of being deployed anywhere in the state to handle a variety of enforcement related needs, such as civil unrest, dignitary protection, traffic enforcement, etc. Hiring trends surround trying to fill occupancy in vacant academy seats with candidates who can pass an extensive background check. Hiring also targets demographics to align staffing with state demographics in population.

The CHP maintains its current allocation of advanced accident investigation teams, under the Multidisciplinary Accident Investigation Team (MAIT) Program, as established in 1978.¹⁷³ The MAIT teams continue to train to meet any current need in accident investigation and respond to investigate when requested. The CHP also

¹⁷² van der Heijden, *Scenarios: The Art of Strategic Conversation*, 3–15.

¹⁷³ “Multidisciplinary Accident Investigation Teams (MAIT).”

maintains its current staffing and mission in the Computer Crimes Investigation Unit (CCIU); it is statutorily the investigatory agency over all computer related crimes involving a state computer resource. The CHP also maintains its current function of tracking all collision data and inputting into its Statewide Integrated Traffic Records System (SWITRS), a database used to store and maintain collision data for California.¹⁷⁴

In 2016, the California Cybersecurity Task Force, run by the California Governor's Office of Emergency Services and the California Department of Technology, foresees the growth in cyber related crimes and begins to lobby for resources and responsibility to investigate cyber related crimes within California. It also lobbies to become the lead investigative agency and preside over any and all cyber-attacks or attempted attacks on autonomous vehicles. Because autonomous vehicles are not state owned entities and autonomous vehicles are not in mass production, the CHP does not push back and allows the other agency to take the lead. The CHP continues to try to reduce the mileage death rate through traditional methods. Additionally, the CHP focuses efforts on training for potential civil unrest and the growing concern over how law enforcement deals with people with mental illness.

The population increases in the state, as do number of vehicles, miles driven, average consumer time spent behind the wheel, and overall traffic congestion. Autonomous vehicles continue to improve, and competition among manufacturers grows. The number of test vehicles in California increases and the public begins to yearn for the technology. Special interest groups, such as Mothers Against Drunk Driving, shift their focus from stopping a crime during the act before someone is killed to having technology prevent a crime from ever occurring. They come out in full support of autonomous vehicles as means to prevent DUI related deaths. Autonomous vehicle testing is promising, as they prove to be better drivers than people. President Obama's goal of having a vehicle-to-vehicle (V2V) plan pushed forward by 2017, comes to fruition and the law is changed mandating all new vehicles, starting in 2020, shall be equipped with a

¹⁷⁴ "Statewide Integrated Traffic Records System," California Highway Patrol, accessed July 6, 2015, <https://www.chp.ca.gov/programs-services/services-information/switrs-internet-statewide-integrated-traffic-records-system>.

V2V system and all existing vehicles shall be retrofitted by 2025. Meanwhile, technology continues to improve, with vehicles becoming faster, lighter, smaller, and cheaper, driving down barriers to entry. Moreover, pressure from manufacturer's, special interest groups, and consumers builds.

Autonomous vehicle legislation is drafted allowing a phased in approach to autonomous driving on California roadways with very little input from the CHP. At first, vehicles can only be driven autonomously on state highways, and a driver must be behind the wheel to take over control if needed. The vehicles must be driven in manual mode on surface streets. The vehicles are so desired and affordable by 2025 that manufacturers cannot keep up with demand. Autonomous vehicles grow exponentially on California roadways. Accidents involving autonomous vehicles are rare, but they do occur. When an accident occurs, the vehicle's onboard, event data recorder must be accessed to seize the vehicle's event data as evidence to determine cause and fault on the collision. The CHP reacts and attempts to purchase hundreds of crash data retrieval tools and cables to attach to each proprietary communication port. It is also beginning to train more personnel on the use and analysis of the tool and data in order to complete an impartial collision investigation. The CHP finds itself in reactive mode costing them additional time and resources. A backlog of vehicles needing to be downloaded occurs causing local agencies to begin to fight for the job and chip away at the CHP's operational environment.

Fewer collisions occur over time, as well as DUIs, traffic infractions, and overall motorist services. The legislature begins to transfer resources, money, and personnel positions to other agencies that need additional resources to support this emerging technology. Eventually, the CHP is whittled down to protecting state buildings, a job once done by the California State Police, an organization that was dissolved into the CHP in 1995.

2. Collaborative Effort Scenario

The CHP recognizes the potential benefits that autonomous vehicles present and the probable public demand for them given the increase in traffic congestion, increase in average time spent commuting, and value of time. The CHP begins to hold regular

meetings with manufacturers, researchers, legislators, and the public to ensure the technology balances the needs of the public and the needs of law enforcement, with those of the manufacturer. The CHP lobbies for standardization of event data recorders, data retained, and communication data ports to streamline investigative efforts in the future. In addition, the CHP begins to research a second job tier for the department, high-tech investigator, and begins to work toward creating this classification to handle any state related cyber investigations, as well as collisions involving autonomous vehicles. This classification will free up the officers to focus on proactive, law enforcement efforts in other areas. Resources from the officer classification can be slowly downsized, while the other grows.

