Autonomous Vehicles: The Future Ramification on Law Enforcement

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Abstract

Law enforcement is facing a new challenge by the emergence of autonomous vehicles on our public roadways. In 2019 level 3 autonomous vehicles have begun to infiltrate our highways. As new technology develops, level 4 and level 5 autonomous vehicles will soon follow. These vehicles will ultimately change law enforcement responsibilities and require all law enforcement agencies to re-strategize. With the increased demand for implementation of autonomous vehicles, law enforcement agency procedures will need to evolve in order to overcome the new challenges. Members of the Florida Highway Patrol and agencies across the nation were surveyed in order to gather input for this research. Both surveys included demographic questions, multiple choice questions, and open-ended questions. Results showed agencies will need to implement and provide autonomous vehicle training, agency re-structuring, and Cybersecurity target hardening to prevent against threats and hacking of vehicles.

Introduction

> "When Henry Ford made cheap reliable cars, people said 'nah, what's wrong with the horse?' That was a huge bet he made, and it worked." ~ Elon Musk.

In the 1960's, the animated series "The Jetsons" revolved around the then futuristic concept of connected devices. The show's opening sequence showed George Jetson dropping his family off at their destination in a flying car. This showed how our lives could one day be transformed by technology. The show depicted the year 2020, and even though we are not flying around in our space cars like George Jetson, the technology and future is here. The advancement in technology is not just a thought anymore but a reality, and the impact will greatly affect how we view transportation. According to a MIT workgroup, by 2040 autonomous vehicles are expected to comprise around 25 percent of the global market. Regarding safety and traffic concerns experts are predicting far fewer accidents, which could result in up to 585,000 lives saved between the years 2035 and 2045. Technology has improved to the point we currently have autonomous vehicles being tested by several manufacturers on our roadways today. (MIT Technology Review Insights, 2017)

With the fast advancements of autonomous vehicles and the future of newer transportation options on the horizon, law enforcement agencies need to prepare for the expected and imminent changes. The first step is forecasting law enforcement responsibilities through the autonomous vehicle implementation and transition.

The implementation of technology in autonomous vehicles will change the policies and procedures of law enforcement agencies throughout the country. Law enforcement

roles and responsibilities will be exposed to new challenges, such as determining who will be responsible in civil and criminal violations when it pertains to autonomous vehicles. With the implementation of autonomous vehicles, law enforcement agencies around the country will need to adapt by changing policies and procedures as case law changes. State, County, and specialized organizations in Florida will be affected by funding issues due to a drop in generated revenue currently received from uniform traffic citations. Officers will need to adapt to criminal and digital forensic investigations and less traffic-related duties. Law enforcement will need to prepare for cyber security breaches and possible malfunctions of autonomous vehicles during states of emergencies and natural disasters. Criminals invest their time and attention to new advancements and technology in order to learn how to manipulate its purpose for their gain. It is imperative for law enforcement to be proactive in educating its members on advanced technology prior to its implementation and diligently focus on a proactive strategic plan in order to be prepared. Federal and State Government will need to act as a mediator between law enforcement, first responders, technology companies, and automobile manufacturers to encourage technology transparency and vehicle networking solutions.

Literature Review

The race to get autonomous vehicles on the road is speeding up and there's big money to whoever crosses the finish line first. The autonomous vehicle market is expected to grow from $54.23 billion in 2019 to $556.67 billion in 2026. The goal of the elimination of traffic crashes due to human error and reduced carbon dioxide emissions is the driving force to produce autonomous vehicles. In 2019, the level 3 segment was the highest revenue segment of autonomous vehicles. The level 3 segment is an automated system that can conduct some of the driving and monitor the driving environment in some instances but allow the human driver to regain control if necessary. (Allied Market Research, n.d.)

The article *Autonomous Vehicles: Are you ready for the new ride,* expresses the fact autonomous vehicles are not just a thought anymore, but a reality and the impact will greatly affect how we view transportation. According to a MIT workgroup, autonomous vehicles are expected to comprise around 25% of the global market by 2040. Regarding safety and traffic concerns, experts are predicting far fewer accidents. (MIT Technology Review Insights, 2017)

In the article, *How Autonomous Vehicles Will Change Law Enforcement,* the writer discusses how officers use driving violations to build probable cause to perform a traffic stop. Without driving violations observed, the officers will not have probable cause to be able to stop and conduct a proactive investigation. A recent poll conducted determined that 80% of Americans fear traveling in autonomous vehicles however 90% of traffic crashes are due to human error. (Boyack, 2018)

On the Road to a New Regulatory Era covers the different levels of autonomous vehicles. Regulatory agencies need to plan to address potential issues that automakers will introduce in the next few years which include vehicles from level 1, which is an automated system in the vehicle that can sometimes assist the human driver and conduct some parts of driving, level 2 is an automated system can conduct some parts of driving,

while the human driver continues to monitor the driving environment and performs most of the driving, to level 3 ("semi-autonomous vehicles"). Drivers may place too much trust in their technology and will be susceptible to distractions that prevent them from making quick driving decisions. The misguided expectations among human drivers, pedestrians, and cyclists about how these vehicles operate may initially result in an increase in crashes. The judicial system continues to struggle with the question of whether the driver or the manufacturer will be responsible in traffic crashes. Google, Mercedes-Benz, and Volvo stated publicly that they, the manufacturers of self-driving cars, would voluntarily take responsibility for any accident caused by the cars. National Highway Traffic Safety Administration (NHTSA) must propose a rule, seek comments, and potentially revise its rule and disseminate for further comments and suggestions before it is finalized. Due to the red tape NHTSA follows, it is suggested that the states should be responsible for enacting new vehicle safety regulations. (Browne, 2017)

According to Robots on the Road, this new technology will change criminal responsibility on the road and will alter law enforcement's ability to stop and search a vehicle under the Fourth Amendment. Officers know that currently an autonomous vehicle (AV) can lawfully be stopped, but how will the stop be performed? Who is ultimately responsible for items within an AV and the passenger's ownership? While most of the regulation of AVs is expected to occur at the state level, the federal government has taken steps to increase its role in AV regulation. The U.S. House of Representatives proposed the SELF DRIVE Act to expand federal jurisdiction to encompass the regulation of AV operations. Traffic stops will become rare as AVs become a fixture on highways reducing the need for traffic enforcement. Law enforcement will need to adapt to criminal investigations and less traffic related duties. Criminals will invest their time and attention to new advancements and technology in order to learn how to manipulate its purpose for their gain. (Vallar, 2018)

NHTSA has shown that 94% of crashes are due to human error (U.S. Department of Transportation, 2018). With the pursuit to make our roadways safer NHTSA has pushed the autonomous project along. In 2018 there was a reported fatality involving an autonomous vehicle that struck a pedestrian crossing the road. The National Transportation Safety Board determined the fatality was caused by an inadequate safety culture. The report notes that even though the pedestrian was noticed, the vehicle did not take action to avoid collision. That traffic fatality slowed the production of testing vehicles but only temporarily. The question that remains, by removing human error, is that going to reduce traffic crashes? Autonomous vehicles have the potential to lead to innovative advancements in transportation safety. Autonomous vehicles sold today are in levels 1 and 2 of Society of Automotive Engineers (SAE) automation rating system. Although some experts forecast market-ready level 3 autonomous vehicles will be available in a few years, deployment of level 4; which is an automated system that conducts the driving and monitors the driving environment, without human interference, but operates only in certain environments and conditions, to fully autonomous vehicles at level 5 appears to be further out (See Appendix C). As vehicle technologies improve, the security of data collected from vehicles are vulnerable and at risk. Hackers are of high concern to federal and state governments, manufacturers, and service providers. (Canis, 2020)

Technology remains vulnerable and just as desk top computers can be hacked, autonomous vehicles are also at risk. Distributed denial of service (DDoS) attacks have

been on the rise for years. These attacks are designed to overwhelm computer networks by sending to many connection requests, causing communication capabilities to be knocked out. This attack would cause an interference with satellites and their communication with autonomous vehicles. Another possible attack could be jamming the sensors that allow AV to sense other traffic, lanes, or pedestrians around them, which would result in a traffic crash. The possibility to hack an AV could be done remotely, while the vehicle is in motion. The hacker could take control of your vehicle in motion and demand ransom or use it as a weapon. As these vehicles become mainstream, it is likely that we will see the rise of third-party mitigation services focused on protecting autonomous vehicles. They will be able to help improve the kinds of firewalls, code and data communication, and other target hardening and preventive measures that will keep autonomous vehicles safe. (Shaw, 2019)

Public safety, first responders, and law enforcement officers need to have ways to interact with automated vehicles during emergencies. Officers will need to explore and implement new procedures and have the capability to signal and communicate with autonomous vehicles to pull over. All first responder personnel will need training to safely interact with autonomous vehicles to fully or partially disable the vehicles at the scene of a crash. Autonomous vehicle developers need to include first responder communities when developing and testing autonomous technology. This networking will provide technology developers pertinent and safety input that could allow them to develop or implement autonomous technology that can enhance emergency response. The Federal Government will need to act as a convener between law enforcement, first responders, technology companies, and automobile manufacturers to build census around data-sharing standards and develop protocols and practices. (U.S. Department of Transportation, 2018)

Technology has tremendously improved throughout the past 20 years and as manufacturers compete against each other with technology improvements and stages of autonomous vehicles, regulations need to be explored to improve Event Data Recorders (EDR). EDRs are also known as automotive black boxes. The EDR is a devise that records pertinent data related to an event that helps understand crash dynamics and help improve vehicle safety. Currently the data recorder will provide 30 event elements but the top three that is focused on by the investigator is speed, seatbelt, and airbag deployment. An investigator is trained to focus on the evidence findings first during a traffic crash and the subjects involved and the witness statements should support their evidentiary findings. EDR data standardization would greatly improve the availability, accessibility, and reliability of crash data. The integration of EDR technology, Automatic Crash Notification (ACN), and global positioning system could provide early notification of an occurrence, location, nature, and severity of a traffic crash. (U.S. Department of Transportation, 2006) With the technology available today, manufacturers need to explore and integrate virtual data collection capabilities for EDRs, which would expedite recovery and eliminate hardware extraction tools.