The CHP begins to hire people with technology backgrounds, in addition to its current standards. All employees begin to receive a high-tech evidence preservation and recovery training. The CHP's CCIU is expanded to meet future investigative needs. The CHP fights to keep its current legal statutes for investigating cyber-crimes and attempts on state systems, as well as lobbies to expand their responsibility in this fast growing environment. Moreover, the CHP rebrands itself as the high-tech, state law enforcement agency in California and emerges as the California Information Highway Patrol (CiHP). It lobbies to become the lead investigative agency regarding autonomous vehicle cyber intrusion.

Manufacturers work with the CHP to ensure their vehicles are accepted by the law enforcement and the motoring public. As a result of the collaborative effort, legislators draw a connection between the CHP and autonomous vehicle and consequently, draft legislation that is favorable to the CHP, the public, and manufacturers. The legislative effort does not hinder the advancement of the technology.

As the vehicles hit the roadways, the CHP is prepared for the high-tech crash of the future with appropriate training and equipment. It is also better prepared as an organization should the technology significantly reduce collisions and traffic violations.

3. Strict Government Rule Scenario

The U.K. is positioning itself to attract autonomous vehicle manufacturers to the U.K. for the economic potential they may bring. Based on these positive test results and pressure from the U.K. to draw autonomous vehicle manufacturers to the U.K., California succumbs to the pressure and pushes forward with approving and legalizing autonomous vehicles for sale to the public. Lobbyists for the manufacturers convince legislators that early market entry is the key to them staying in the state. As a result, legislation favors the technology and law enforcement does not have an opportunity to convey their needs. The CHP is left trying to amend already enacted legislation. Consequently, all attempts from the CHP to standardize event data records, data retention, and data access ports will become difficult, which causes a need for a wide array of equipment and training to capture necessary data.

The CHP again plays catch-up with high-tech accident investigation and deployment of resources. As more autonomous vehicles hit the roads, the higher the likelihood the CHP will have to respond to investigate a collision involving one. The CHP MAIT teams initially handle the need; however, in a short period of time, the CHP realizes the complexity of the collisions and time it takes to complete one. The MAIT teams become overworked and fall behind in their efforts. The CHP begins to train more officers in this key area; however, the small number of courses offered and available instructors prevents the training from occurring in a timely fashion. Further complicating matters is the lack of standardization, which leads to a backorder in the event data retrieval tool and the various cables needed to connect to the various vehicles on the road.

Early entry to the marketplace has created a patchwork of legislation across the U.S. requiring states to play catch-up to enact like rules and regulations. The confusion among states leads to an overall unsatisfied public, who just want to be left to ride and work from inside their new traveling environment. Consumers are happy with the added time they have to work, sleep, or eat while travelling to and from their destinations. Congestion is relieved slightly because vehicles communicating with other vehicles are able to travel in packs more efficiently.

The first cyber-attack occurs on an autonomous vehicle and the vehicle intentionally collides with a school bus, killing the driver and two small children. The public demands answers and begins to question the safety of the technology. The manufacturer completes an investigation and claims it was the work of foreign, state-sponsored terrorists. The FBI begins to investigate and does not release any details while the investigation is underway. The president begins to feel the pressure and also demands answers. The future of the autonomous vehicle is in jeopardy. Cybersecurity companies begin to write security algorithms to prevent such an attack from occurring in the future in an attempt to save the program. As time passes, people begin to trust the technology again and autonomous vehicles continue to grow in popularity. Eventually, non-autonomous vehicles become too dangerous for roadways and are banned. More and more people are choosing to car share rather than own, maintain, and store their own vehicle(s).

The need for driver's licenses evaporates and the need for a national standard identification system develops. In the interim, law enforcement begins to have trouble properly identifying subjects it encounters because no one carries identification anymore. The CHP finds itself reacting to each and every change as it evolves.

C. ANALYSIS AND EVALUATION

Once an organization performs scenario planning, it can begin to extrapolate from the scenarios any common elements that remain true in each scenario. In the above scenarios,¹⁷⁵ the following factors appear to be common elements:

- Technology improves at a rapid pace,
- Autonomous vehicles are no longer held back by engineering,
- Autonomous vehicles have reached the testing phase,
- Autonomous vehicles are being tested on California roadways today,

¹⁷⁵ Normally scenario planning should include those in an organization that have foresight and the ability to affect change. An organization would create a team to perform the scenarios and dissect the outcomes. These scenarios are done by this author as an example of the process and do not include all possible outcomes or elements. In practice, a team approach should yield better results.

- Autonomous vehicle tests indicate they are better drivers than their human counterpart,
- Legislation is patchwork and reactive,
- Standardization of some features in autonomous vehicles will aid law enforcement,
- Cyber-crimes are on the rise,
- Law enforcement needs to be trained to recover electronic evidence, as it will only grow with time,
- CHP does not have enough trained personnel to retrieve and analyze electronic collision data should the vehicles be approved for sale.
- CHP needs additional equipment to properly retrieve electronic collision data,
- CHP has an opportunity to work now with manufacturers, legislators, and the public,
- CHP's goal of reducing the mileage death rate could happen with the use of technology, so why not fully support it,
- If the technology is successful, the CHP will need to pivot into another area of focus to maintain relevancy,
- Performing regular thinking exercises to identify multiple possible futures will help the CHP cluster related elements and plan accordingly.

By examining and identifying common elements through scenario planning, the CHP can begin to use its identified strengths to overcome any weaknesses and capitalize possible opportunities and reduce any possible threats.

V. ANALYSIS

The world of politics is dictated by rules. Short is the term of any ruler foolish enough to govern without submitting to these rules to rule by.¹⁷⁶

Rules, especially laws, once codified, are difficult to retract based on the principle of “path dependency.” The best time to create solid rules, strategies, policy, and/or law is therefore in the beginning of an emerging technology, rather than after its full adoption.

Autonomous vehicles are one such emerging technology and are no longer considered a sci-fi dream. They are here, on California roadways, and their numbers will continue to grow. The speed at which they will grow is debatable, but their adoption is not. This shift in ground transportation will be revolutionary, and many stakeholders will need to change the way they operate or risk extinction. The CHP is one such entity that could be defined by or devoured by this emerging technology.

As Clayton Christensen states in *The Innovator’s Dilemma*, “the firms that led the industry in every instance of developing and adopting disruptive technologies were entrants to the industry, not its incumbent leaders.”¹⁷⁷ Following Christensen’s logic, the CHP, a recognized leader in law enforcement in California, must keep a close watch on this emergence and attempt to transform its core missions to meet current and future needs of the state.

A. POLITICAL INFLUENCES OF THE CHP

The CHP is governed by many internal and external political influences, not unlike most government agencies. The CHP is governed by many stakeholders, as well as many formal and informal rules. The commissioner of the CHP, currently Commissioner Joe Farrow, is the executive leader of the department and presides over all departmental

¹⁷⁶ Bruce Bueno de Mesquita, and Alastair Smith, *The Dictator’s Handbook: Why Bad Behavior is Almost Always Good Politics* (New York: Public Affairs, 2011) Kindle edition, location 104.

¹⁷⁷ Clayton M. Christensen, *The Innovator’s Dilemma: When New Technologies Cause Great Firms to Fail (Management of Innovation and Change)* (Cambridge: Harvard Business Review Press, 2013), Kindle edition, Kindle locations 743–744.

matters at the direction of the governor of California. As an appointee of the governor, the commissioner position is highly influenced by the political climate within the state and thus can be hired and/or fired at will. During elections and following a change in office, each incumbent appointee is highly scrutinized. Re-appointments are not guaranteed or even expected. Thus, the CHP is heavily influenced and ruled by the governor, the governor's agenda and, by way of proxy, the governor's political party.

Although not guaranteed, the governor has traditionally appointed a commissioner from within the CHP. This internal appointment helps the CHP maintain its mission, vision, long-range planning, and traditions that have helped the organization become a recognized leader in law enforcement. This recognition and overall outstanding professional image helps the governor continue the practice of promoting from within, and in turn, helps maintain rich traditions and high standards within the organization. However, this practice and political environment potentially inhibit fresh, unbiased thoughts, plans, or ideas.

In the instance of autonomous vehicles, the CHP is politically positioned to support their use and continued development because California is in the heart of the technology sector and is often progressive when it comes to new technologies designed to improve the lives of citizens. Essentially, if the people want it, any governor or future governor will most likely support them. Currently, both the governor and the legislature are very proactive toward the furtherance of technology within the state for both jobs and economic reasons. When Governor Brown signed Senate Bill 1298 in 2012 allowing autonomous vehicles on public roads for testing purposes, California became one of the first states to allow such testing. Governor Brown stated, "Autonomous vehicles are another example of how California's technological leadership is turning today's science fiction into tomorrow's reality. This law will allow California's pioneering engineers to safely test and implement this amazing new technology."¹⁷⁸ Consequently, by supporting the technology and safe adoption in California, the CHP is not opposing political sentiment. In fact, it would be aligning with political sentiment and helping the process.

¹⁷⁸ "Governor Brown Signs Bill to Create Safety Standards for Self-Driving Cars," Office of the Governor, September 25, 2012, accessed July 9, 2015, <http://gov.ca.gov/news.php?id=17752>.

The next largest influence on the CHP is the public. The public, especially the motoring public, are the CHP's consumers. The CHP provides education, enforcement, protection, response, and recovery efforts for those on California's highways and in California State owned or leased facilities. If the members of the public are not satisfied with the CHP's level of service, they can apply political pressure to legislators and the governor to attempt to effect change in the organization. Political pressure can come in many forms. Some examples are: laws or regulations changes, governor's orders, financial appropriation changes. Therefore, the CHP must continue to provide public and provide those services that are indispensable to maintain a great image.

As autonomous vehicles begin to enter our roadways, the CHP has a tremendous opportunity to support their widespread adoption while simultaneously ensuring they are safe. The CHP holds a significant advantage should an autonomous vehicle crash in that it can independently investigate the cause of the collision. The public will be more trusting of the CHP in determining the cause of a collision. Much like the National Transportation Safety Board's (NTSB) role to investigate all aviation accidents, the CHP could become the expert in autonomous vehicle collision investigations in California. They can also become the sole tracking mechanism for collisions involving autonomous vehicles in California, a job that was recently given to the Department of Motor Vehicles.