Methods

The purpose of this research was to initiate networking with all involved stakeholders in order to begin developing a strategic plan for the Florida Highway Patrol on the emergence of autonomous vehicles. Now that level 3 autonomous vehicles have been introduced to our roadways, it is imperative to be proactive and forward thinking in order to prepare law enforcement communities to adapt to the advancing technology. The introduction of level 4 and level 5 autonomous vehicles is predicted to unveil in the near future. The implementation of the newer technology could alter and change law enforcement roles and responsibilities.

Data was gathered through a survey given to members of the Florida Highway Patrol who hold the ranks of Trooper, Corporal, Sergeant, and Lieutenant. The Florida Highway Patrol has approximately 1700 law enforcement officers that hold the listed ranks at the time of this survey. These ranks were selected to be surveyed based on their primary job functions. Members within those ranks are primarily responsible for traffic enforcement and traffic crash investigation and they would be exposed to autonomous vehicles on a regular basis. Questions were asked to gather their general knowledge of autonomous vehicles, and if the implementation of autonomous vehicles would affect policing practices.

The survey was kept anonymous to allow members to feel secure in answering truthfully without fear of reprisal. Anonymous surveys provide security; however, it made it impossible to track who did or did not respond to the survey.

Data was also gathered through a survey sent to 50 state law enforcement agencies around the country who participate in the State and Provincial Police Planning Officers Section (SPPPOS) information sharing. The purpose of reaching out to agencies outside of Florida was to see if they have created an agency strategic plan to prepare for the implementation of autonomous vehicles. The survey also helped to identify those agencies that have current working experience with autonomous vehicles and on which levels, because different levels of autonomous vehicles have already been testing on the roadways throughout the country.

The survey sent to other agencies was also anonymous, however it did have a question that allowed for identification for information sharing purposes. This was beneficial to determine which agencies have had exposure to autonomous vehicles and if they have strategic plans or procedures in place. The information gathered will allow further discussion and networking to determine best practices in handling and preparing for autonomous vehicles.

Results

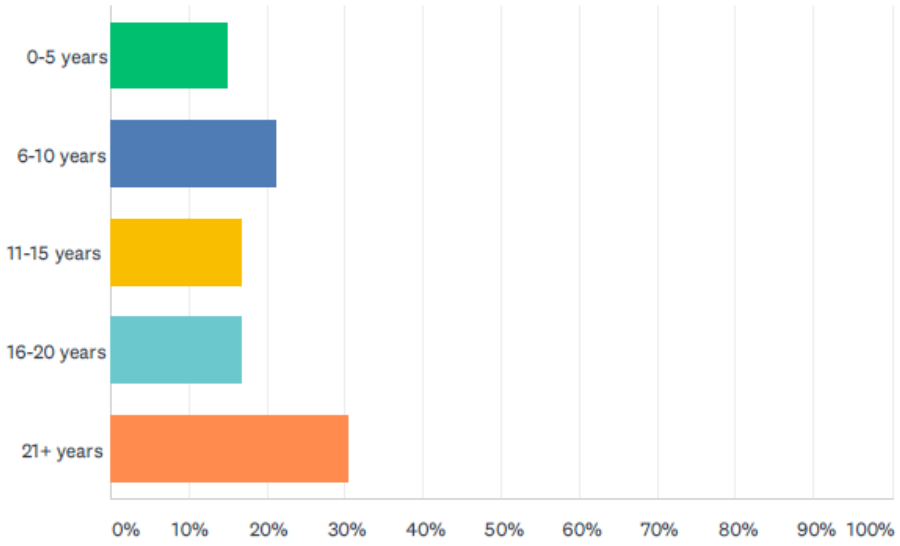
Internal Survey

NOTE: Response rates are reported in the narrative as whole percentages rounded up/down to nearest whole percentage – consequently, whole percentages per question may not add to 100%. Percentages listed in each table are reported to two decimal places. Percentage values in each table will add to a total of 100%.

Two hundred fifty-one (251) sworn law enforcement members responded to the survey for a fourteen (14) percent response rate. The first question asked was for members to provide their years of service. No one skipped the question for a 100% response rate.

Fifteen (15) percent of the respondents served as a sworn law enforcement officer for zero (0) to five (5) years. Twenty-one (21) percent of the respondents have served as a sworn law enforcement officer for six (6) to ten (10) years. Seventeen (17) percent of the respondents served as a sworn law enforcement officer for eleven (11) to fifteen (15) years. Seventeen (17) percent of the respondents served as a sworn law enforcement officer for (16) to twenty (20) years. Thirty (30) percent of the respondents served as a sworn law enforcement officer for Twenty-one (21) plus years.

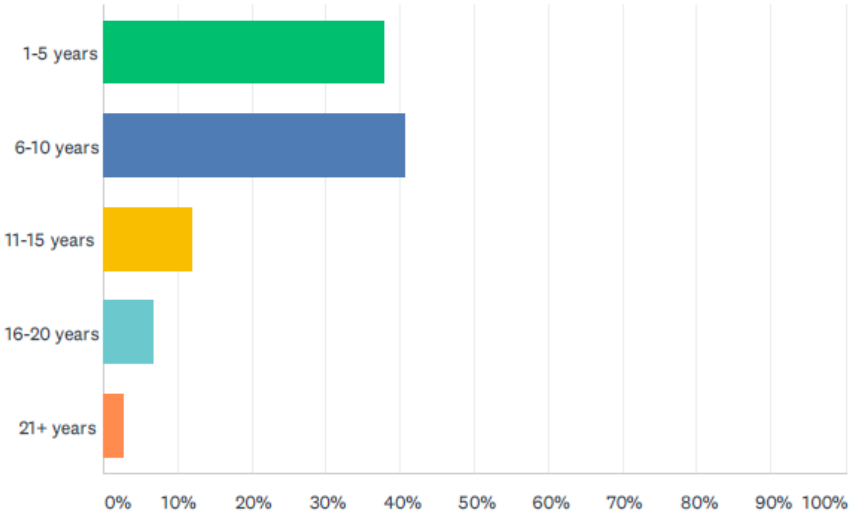
- 0-5 years – 15.14% (38)
- 6-10 years – 21.02% (53)
- 11-15 years – 16.73% (42)
- 16-20 years – 16.73% (42)
- 21 plus years – 30.28% (76)



Question two asked how soon do you think it will be before fully autonomous vehicles are traveling on our roadways? No one skipped the question for a 100% response rate. Forty-one (41) percent of the respondents believe autonomous vehicles will be traveling our roadways within the next six (6) to ten (10) years. Thirty-eight (38) percent believe that within one (1) to five (5) years autonomous vehicles will be traveling our roadways. Together Seventy-nine (79) percent surveyed, believe that within the next one (1) to ten (10) years autonomous vehicles will be traveling our roadways. Twelve (12) percent believe that within eleven (11) to Fifteen (15) years autonomous vehicles will be traveling our roadways. Seven (7) percent believe within sixteen (16) to twenty (20)

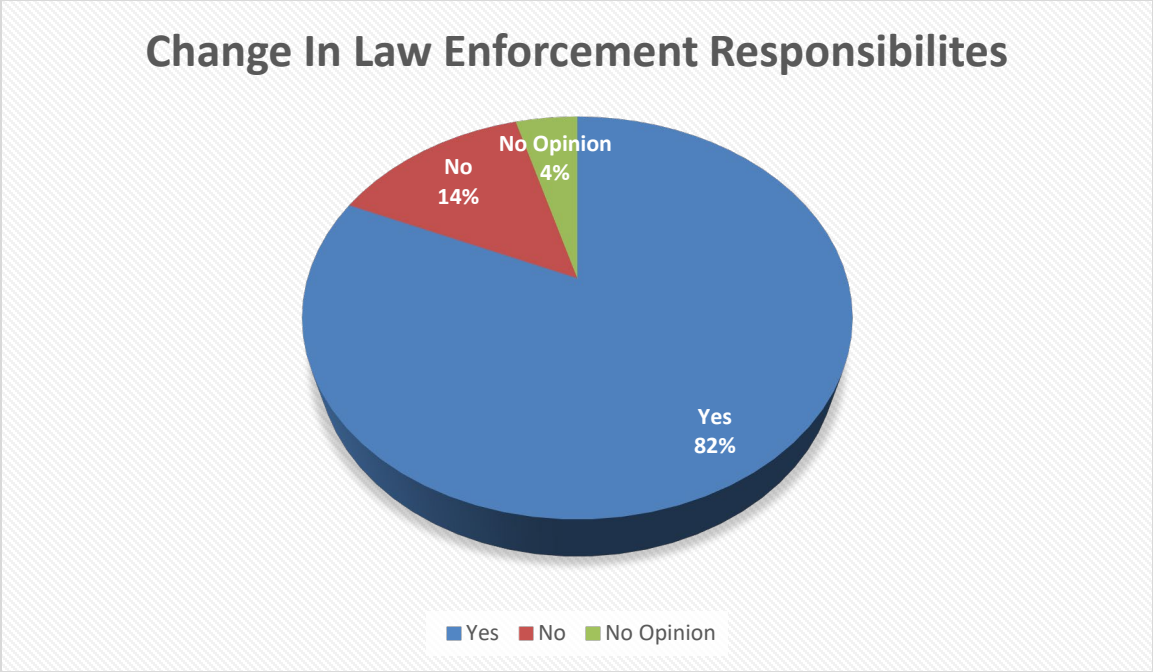
years autonomous vehicles will be traveling our roadways. Three (3) percent believe autonomous vehicles will be traveling our roadways more than twenty-one years from now.

- 1 - 5 years – 37.85% (95)
- 6 -10 years – 40.64% (102)
- 11-15 years – 11.95% (30)
- 16 – 20 years – 6.77% (17)
- 21 plus years – 2.79% (7)



Question 3 asked if the participants anticipate a change in law enforcement responsibilities and operations once autonomous vehicles are implemented. No one skipped the question for a 100% response rate. Eighty-two (82) percent of the members surveyed believed that there will be a change in law enforcement responsibilities after autonomous vehicles are implemented. Fourteen (14) percent believe there will not be a change and four (4) percent had no opinion. The results showed:

- Yes – 81.67% (205)
- No – 13.94% (35)
- No opinion – 4.38% (11)



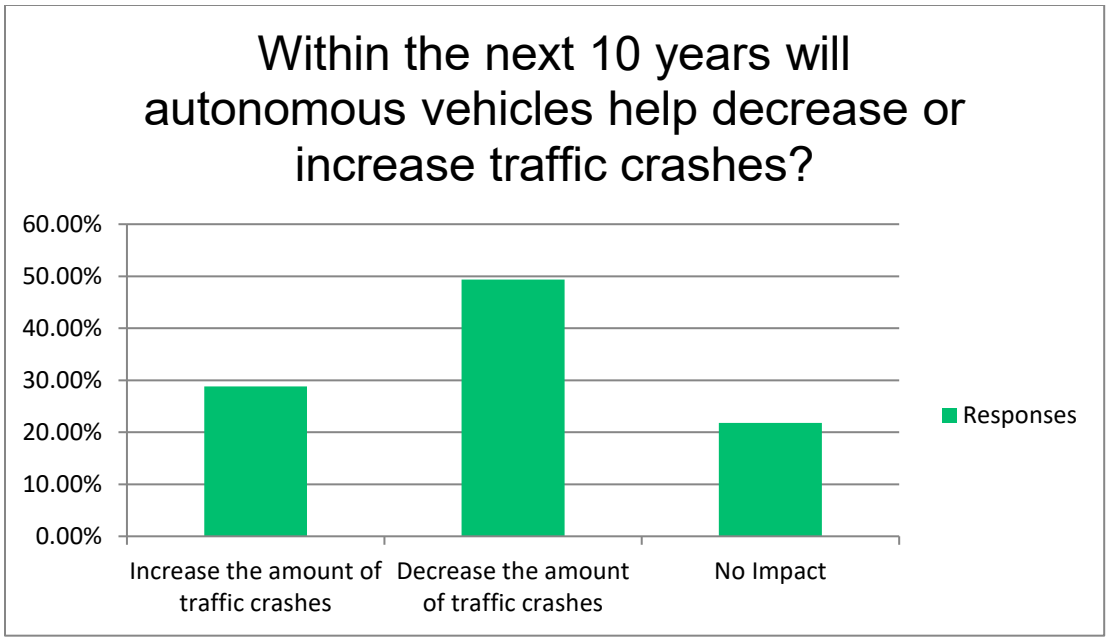
Question 4 asked members participating in the survey how they felt law enforcement responsibilities would change. Sixty-seven (67) percent of the participants provided a response to the question. Thirty-three (33) percent skipped the question. The responses varied from:

- Laws, and standards need to be changed.
- Clarity as to who would be in actual physical control of the vehicle.
- Owner responsibility and who would be liable.
- Improve technology within law enforcement.

Question 5 asked surveyed members if they believe there will be a decrease or increase in the amount of traffic crashes due to the implementation of autonomous vehicles. Ninety-six (96) percent of the members responded and four (4) percent of the members skipped the question.

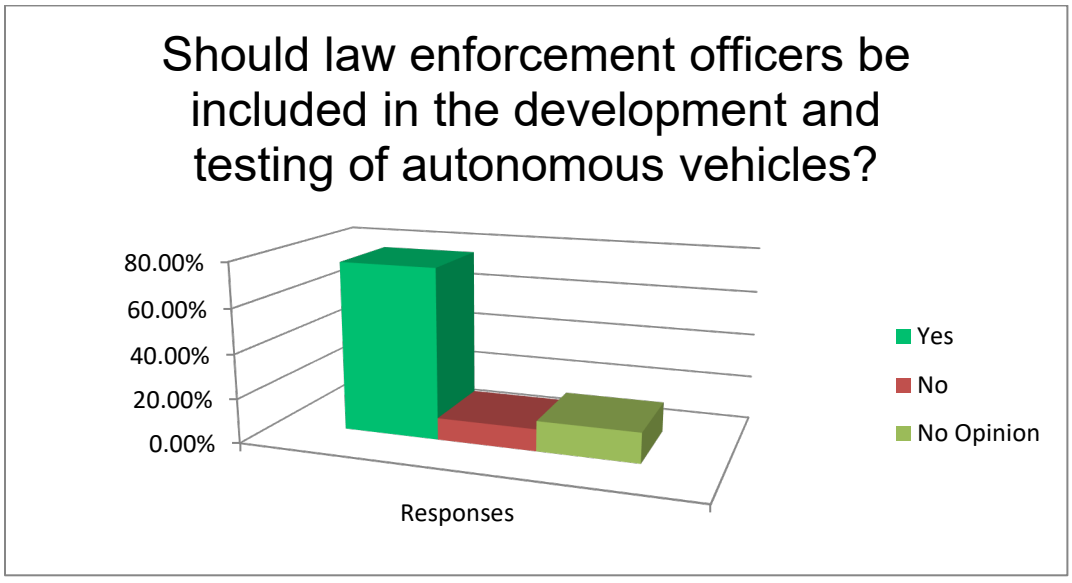
Fifty (50) percent of the members surveyed believe there will be a decrease in the amount of traffic crashes due to the implementation of autonomous vehicles. Twenty-nine (29) percent believe that there will be an increase in the amount of traffic crashes. Twenty-one (21) percent believe there will be no change in the amount of traffic crashes due to autonomous vehicle implementation. Below are the results:

- Increase – 28.93% (70)
- Decrease – 49.59% (120)
- No opinion – 21.49% (52)



Question 6, members were asked if law enforcement officers be included in the development and testing of autonomous vehicles. Ninety-six (96) percent of the members responded and four (4) percent of the members skipped the question. Seventy-six (76) percent of the members surveyed noted that law enforcement officers need to be included in the development and testing of autonomous vehicles. Ten (10) percent marked no and fourteen (14) percent had no opinion.

- Yes – 76.45% (185)
- No – 9.92% (24)
- No Opinion – 13.64% (33)

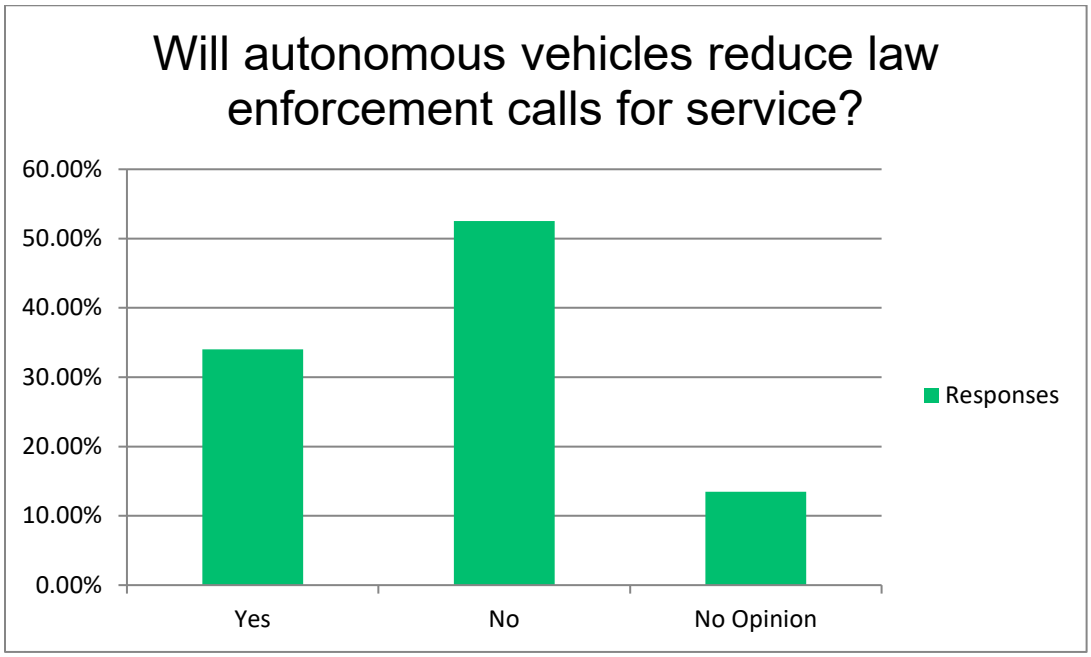


Question 7 asked how should law enforcement officers be included in the development and testing of autonomous vehicles. Fifty-six (56) percent of the participants responded to the question. Below are the top recommendations:

- To provide discussion groups to assist traffic crashes investigations
- Network with developers to provide a safer environment for traffic stops and technological hardening to prevent hacking.
- Educate law enforcement personnel on the vehicles and capabilities

Question 8 asked members if autonomous vehicles will reduce law enforcement calls for service. Ninety-four (94) percent of the members responded and six (6) percent of the members did not respond. Fifty-two (52) percent of the members surveyed indicated that autonomous vehicles will not reduce law enforcement calls for service. Thirty-four (34) percent believes it will increase law enforcement calls for service and fourteen (14) percent had no opinion.

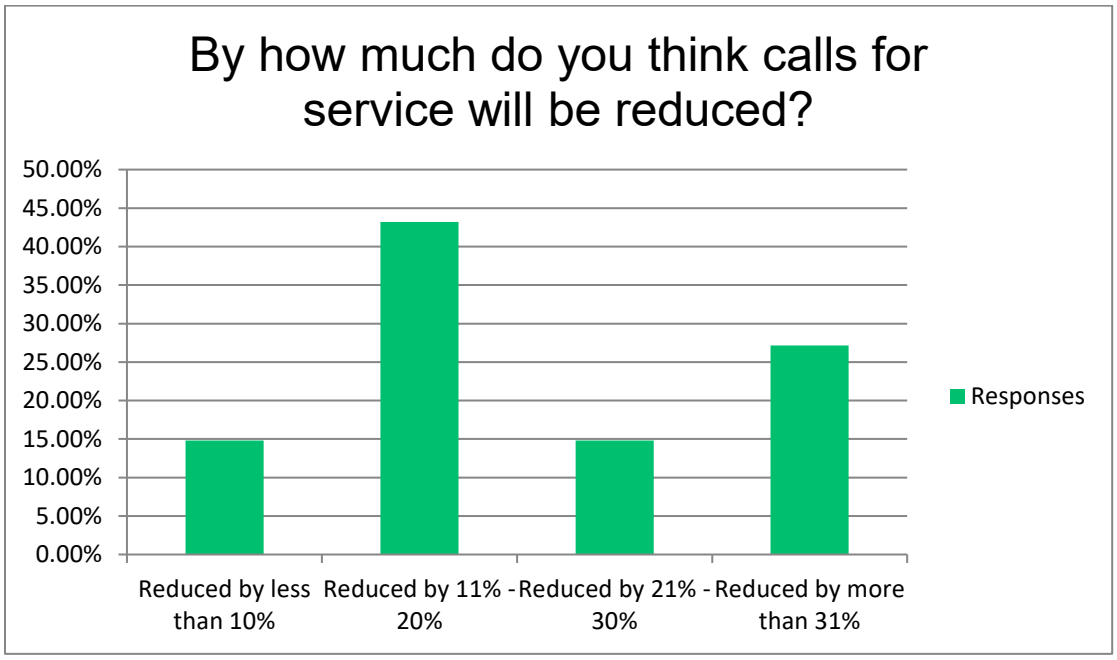
- Yes – 34.18 (81)
- No – 52.32% (124)
- No Opinion – 13.50% (32)