This leads to the need to ensure legislation favors the CHP for many of these roles. The CHP, like all other entities in the state, is governed by laws, both federal and state. The most notable are the California Government Code, California Penal Code, and California Vehicle Code, through which the CHP and the commissioner are granted the authorities to provide certain functions, services, or duties. If the CHP were able to position itself through legislation and laws were written to include the CHP in some capacity with the introduction of autonomous vehicles, the CHP could emerge as a leader in this new industry. One example would be to become the statewide response agency for collision data collection following an accident involving an autonomous vehicle. A law of this nature would most assuredly place the CHP as a leader in autonomous vehicle collision investigation; however, the transverse could also occur. If the CHP does not establish itself as an early leader, another agency could be formed from scratch or

established from an existing agency to handle this new workload. Many of the CHP's authorities could be threatened and transferred to another entity, thus severely impacting the CHP and its operations.

B. THE WAY FORWARD, A STRATEGY FOR SUCCESS

If the CHP wants to emerge as a market leader in the future, its leaders need to start thinking toward the future today. This is not an easy task, especially for a government agency. University of California, Los Angeles (UCLA) management professor Richard Rumelt states, "A good strategy does more than urge us forward toward a goal or vision; it honestly acknowledges the challenges we face and provides an approach to overcoming them."¹⁷⁹ He also points out that government agencies may be at a disadvantage. He remarks, "Heavy with goals and slogans, governments have become less and less able to solve problems."¹⁸⁰ Professor Rumelt identifies that organizations create bad strategy because they fail to face the problem, mistake goals for strategy, create bad strategic objectives, and they hide the lack of thought with fluff.¹⁸¹

For the CHP to attempt to meet the challenges autonomous vehicles will present, they should attempt to identify those items that will be predictable elements. Strategist and author, Kees van der Heijden, wrote when faced with future planning, "The primary task is to separate what is predictable from what is fundamentally uncertain."¹⁸² Kees suggests that organizations use scenario planning where the predetermined items are in each scenario and the uncertainties are changed. This type of planning may not find all the possibilities, and it will most likely not find the one perfect strategy; however, it will help the organization become more adaptable and start to think about those many plausible outcomes.

The CHP should create a strategic working group comprised of various partners from the public and private sector, including law enforcement, manufacturers, university

¹⁷⁹ Richard Rumelt, "The Perils of Bad Strategy," *McKinsey Quarterly* (June 2011): 1.

¹⁸⁰ Ibid.

¹⁸¹ Ibid., 2–3.

¹⁸² van der Heijden, *Scenarios: The Art of Strategic Conversation*, 4.

researchers, government researchers, private citizens, other state agencies (e.g., DMV and CALTRANS), and any other pertinent entities to begin collaborate on the future of autonomous vehicles and how the CHP can blend with that future. The CHP should also perform periodic scenario planning sessions to identify those common elements that it can begin to strategize around.

The problem is NOT that autonomous vehicles are going to become prevalent on our highways and in our everyday lives. The problem the CHP faces is obsolescence. To overcome this, the CHP must shift its practices and services to show a vital need in the future of ground transportation. This will only occur with strategy and the strategy will have to shift the focus away from some of today's priorities in order to meet tomorrow's needs. However, as Christensen articulates,

The strategies and plans that managers formulate for confronting disruptive technological change, therefore, should be plans for learning and discovery rather than plans for execution...managers who believe they know a market's future will plan and invest very differently from those who recognize the uncertainties of a developing market.¹⁸³

C. LEVERAGING THE CHP'S INFLUENCE WITHIN THE INTERNATIONAL ASSOCIATION OF CHIEFS OF POLICE

The International Association of Chiefs of Police (IACP) hosts a variety of committees and projects, and as a whole, the organization is a collaborative entity with influential status among legislatures across the nation.¹⁸⁴ The following is a list of IACP committees and their stated mission sets, as listed on the IACP website. These committees could aid law enforcement, the public, and policymakers in moving forward with appropriate policy decisions regarding the advancement of autonomous vehicle technology:

- **Civilian Law Enforcement—Military Cooperation Committee** - The Civilian Law Enforcement—Military Cooperation Committee (CLEMCC) shall act as a liaison agency between military law enforcement and civilian law enforcement. The goal of the committee shall be to foster a closer

¹⁸³ Christensen, *The Innovator's Dilemma*, Kindle locations 2680–2681.

¹⁸⁴ "Committees," International Association of Chiefs of Police, accessed July 6, 2015, <http://www.theiacp.org/Committees>.

relationship between the civilian and military law enforcement disciplines so that each discipline can take mutual advantage of the other's skills, knowledge, training research and development, and equipment in the law enforcement field for the benefit of the people who are served.