Question 9 asked by how much do you think calls for service will be reduced. Thirty-two (32) percent of the members provided a response and sixty-eight (68) percent of the members did not respond to the question. Fifteen (15) percent of the participants of the survey believe that law enforcement calls for service will be reduced by ten (10) percent. Forty-three (43) percent of the members feel that it will reduce the calls for

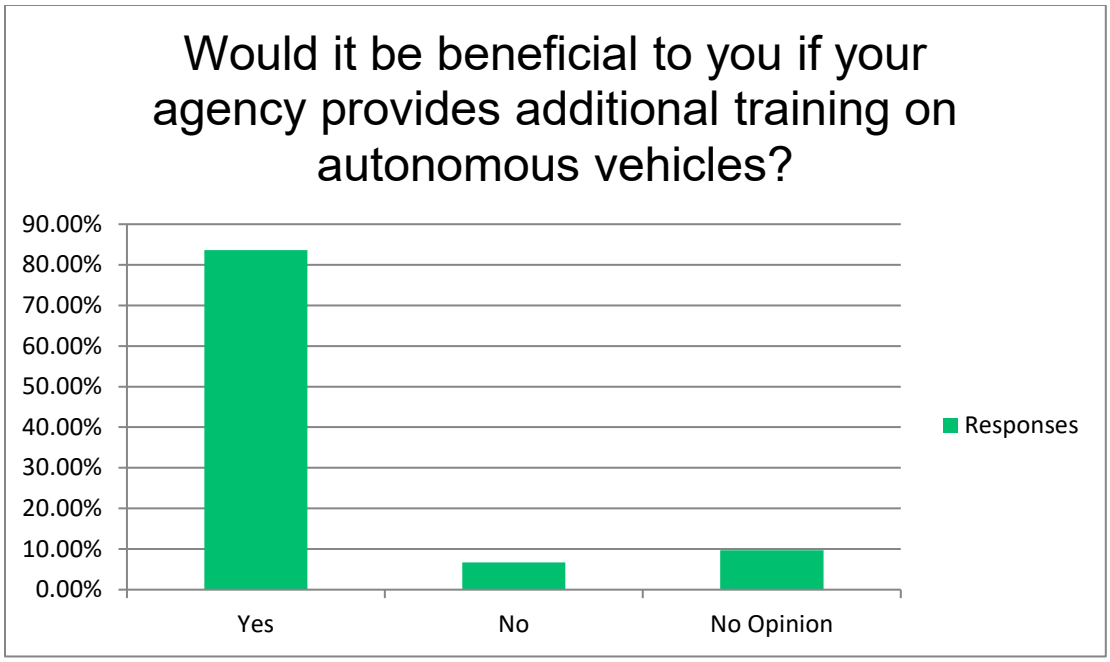
service between eleven (11) and twenty (20) percent. Fifteen (15) percent of the members surveyed felt that calls for service will be reduced by twenty-one (21) to thirty (30) percent. Twenty-seven (27) percent of the members surveyed felt that calls for service will be reduced more than thirty-one (31) percent.

- Less than 10% - 14.81% (12)
- Reduced between 11% to 20% - 43.21% (35)
- Reduced between 21% to 30% - 14.81% (12)
- Reduced more than 31% - 27.16% (22)



Question 10 asked the member if it would be beneficial to them if their agency provides additional training on autonomous vehicles. Ninety-four (94) percent of the members responded to this question and sic (6) percent did not respond. Eighty-four (84) percent of the members surveyed believe that additional training on autonomous vehicles would be beneficial to them and their agency. Seven (7) percent of the members surveyed feel that additional training on autonomous vehicles is not needed and ten (10) percent of the members surveyed had no opinion.

- Yes – 83.54% (198)
- No – 6.75% (16)
- No pinion – 9.70% (23)

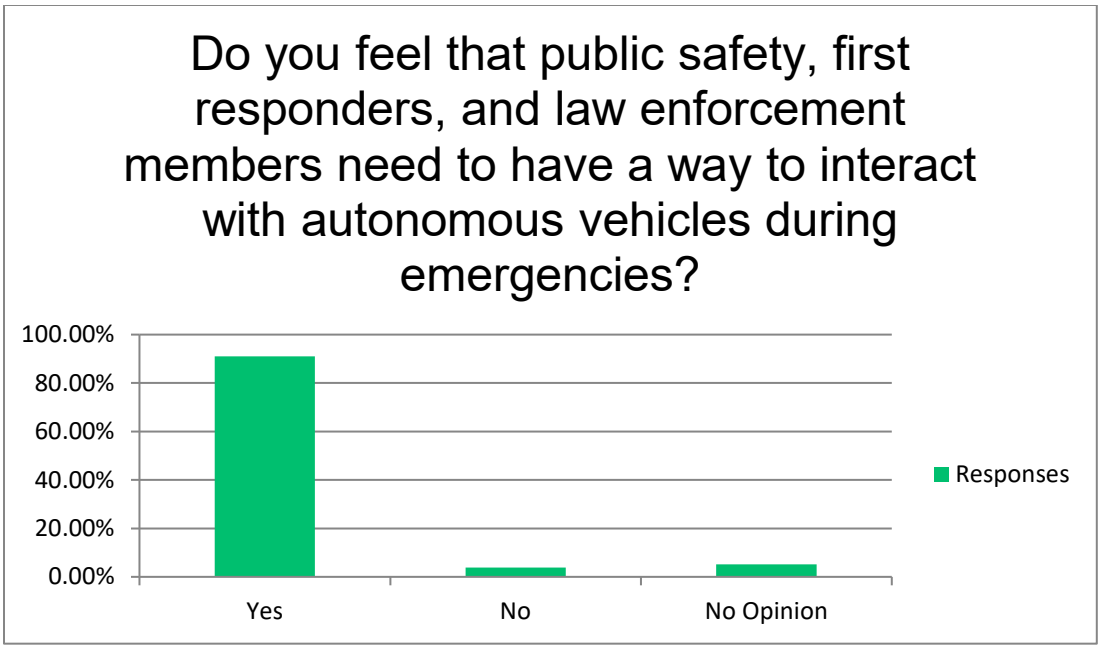


Question 11 asked members what kind of training do believe would be necessary. Sixty-three (63) percent of the members surveyed responded and ninety-three skipped the question. The responses varied from:

- Legal Training
- Vehicle Familiarization Training
- Crash Investigation Training
- The Vehicles Technology

Question 12 asked, do you feel that public safety, first responders, and law enforcement members need to have a way to interact with autonomous vehicles during emergencies. Ninety-three (93) percent of the members responded and 17 members skipped the question. Ninety-one (91) percent of the members that responded felt that public safety, first responders, and law enforcement members need to have a way to interact with autonomous vehicles during emergencies. Four (4) percent do not think that public safety, first responders, and law enforcement members need to have a way to interact with autonomous vehicles during emergency mode and five (5) percent had no opinion.

- Yes – 91.03% (213)
- No – 3.85% (9)
- No Opinion – 5.13% (12)

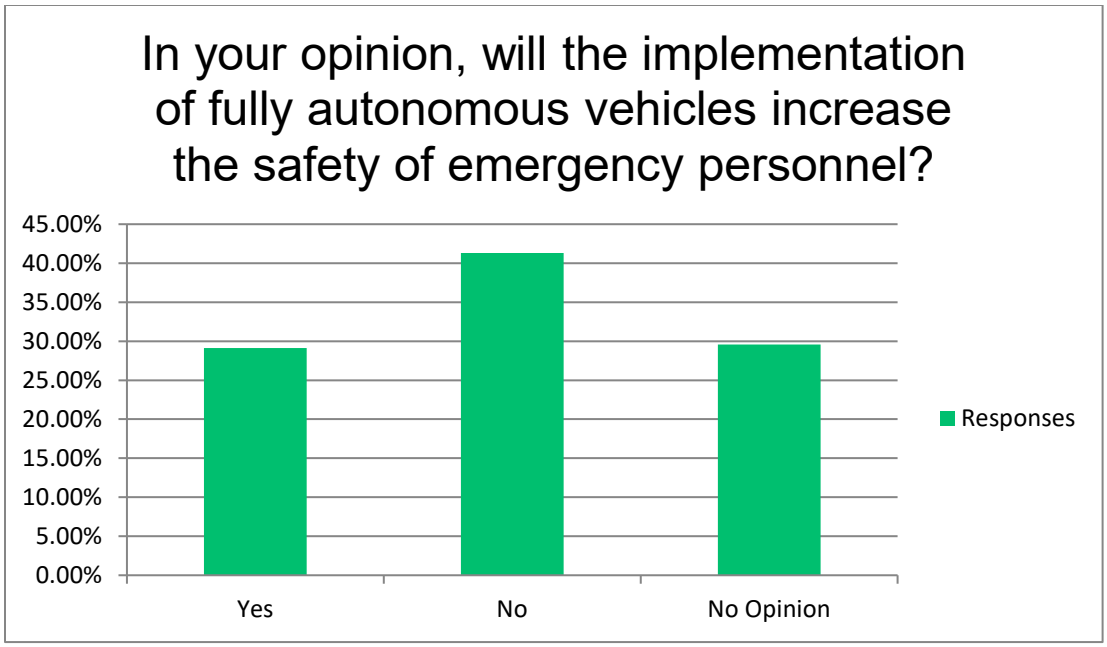


Question 13 members participating in the survey was asked, how do you believe law enforcement and first responders should be able to interact with autonomous vehicles? Sixty-two (62) percent of the participants provided a response to the question, and 95 skipped it. The responses varied from:

- An override to allow for contra flow situations.
- Shutdown capability for medical duress, criminal activity, or other emergency situations.
- When an autonomous vehicle is identified as a vehicle that results in an Amber Alert, Silver Alert, or Blue Alert, then GPS coordinates are provided to law enforcement personnel.

Question 14 asked, in your opinion, will the implementation of fully autonomous vehicles increase the safety of emergency personnel. Ninety-one (91) percent of the members responded and 22 members skipped the question. Twenty-nine (29) percent of the survey participants felt that the implementation of fully autonomous vehicles will increase the safety of emergency personnel. Forty-one (41) percent did not think it will increase the safety of emergency personnel and thirty (30) percent had no opinion.

- Yes – 29.26% (67)
- No – 41.05% (94)
- No Opinion – 29.69% (68)

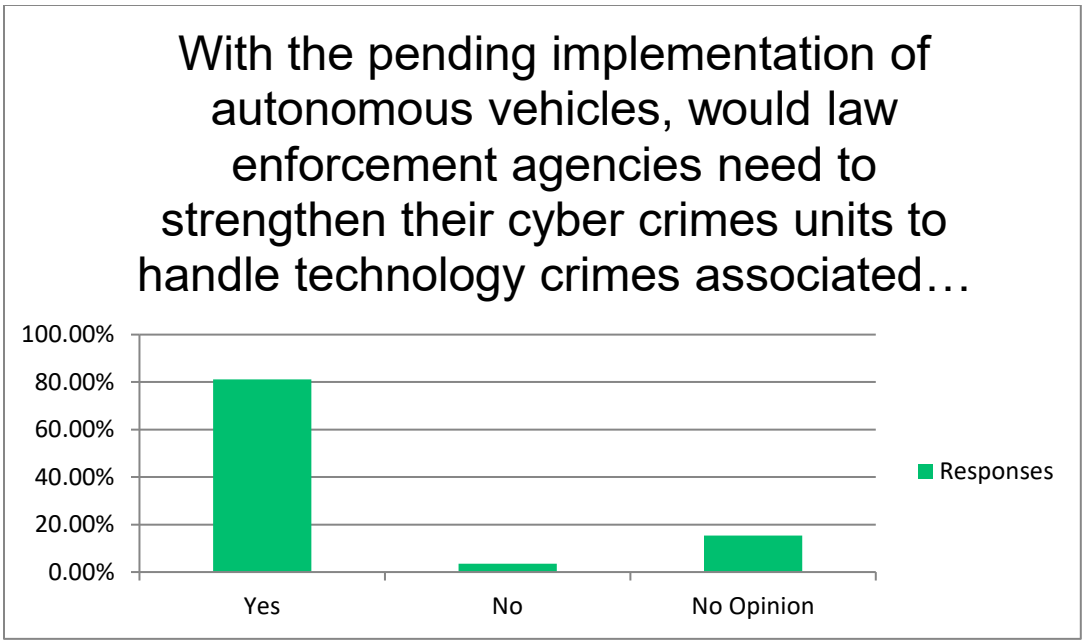


Question 15 asked, how do you believe autonomous vehicles will increase the safety of emergency personnel. Twenty-one (21) percent of the members responded and One hundred nighty-nine (199) skipped the question. The responses varied from:

- Less Humane Error
- Vehicles programmed to slow down and move over when approaching an emergency vehicle
- Less distractions

Question 16 asked with the pending implementations of autonomous vehicles, would law enforcement agencies need to strengthen their cybercrimes units to handle technology crimes associated with autonomous vehicles. Ninety (90) percent of the members responded to the question and 24 skipped the question. Eighty-one (81) percent of the members surveyed felt that with the implementation of autonomous vehicles, law enforcement agencies would need to strengthen their cyber crimes units to handle technology crimes associated with autonomous vehicles. Four (4) percent of the members surveyed felt that law enforcement agencies do not need to strengthen their cyber crimes units and fifteen (15) percent had no opinion.

- Yes – 81.06% (184)
- No – 3.52% (8)
- No opinion – 15.42% (35)



Question 17, members participating in the survey was asked, what would be your recommendations to handle cyber crimes? Fifty-one (51) percent of the participants provided a response, and 124 skipped the question. The responses varied from:

- Prevent Hacking
- Implement a task force strictly for the prevention of cyber crimes and investigations
- Training on the technology

Question 18, members participating in the survey was asked, in your opinion, what is the most pressing issue related to autonomous vehicles that must be addressed by FHP in the future. Eighty-seven (87) percent of the participants provided a response, and 32 skipped the question. The responses varied from:

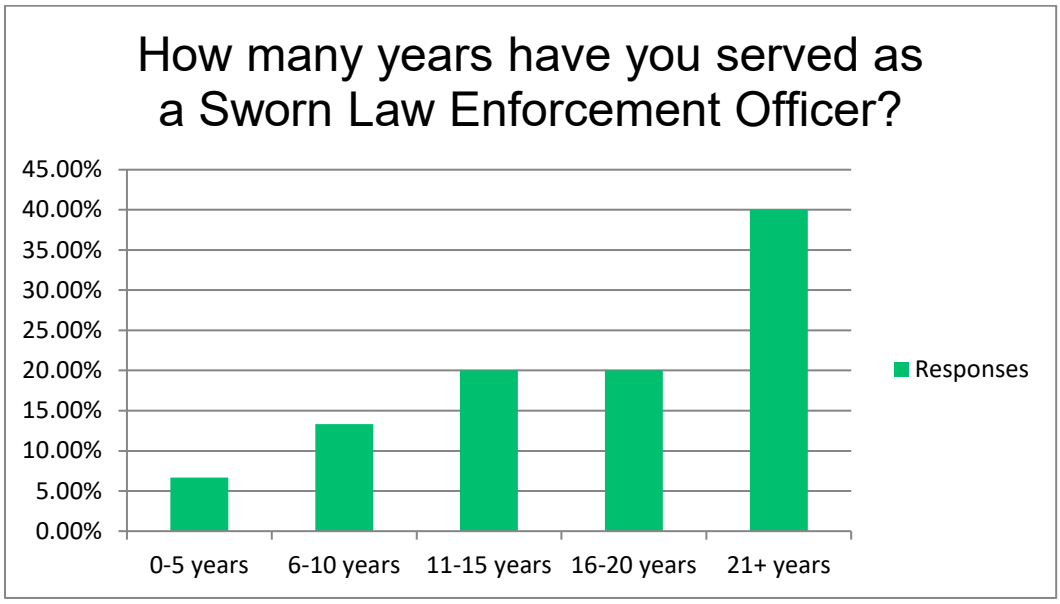
- Enforcement action and how to stop
- Traffic crashes and who is at fault
- Training on the technology and cyber crimes
- Legal issues

External Survey

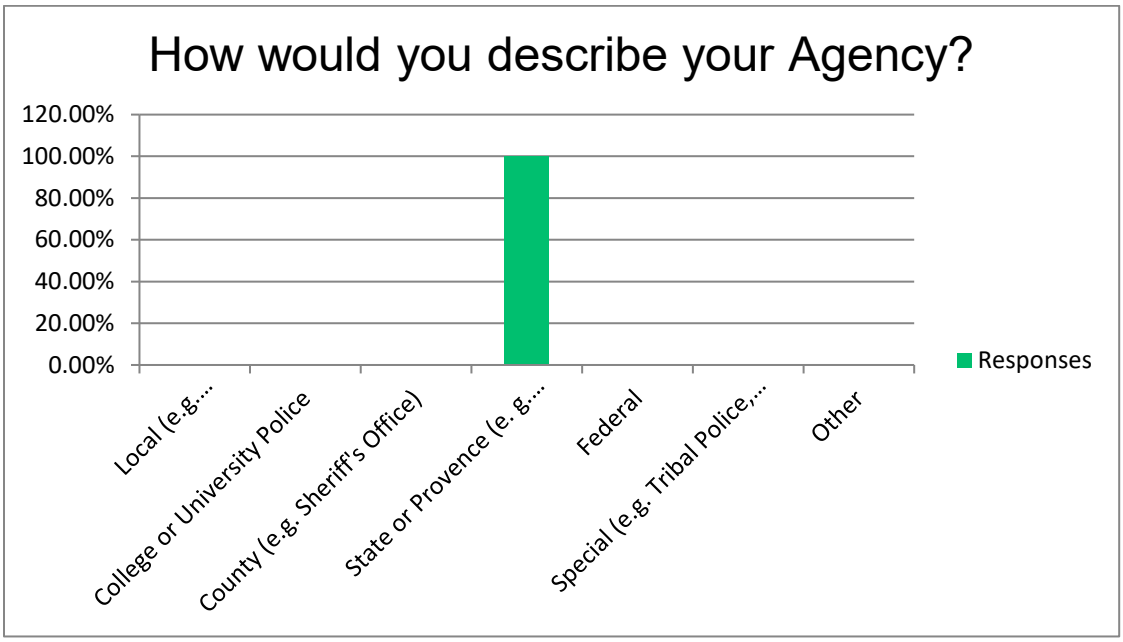
NOTE: Response rates are reported in the narrative as whole percentages rounded up/down to nearest whole percentage – consequently, whole percentages per question may not add to 100%. Percentages listed in each table are reported to two decimal places. Percentage values in each table will add to a total of 100%.

Fifteen (15) state law enforcement agencies responded to the external survey for a thirty (30) percent response rate. The first question asked was for members to provide their years of service. No one skipped the question for a 100% response rate. Forty (40) percent of the state agency representative respondents have served as a sworn law enforcement officer for twenty-one (21) plus years. Twenty (20) percent of the participants that responded on behalf of their agency have served as a law enforcement officer between sixteen (16) and twenty (20) years. Twenty (20) percent of the respondents that participated served as a law enforcement officer between eleven (11) and fifteen (15) years. Thirteen (13) percent of the respondents served as a law enforcement officer between six (6) to ten (10) years. Seven (7) percent of the respondents served as a law enforcement officer zero (0) to five (5) years.