- **Communications and Technology Committee**—Acts as a liaison agency for this Association with the governmental agencies of the United States and other nations represented in this Association and with other public, civic, and industrial agencies whose facilities are devoted to the development science and technology and use of modern communication systems; keeps abreast of, and fully informed on, all developments relating to the science of communications and other technology and its practical use in police service; and reports to this Association as frequently as is necessary for dissemination to all police agencies all pertinent information and recommendations that will advance and assist in the application of such technology in police service.
- **Computer Crime and Digital Evidence Committee**—Strengthens law enforcement capabilities to prevent, investigate and prosecute information age crimes involving digital technologies and evidence, promotes expert collaboration among agencies, government, business and academia, identifies resource needs, advocates for enhancements and sharing, and advises Association leadership and members.
- **Education and Training Committee**—Provides adequate organization and an opportunity for members of this Association concerned with education and training to conduct meetings; transact the necessary business, discussions, research, evaluations, and determinations of police education and training matters of mutual interest; promote a more intimate and meaningful relationship between the police executive and the police educator; assist this Association with coordinated and cooperative effort in the implementation of the mutual objectives of effective police education and training, promotion of adequate police educational programs, and achievement of an accepted professional status of the police service; promote other essential mutual interests, assistance, professional standards, and relationships among police educators.
- **Highway Safety Committee**—Studies, considers, and evaluates all matters pertaining to policies, practices, standards, and rates of state and municipal policy organizations relating to traffic accident investigation, traffic records, traffic patrol, traffic law enforcement, organization and administration, and other highway safety functions that may be responsibilities of the membership of the Association; reports to this Association for dissemination to its members and interested agencies information and recommendations for the improvement of police traffic management and the promotion of highway safety; makes recommendations to the Traffic Institute of Northwestern University

relating to its traffic police training programs; and makes recommendations to the Association and other interested organizations and agencies of needed research projects essential to optimum highway safety programs by police agencies.

- **Homeland Security Committee**—Serves as the IACP’s central coordination point for Department of Homeland Security (DHS) information, issues, policy development, and program reviews. Provides the IACP leadership with a consortium of expertise chartered to advise on a full spectrum of issues including, but not limited to, the review of draft DHS policy documents and relevant legislative proposals. Assembles, prioritizes, and articulates law enforcement’s most critical needs and issues and provide them to DHS, a complex and rapidly evolving national protection agency.
- **Legislative Policy Committee**—This committee shall study and evaluate all proposed legislation and regulations that may favorably or adversely affect law enforcement or the welfare of police officers on a national basis and report as frequently as necessary to this Association, or its Executive Committee, its findings and recommendations relating thereto for dissemination to the membership or for other appropriate action.
- **Private Sector Liaison Committee**—Composed of representative members from all facets of the private security sector and the law enforcement community, this committee strives to improve the relationship between the private sector and public sector by the discussion and dissemination of meaningful data on a continuing basis.
- **Research Advisory Committee**—Promotes and supports police based research in the U.S. and the world.
- **Strategic Planning Committee**—The Board of Officers shall serve as the Strategic Planning Committee, and will utilize all available data pertaining to historical, external, and internal trends and current events affecting the organization in order to maintain the Strategic Plan as a dynamic, flexible, living document that is solidly entrenched in the culture of IACP.
- **Terrorism Committee**—Analyzes the problem of terrorism and its implications for the law enforcement community, both domestically and internationally.¹⁸⁵

Because the technology has the potential to touch a variety of different issues and areas for concern, the IACP committees offer a great starting point for law enforcement to research and collaborate on those varying issues in order to provide guidance and influence from law enforcement as an industry.

¹⁸⁵ Ibid.

One of the more influential committees regarding traffic safety is the IACP Highway Safety Committee (HSC), an international committee:

comprised of 30 members representing federal (Royal Canadian Mounted Police), state (Alabama, Arizona, California, Colorado, Florida, Missouri, Montana, Nebraska, New Hampshire, New York, Virginia, and Washington), provincial (Ontario Provincial Police), county (Baltimore County MD, Fairfax County VA, and Montgomery County MD), and municipal (Boulder City NV, Braintree MA, Cheyenne WY, Cincinnati OH, Fresno CA, Hoffman Estates IL, New Orleans LA, Oro Valley AZ, Schaumburg IL, and Waterford CT) law enforcement agencies, as well as criminal justice institutes (Center for Public Safety of Northwestern University and the Institute of Police Technology and Management).¹⁸⁶

For the CHP, this committee would serve as the perfect launching pad for the IACP collaboration because CHP's executive leader, Commissioner Joseph Farrow, is the current committee chair and runs the three meetings it has each year.¹⁸⁷

Through IACP, the CHP can start the process of collaborating with thinkers and researchers focused on issues affecting law enforcement in order to establish many of the possible solutions law enforcement can provide as autonomous vehicles gain traction. It can then influence regulators at all levels to create policies, standards, and legislation that will support both movements. Figure 10 shows the organizational structure of the HSC and to whom it provides input.

¹⁸⁶ "Committees and Projects," International Association of Chiefs of Police, accessed July 6, 2015, <http://www.theiacp.org/Committee-Projects>.

¹⁸⁷ Ibid.