- 0-5 years – 6.67% (1)
- 6-10 years – 13.33% (2)
- 11-15 years – 20.00% (3)
- 16-20 years – 20.00% (3)
- 21 plus years – 40.00% (6)

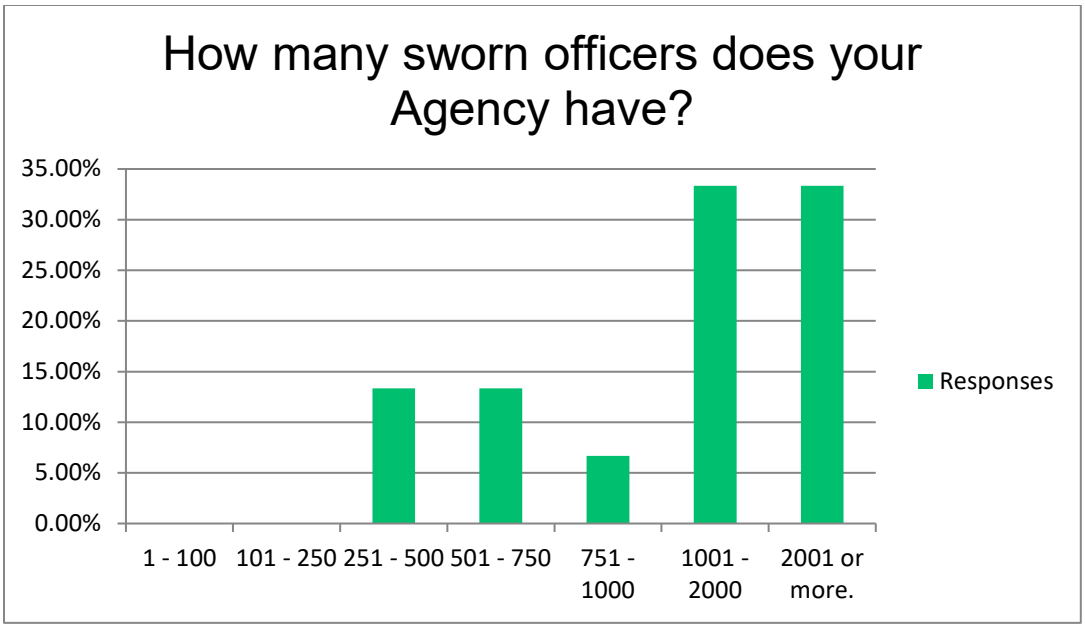


Question 2 One hundred (100) percent of the law enforcement respondents to the external survey represented a State or Provence (e.g. Highway Patrol, State Fire Marshals, State Police, etc.)



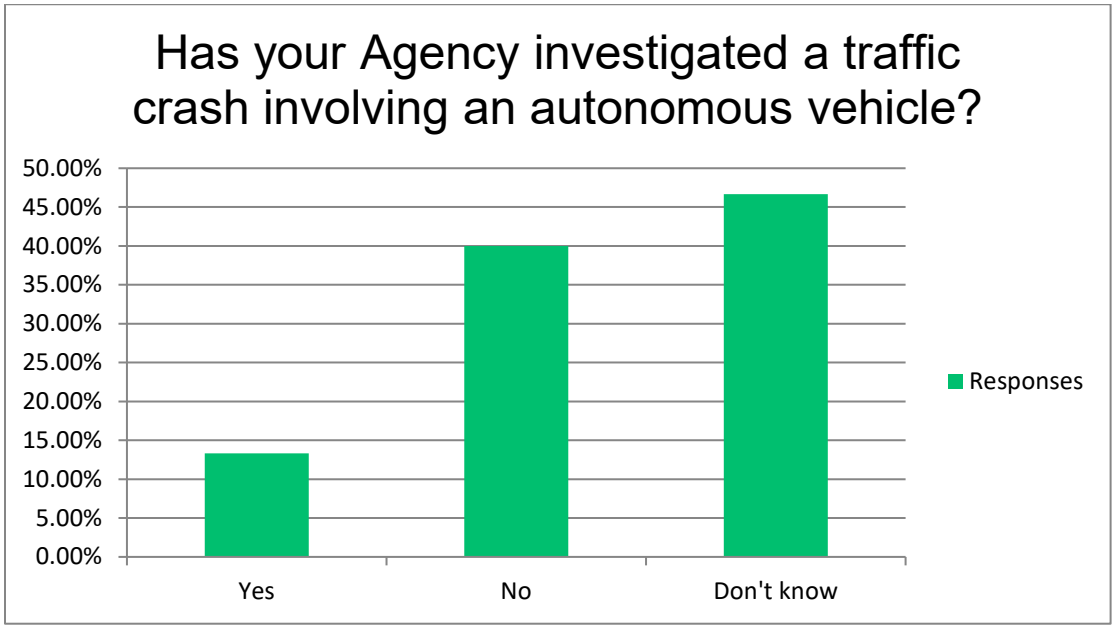
Of the agencies that responded, zero (0) percent of the participants worked for an agency that has between one (1) and one hundred (100) sworn members. Zero (0) percent of the respondents work for an agency that has between one hundred and one (101) and two hundred and fifty (250) sworn members. Thirteen (13) percent of the respondents work for an agency that has between two hundred and fifty-one (251) and five hundred (500) sworn members. Thirteen (13) percent of the respondents work for an agency that has between five hundred and one (501) and seven hundred and fifty (750) sworn members. Seven (7) percent of the respondents work for an agency that has between seven hundred and fifty-one (751) and one thousand (1000) sworn members. Thirty-three (33) percent of the respondents work for an agency that has between one thousand and one (1001) and two thousand (2000) officers. Thirty-three (33) percent consisted of more than 2001 sworn members.

- 1 – 100 members – 0% (0)
- 101 – 250 members – 0% (0)
- 251 – 500 members – 13.33% (2)
- 501 – 750 members – 13.33% (2)
- 751 – 1000 members – 6.67% (1)
- 1001 – 2000 members – 33.33% (5)
- 2001 or more members – 33.33% (5)



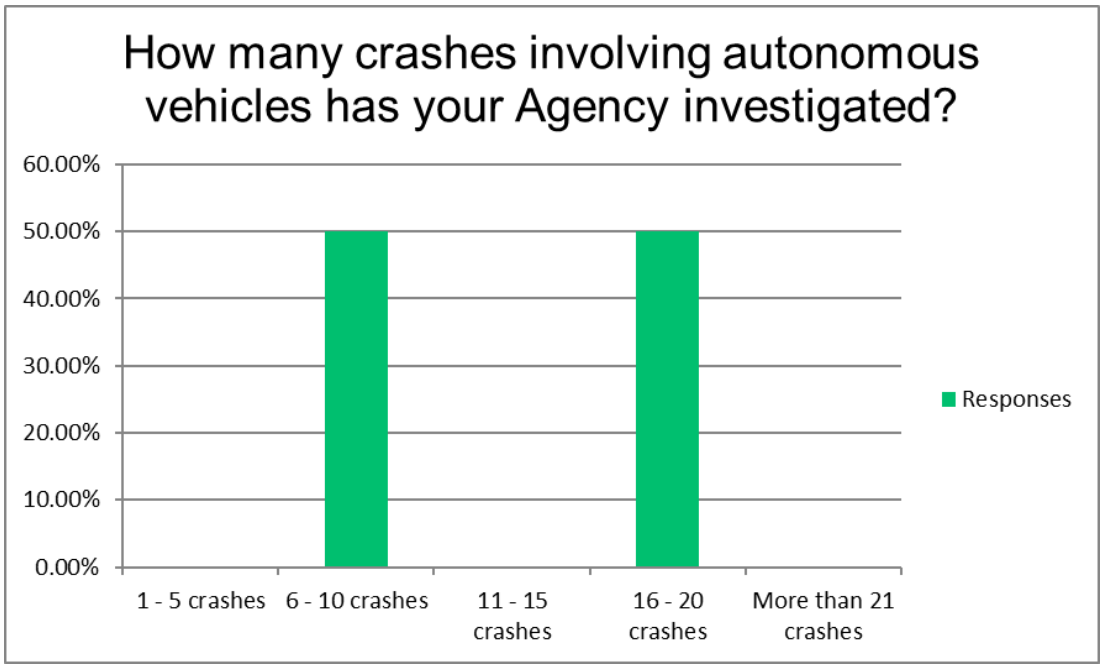
At the time of the survey forty-seven (47) percent of the agencies do not know if their agency investigated a traffic crash involving an autonomous vehicle. Forty (40) percent have not investigated a traffic crash involving an autonomous vehicle. Thirteen (13) percent of the agencies have already investigated a traffic crash involving an autonomous vehicle.

- Yes – 13.33% (2)
- No – 40.00% (6)
- Unknown – 46.67% (7)



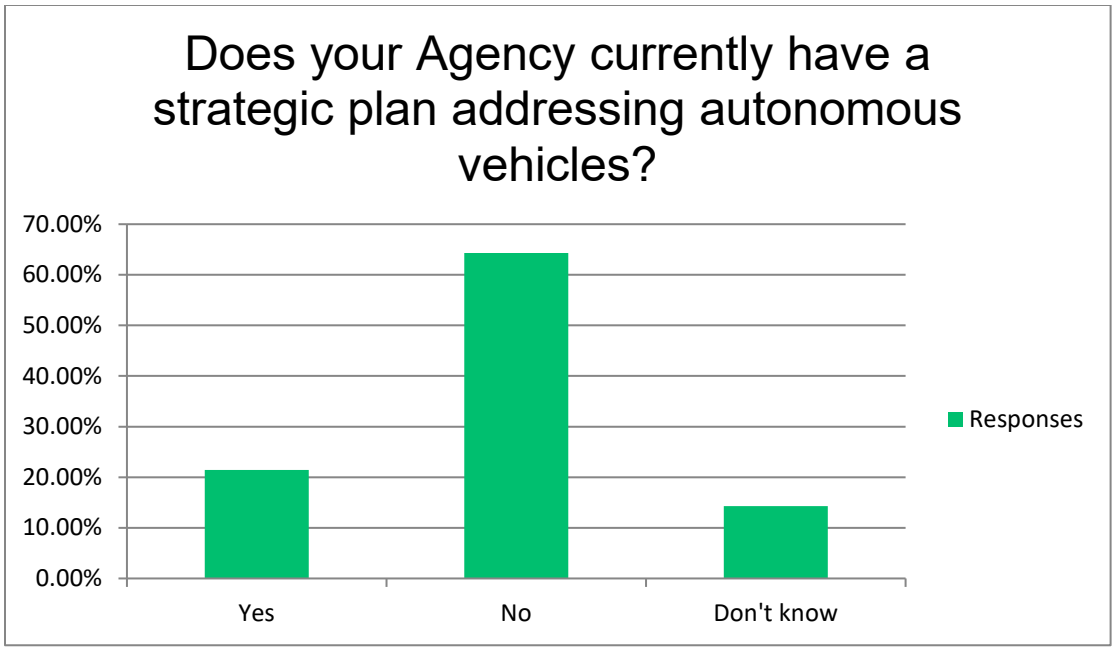
At the time of this survey only two (2) agencies that participated in this survey had worked a crash involving an autonomous vehicle. Out of the two agencies one (1) worked between six (6) and ten (10) traffic crashes involving autonomous vehicles and the other agency worked between sixteen (16) to twenty (20) crashes involving autonomous vehicles. Thirteen (13) percent of the agencies responded and 13 skipped the question.