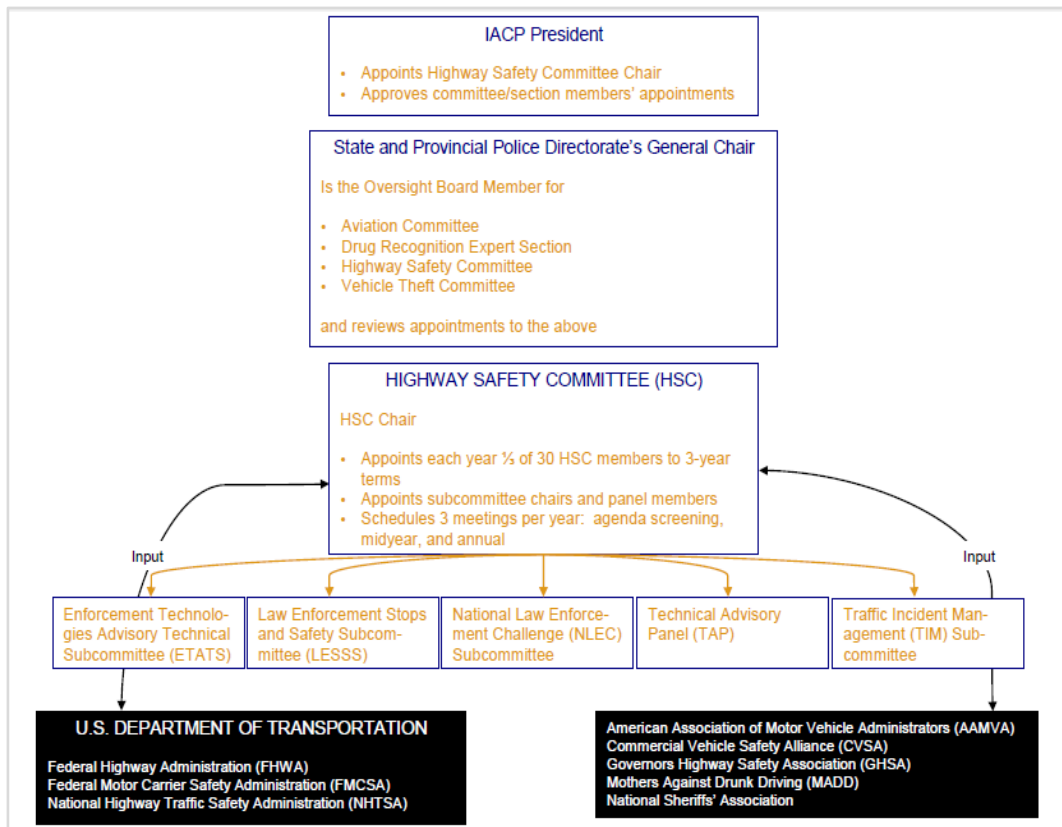


Figure 10. IACP Highway Safety Committee Organization Chart¹⁸⁸

As the chart indicates, the HSC provides input to the U.S. DOT entities, as well as numerous associations and public service groups nationwide. Their input and support could prove instrumental for the CHP and law enforcement in general. Moving identified issues and possibilities through the various IACP committees for vetting and general discussion, could help the CHP identify other areas of focus and/or concern for California, as well as help nationalize common terms, standards, and practices for states to adopt.

D. POLICY RECOMMENDATIONS

At this early stage, the CHP needs at least to identify the importance of autonomous vehicles and the potential impact they may have, and then shift research and

¹⁸⁸ "Organization Chart," International Association of Chiefs of Police Highway Safety Committee, accessed July 6, 2015, <http://www.theiacp.org/portals/0/pdf.s/HSCOrgChart.pdf>.

planning resources to investigate, plan for, and strategize the future of the CHP as an organization. Professor Rumelt states,

Good strategy works by focusing energy and resources on one, or a very few, pivotal objectives whose accomplishment will lead to a cascade of favorable outcomes. It also builds a bridge between the critical challenge at the heart of the strategy and action—between desire and immediate objectives that lie within grasp. Thus, the objectives that a good strategy sets stand a good chance of being accomplished, given existing resources and competencies.¹⁸⁹

To avoid eventual obsolescence, the CHP should evolve with autonomous vehicles and attempt to emerge as a law enforcement leader in policy development toward autonomous vehicles. To accomplish this the CHP should:

1. Engage Stakeholders

The CHP should use its reputation and influence to engage stakeholders about the need for future law enforcement to shift from its traditional methods to more futuristic endeavors.

2. Expand the CHP's High-Tech Workforce

By seeking, hiring, and training a workforce with advanced computer skills, the CHP can grow its responsibility in the cyber-crimes arena, an area needing growth, and seek to become the statewide investigatory agency over any intrusion of a vehicle's computer system, whether fully autonomous or not. The CHP could also use its new high-tech workforce to better investigate collisions in the future by giving its people the training and equipment to retrieve and analyze data recovered from a vehicle's event data recorder.

The CHP may want to split its workforce into two career tracks to accomplish this task and maximize resource deployment by having both law enforcement officers and computer forensic investigators. Or it may want to keep them together as one. This will be an area to evaluate and consider moving forward.

¹⁸⁹ Rumelt, "The Perils of Bad Strategy."

3. Expand the CHP's Role in Accident Investigation

The CHP should use its position as a recognized leader in law enforcement and advanced accident investigation to lead the way for law enforcement to have the responsibility of responding to and investigating any and all collisions involving autonomous vehicles. The CHP should also use its influence to steer legislative efforts to standardize legislation regarding the definitions of autonomous vehicles, autonomous driving, and any other key terms needed to properly investigate and document a collision in any state.

By stepping up now and justifying the benefits of having the CHP respond to and investigate any and all autonomous vehicle collisions during the testing phase, the CHP could align itself to continue this assignment when they are adopted fully. This can be done by sending officers to additional training now to avoid a backlog later and properly equipping them. In the interim, the CHP could use its MAIT teams to respond and handle any collisions in the near term.