- 1 – 5 crashes – 0% (0)
- 6-10 crashes – 50.00% (1)
- 11-15 crashes – 0% (0)
- 16-20 crashes – 50.00% (1)
- 21 plus crashes – 0% (0)



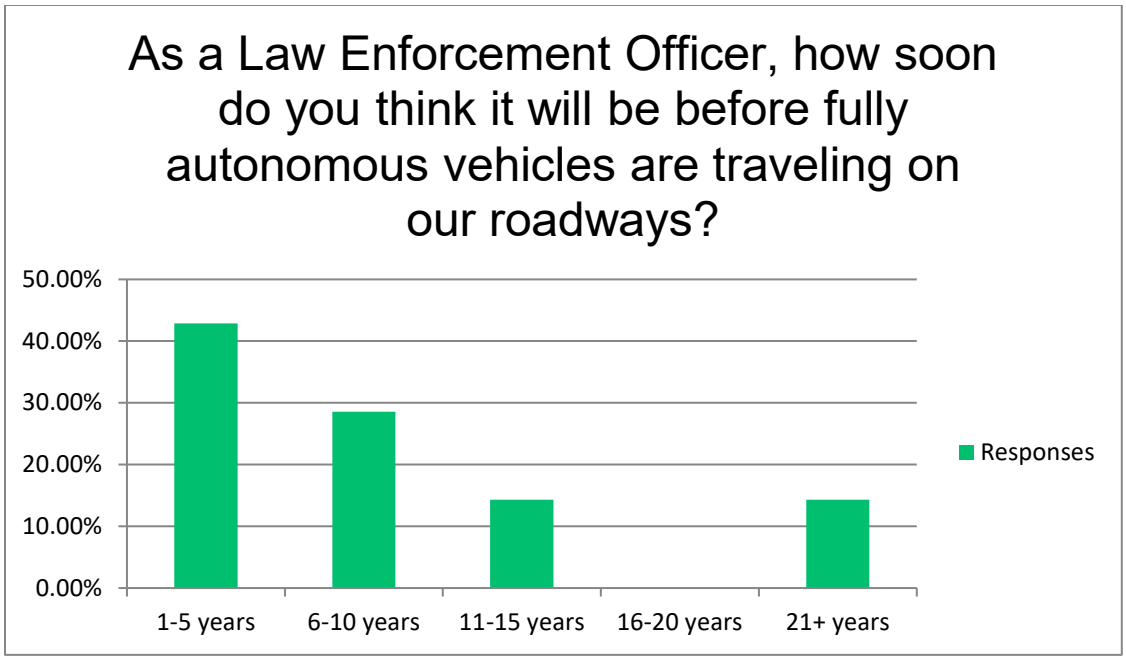
Question 6, ninety-three (93) percent of the agencies responded, and seven (7) percent of the agencies did not respond to the question. Sixty-four (64) percent of the participating agencies currently do not have a strategic plan to address autonomous vehicles. Twenty-one (21) percent have a strategic plan addressing autonomous vehicles. Fourteen (14) percent do not know if they have a strategic plan addressing autonomous vehicles.

- Yes – 21.43% (3)
- No – 64.29% (9)
- Don't know – 14.29% (2)



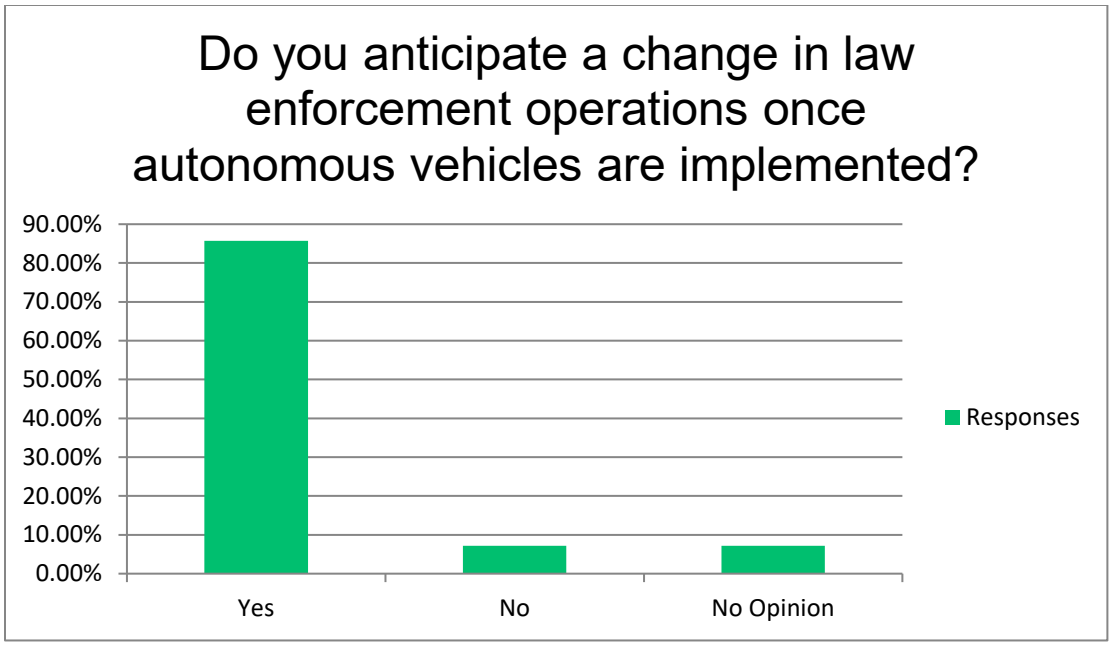
Question 7 asked how soon you think it will be before fully autonomous vehicles are traveling our roadway. Ninety-three (93) percent of the agencies responded and seven (7) percent did not. Forty-three (43) percent of the law enforcement agency representatives surveyed believe fully autonomous vehicles will be traveling our roadways within one (1) to five (5) years. Twenty-nine (29) percent of those surveyed believe it will be six (6) to ten (10) years before autonomous vehicles will be traveling our roadways. Fourteen (14) percent surveyed think it will be eleven (11) to fifteen (15) years and fourteen (14) percent surveyed think it will be twenty-one (21) plus years before autonomous vehicles are traveling our roadway.

- 1 -5 years – 42.86% (6)
- 6-10 years – 28.57% (4)
- 11-15 years – 14.29% (2)
- 16-20 years – 0% (0)
- 21 plus years – 14.29% (2)



Question 8 asked do you anticipate a change in law enforcement operations once autonomous vehicles are implemented. Ninety-three (93) percent of the agencies responded and seven (7) percent did not answer the question. Eighty-six (86) percent of the state law enforcement agency participants anticipate a change in law enforcement operations once autonomous vehicles are implemented. Seven (7) percent indicated no change and seven (7) percent had no opinion to the question.

- Yes – 85.71% (12)
- No – 7.14% (1)
- No opinion – 7.14% (1)

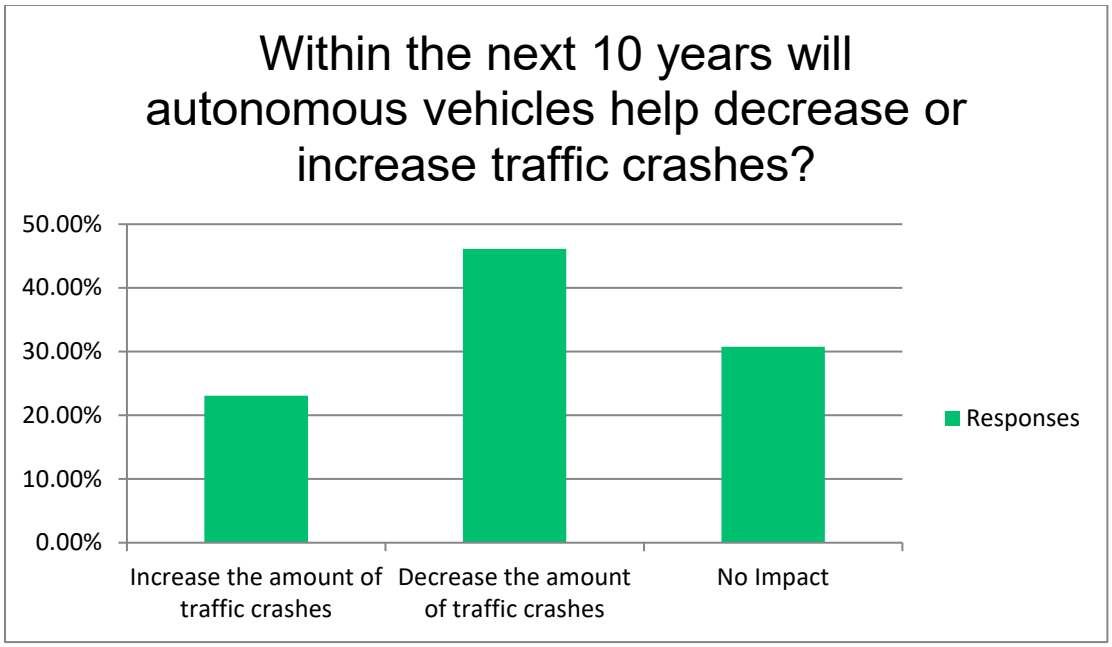


Question 9 asked state agency representatives that participated in this survey, how will law enforcement operations change. Sixty-seven (67) percent of the participants provided a response to the question and thirty-three (33) percent did not respond. The responses varied from:

- Altering to how traffic crashes are conducted by requiring additional time and resources to collecting all data necessary to finalize the investigation.
- Domestic security issues and crimes committed by unmanned autonomous vehicles.
- Police, Procedures, and laws will need to adapt to the technology