Furthermore, as the subject matter expert and author of the Collision Investigation Manual, the CHP should amend the manual to include key definitions and measures to consider when investigating a collision involving a vehicle with an automated driving function and/or autonomous driving mode.

To assist the DMV with tracking of autonomous vehicle collisions, the CHP should amend the CHP form 555, Traffic Collision Report, form to include boxes for statistical collection for:

- Autonomous vehicle (yes/no)
- Autonomous mode active (yes/no)

The CHP already maintains all collision data in SWITRS for the state, so updating it to include the autonomous vehicle amendments will only aid the state when making future safety considerations.

The CHP will need to begin to look at its recruitment and hiring equations and begin to factor in the need for more high-tech cops. It will also need to begin training

more officers on the specialized crash data retrieval tools, process, and analysis.¹⁹⁰ Not only are these tools expensive to purchase, but they require a lot of highly technical training to use. The classes are not offered in large scale and consequently, it will take some time for the CHP to rotate officers through them in order to ensure it has enough trained personnel throughout the state to perform this necessary task. By starting today, the CHP can do this incrementally to avoid reactionary problems, like lack of availability, lack of funding, and insufficient resources.

By building on the CHP's rich tradition of being a leader in accident investigation, the CHP has opportunity to continue that tradition and reputation. It can also use its reputation to work with manufacturers to build investigative knowledge and work collaboratively, so that when a vehicle crashes in autonomous mode, the CHP officers will not be left scratching its head, like other agencies. In addition, the CHP needs to use its geographical advantage of residing in California where the technology is evolving, to further the its working knowledge of the technology and how to interact with it, especially post collision. The CHP also needs to amend its CIM to include definitions for autonomous vehicles and include a section discussing the investigation of a collision involving an autonomous vehicle. This addition to its manual will establish, both internally and externally, that the CHP is watching this technology and keeping up with the changes. It should also amend the collision investigation forms (that everyone in California currently uses) to include check boxes for "autonomous vehicle," "manual mode," and "autonomous mode."

4. Expand the CHP's Role in Computer Crimes Investigations

Work with legislators to ensure the CHP retains the legal authority as the primary investigative agency for computer related crimes involving state resources in California and argue to expand the CHP's jurisdiction to include vehicle computer systems and systems that interact with vehicles on California roadways. The CHP should essentially transform many of its officers into high-tech, vehicle computer forensic experts to meet future needs.

¹⁹⁰ "Bosch Diagnostics," Bosch, accessed July 7, 2015, <http://www.boschdiagnostics.com/cdr/training>.

The CHP could use existing authorities and influence to convince the state of California that it should take a larger role in cyber intrusion investigations, especially those involving any vehicle or traffic related device. By expanding its role in cyber investigations now, prior to the full adoption of autonomous vehicles, the CHP can maintain relevance in an investigative area that is showing no signs of slowing. This would help it build expertise, increase its investigatory realm, and grow its reputation as a leader in the investigation of cyber related crimes. By doing this now, the CHP can further establish relevance in the future with this growing and important area of future law enforcement. As more autonomous vehicles hit the streets and more vehicles become automated in general, the need for an investigative agency to handle any and all vehicle related cyber-crimes will only increase as well. This new opportunity is one the CHP could pursue and attempt to become the lead investigative agency for future intrusions. If legislation is enacted granting the CHP this authority, it will further solidify its future mission and help them maintain relevance in a fast changing environment.

5. Provide Input and Influence to Amend National Strategies

The CHP could use its support and influence to amend EDR requirements to ensure all autonomous vehicles are equipped with EDRs and that data is accessible to law enforcement, data access is standardized, and the warrantless search requirement is visited by the courts to provide legal opinion to help guide law enforcement.

At present, the law under the Code of Federal Regulations (CFR), Title 49, Part 563, last amended in 2014 (49 CFR Part 563), does not require EDRs for autonomous vehicles (it is still voluntary), it merely regulates those EDRs that are installed voluntarily by manufacturers. In addition, the CHP could attempt to convince national stakeholders of the need to expand the EDR mandates and rules regarding data acquisition for collision investigation purposes. They could also mandate that manufacturers adopt a standardized EDR port for law enforcement to access and acquire the data, thus alleviating the need to public agencies to continuously purchase and carry a wide variety of proprietary cables and plugs. This will significantly aid law enforcement in the long term by reducing costs and equipment maintenance and storage.

Furthermore, the CHP could also urge the NHTSA to release a national policy regarding autonomous vehicles that has common definitions, testing requirements, licensing requirements, law regulating travel beyond state lines, etc., to end put an end to the patchwork of legislation that currently rules the industry.

6. Countering Technology as a Weapon

The possibilities for exploitation by bad actors will be high. To overcome or reduce these exploitations, law enforcement could start the conversation now with inventors, developers, manufacturers, and policymakers to attempt to identify some possible solutions to reduce some of the potential threats. Some examples might include, remote disabling capabilities for law enforcement to use to stop a vehicle, technological and legislative requirements that an autonomous vehicle can only operate with a live human in the vehicle, and/or using vehicle data to track down and apprehend a wanted subject. The CHP needs to begin researching and recommending many of these features because it is a statewide law enforcement agency, and it could leverage the technology used to apprehend criminals and locate victims under America's Missing: Broadcast Emergency Response (AMBER) alert system (a function the CHP currently administers for California). The CHP can use its status as the AMBER alert coordinator to get other agencies together to start the process of identifying any potential threats and opportunities.

E. MEASURES OF SUCCESS

The CHP's transformation needs to occur before widespread adoption of autonomous vehicles. If the CHP needs to recruit, hire, and train more technologically savvy officers, it will take years to implement. If the CHP determines it should run a working group consisting of various public and private partners to examine autonomous vehicles, legislation, policy, safety requirements, standards, etc., it would behoove CHP to start this early in the product life cycle for it to have any bearing on the end product. There are also many more areas of focus that have not been identified. The point is disruptive technologies and futuristic strategy can cause problems for organizations if CHP does not begin to think about what the future will look like and how it can fit into

that future. As Christensen argues, “Applying inappropriate marketing, investment, and management processes can render good companies incapable of creating the new markets in which enabling or disruptive technologies are first used.”¹⁹¹ If the CHP fails to recognize and think about this potentially disruptive technology, it could make further mistakes down the road and find itself incapable of correcting those errors.

To avoid those errors and properly strategize, an organization must identify its influential stakeholders now and in the future, then get those stakeholders engaged in the battle. For the CHP, stakeholders are regulators, governing bodies, insurance companies, politicians, manufacturers, research institutions, and most importantly, the public. The CHP is the only entity tied to a traditional mission that could be devastated by a future with far fewer collisions, DUIs, traffic, driving related infractions, etc. If the CHP continues with the status quo, it will have the most to lose should this technology prove successful. The result will be a gradual decrease in services and an eventual decision by the public that it is no longer needed or need to be significantly scaled back. However, should the CHP want to continue to provide a high level of service to the public, it will have to reshape the way it operates and convinces the legislature and the motoring public that it is the best agency for the job. Given CHP’s track record and excellent reputation, this is possible.

As described in *The Dictator’s Handbook, Why Bad Behavior is Almost Always Good Politics*, for a leader, or in this case a leading organization, to stay in power, it must shore up the coalition of supporters.¹⁹² The CHP as an organization has the opportunity to leverage its reputation and geographical area of responsibility to form a solid coalition of public and private partners as autonomous vehicles evolve. Having the Silicon Valley and many of the manufacturers here in California is a huge advantage that other agencies do not have. Manufacturers would benefit from including the CHP because it will help with safety, regulation, testing, and most importantly, public perception, and acceptance. A measure of success in this area will be to see how much traction the CHP can get with regulators in the state.

¹⁹¹ Christensen, *The Innovator’s Dilemma*, Kindle locations 2692–2693.

¹⁹² de Mesquita, and Smith, *The Dictator’s Handbook*, 49.

Another indicator of success will be the number of personnel the CHP sends to EDR training and necessary amendments to departmental policy to include necessary language for autonomous vehicles and autonomous driving. Success nationally will be measured by the number of recommendations to the NHTSA that are adopted and/or discussed nationally. Not all of them have to be adopted for success. Just the fact that they are brought to the table and discussed will be a success. A rollout of a national policy, expanding on policies like those in the U.K., will also aid states in their endeavor and should be measured as a success.

Finally, long-term measurements of success will be the CHP's ability to expand its legislatively mandated role in the state. Any legislative decrease in the CHP's legal authority will indicate the CHP is failing to transition to meet future opportunities, especially in the cybersecurity or cyber investigation realm. Any expansion can be deemed a success and prevent possible obsolescence should autonomous vehicles prevent most collisions, DUIs, and traffic infractions.

F. CONCLUSION

The people cooperate because it will mean more public goods for them and the coalition cooperates because it will mean reducing the risk of their ending up out on their ear.

– Bruce Bueno and Alastair Smith¹⁹³

By planning for and training for the arrival of autonomous vehicles, the CHP can emerge as the leader and maintain its position in California as the only true statewide law enforcement agency. If the CHP fails to think about the possibilities and then fails to shift its operations when they arrive, the CHP could become obsolete and California could form a new agency to rise to the occasion.

The CHP is ripe to handle the task and should not allow politics or traditions to stop them. As the authors stated in *The Dictator's Handbook*,

By now it should be clear that there is a natural order governing politics, and it comes with an ironclad set of rules. They cannot be altered. But that

¹⁹³ Ibid., 60.

does not mean that we cannot find better paths to work within the laws of politics.¹⁹⁴

The ultimate goal of the CHP is saving lives and protecting the public; therefore, if autonomous vehicles save more lives, the CHP should embrace them and fully support their safe introduction into society. The CHP will simply need to pivot its mission and strategies and progress into the next century as the leader in state law enforcement, regardless of disrupting technologies.

The CHP has a great opportunity to leverage its geographical advantage of residing in the state where many of the technologies driving autonomous vehicles are being designed, tested, and manufactured. With this, paired with its statewide jurisdiction and positive reputation, the CHP can emerge as a leader in law enforcement in a world with autonomous vehicles. Even if autonomous vehicles are still a decade or two away from large scale adoption, the technologies that drive them are finding their way slowly into vehicles leaving the production lines today. If the CHP does not jump on this opportunity, another agency will, further pushing the CHP toward obsolescence. Now is the opportune time to get involved and make a difference for the organization, as well as the public it serves.

¹⁹⁴ Ibid., 279.

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