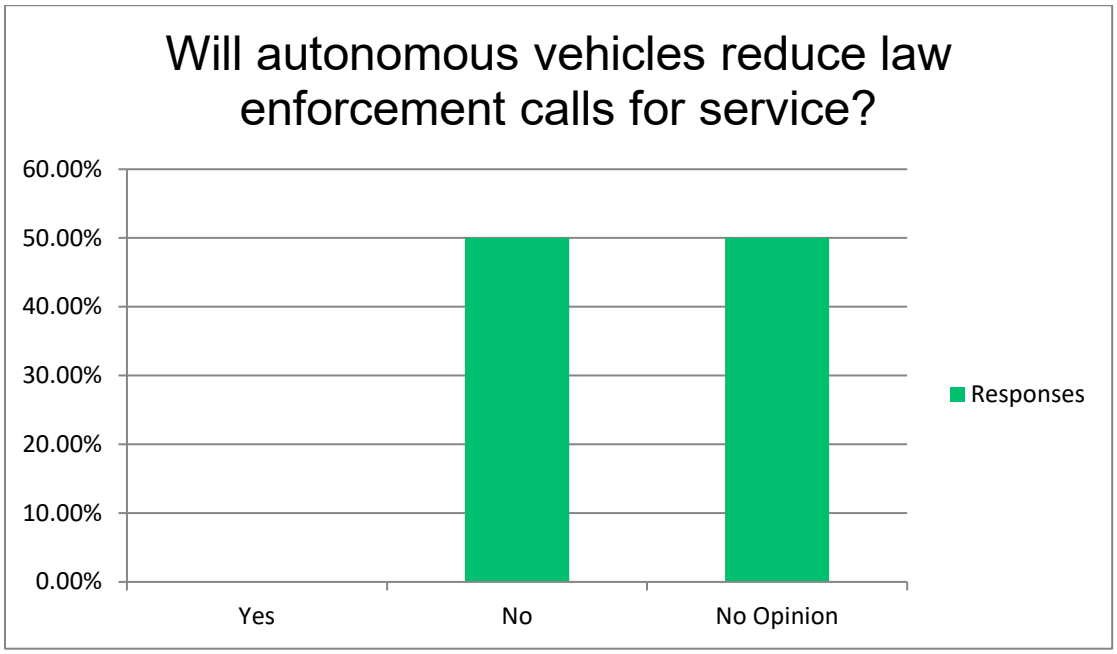
Question 10 asked within the next 10 years will autonomous vehicles help decrease or increase the amount of traffic crashes. Eighty-seven (87) percent of the agencies responded and thirteen (13) percent of the agencies did not respond to the question. Forty-six (46) percent of the survey participants feel that within the next 10 years autonomous vehicles will help decrease the amount of traffic crashes. Thirty-one (31) percent surveyed think there will be no impact and twenty-three (23) percent surveyed indicated there will be an increase in traffic crashes within the next 10 years.

- Increase the amount of traffic crashes – 23.08% (3)
- Decrease the amount of traffic crashes – 46.15% (6)
- No impact – 30.77% (4)



Question 11 asked if autonomous will reduce law enforcement calls for service. Eighty (80) percent of the agencies responded and twenty (20) percent skipped the question. Fifty (50) percent of the respondents feel that autonomous vehicle will not reduce the law enforcement calls for service. Fifty (50) percent had no opinion to the question.

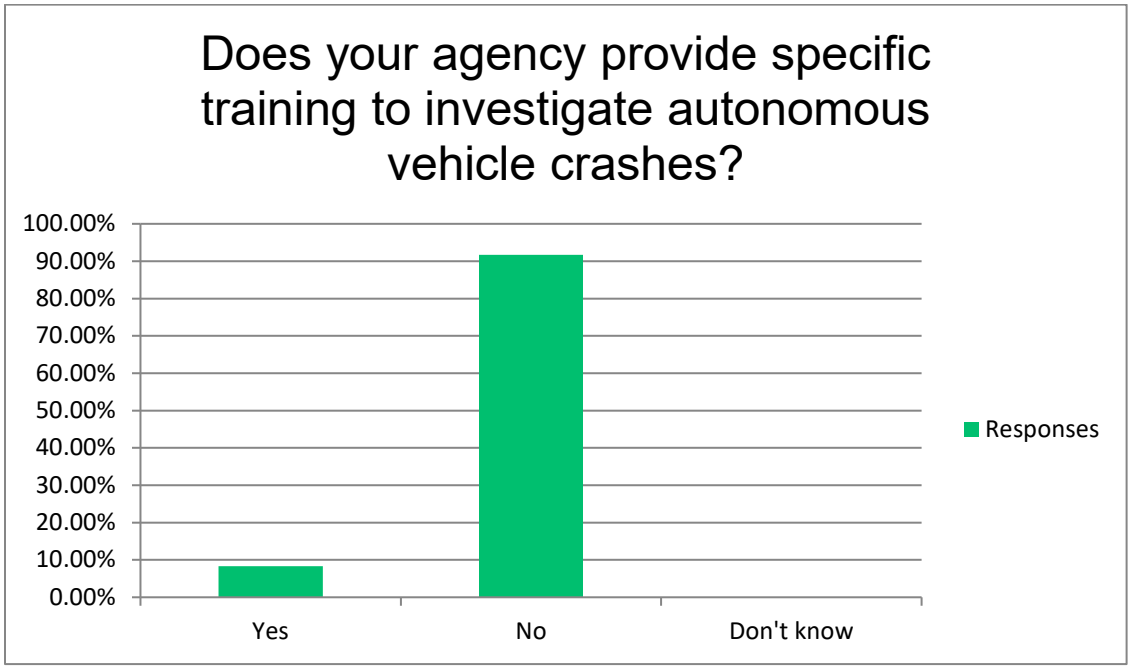
- Yes – 0% (0)
- No – 50.00% (6)
- No opinion – 50.00% (6)



Question 12 was a follow up from question 11. Question 12 asked, by how much will autonomous vehicles reduce law enforcement calls for service. There were no selections of yes noted on question 11, therefore it skipped over question 12.

Question 13 asked all participating agencies if their agency provides specific training to investigate autonomous vehicle crashes. Eighty (80) percent of the agencies responded and twenty (20) percent of the agencies skipped the question. Ninety-two (92) percent indicated they do not, and eight (8) percent of agencies surveyed do provide specific training.

- Yes – 8.33% (1)
- No – 91.67% (11)
- Don't know – 0% (0)



Question 14 asked what kind of training does your agency provide. Seven (7) percent of the agencies responded and ninety-three (93) percent of the agencies skipped the question. The response was that they created first line supervisor training on autonomous vehicles and basic education.

Question 15 state agency representatives that participated in this survey was asked, in your opinion, what is the most pressing issue related to autonomous vehicles that must be addressed by law enforcement agencies in the future. Eighty (80) percent of the participants provided a response, and twenty (20) percent skipped the question. The responses varied from:

- Safety – safe identification, approach, access, secure/movement of an autonomous vehicle
- Awareness and understanding of autonomous vehicles
- Relationship with industries
- Who to hold accountable if there is a vehicle crash
- Education and training emergency personnel

Discussion

The participants of the survey were professional law enforcement officers and other state law enforcement agencies that primarily focus on traffic control, traffic enforcement, and traffic crash investigation. 79% of the information provided was from law enforcement officers with 1-10 years of experience. 66% of the state law enforcement agencies that responded to the survey consisted of 1001 law enforcement members or greater. The Florida Highway Patrol's internal member survey was very comparable to the state law enforcement agencies survey results.

The responses received on both surveys indicated a high expectation that implementation of autonomous vehicles to our roadways will take place within the next ten years. Seventy-seven (77) percent of the Florida Highway Patrol's sworn members and 72% of the national agencies surveyed believe that within one to ten years autonomous vehicles will be traveling our roadway. With the implementation of autonomous vehicles 84% of the respondents feel that training would be beneficial. At the time of the survey 92% of the state law enforcement agencies surveyed do not provide specific training on autonomous vehicles. Participants felt that training pertaining to autonomous vehicles need to focus on; the technology, laws and legal, traffic crash investigations, traffic stops, and safety risks.

Through advancing technology, the respondents felt that autonomous vehicles will decrease traffic crashes between 46 to 50% in the next ten years. As a result, 82% of law enforcement officers and 86% of state law enforcement agencies indicated law enforcement responsibilities will need to change. Eighty- one (81) percent of the law enforcement officers surveyed indicated we need to strengthen the cybercrimes units to handle technology crimes associated with autonomous vehicles.

Ninety-one (91) percent of the law enforcement officers felt members within law enforcement, and other public safety personnel, need to have a way to interact with autonomous vehicles during emergencies. The provided recommendations for law enforcement interaction with autonomous vehicles from the survey that stood out was;

1. An override to allow for contra flow situations.
2. Shutdown capability for medical duress, criminal activity, or other emergency situations.
3. When an autonomous vehicle is identified as a vehicle that results in an Amber Alert, Silver Alert, or Blue Alert, then GPS coordinates are provided to emergency personnel. The vehicles flashers are activated on the vehicle, vehicle begins deceleration and maintains a slow roll till intercepted by law enforcement personnel.

Recommendations

The advancement of technology and the implementation of autonomous vehicles is inevitable. The survey data clearly identifies that training pertaining to autonomous vehicles would be beneficial to law enforcement personnel. However, agencies have not developed or implemented training on autonomous vehicles or its technology at the time of this research.

Throughout time, law enforcement has evolved in order to provide critical services to the public. As technology advances so does the danger for cyber related threats and attacks. Change in law enforcement responsibilities will need to occur in order to stay relevant. Developing a cyber security crime unit is recommended to handle in-depth investigations pertaining to the advancing technology and autonomous vehicle crimes.

Tracking of autonomous vehicle crashes and incidents will need to be explored for statistical reasons. The Florida Traffic Crash Report form will need an autonomous vehicle (AV) check box, along with an autonomous mode activated (AMA) check box, now that autonomous vehicles are being implemented. The proposed boxes could be located at the top of each driver and vehicle section on the crash report form, next to the pedestrian or vehicle check boxes. By tracking these crashes NHTSA and law enforcement agencies would be able to identify trends or issues as they relate to autonomous vehicles.

Advanced technology with autonomous vehicles opens the door to new opportunities for law enforcement officers as well the majority of those polled liked the idea of allowing public safety personnel the ability to interact with autonomous vehicles during emergencies. Allowing law enforcement members, the ability to interact with autonomous vehicles will help reduce traffic crashes, locate vehicles, stop vehicles, redirect vehicles in case of emergencies, and prevent autonomous vehicle usage in criminal activity.

It is highly recommended to implement a law enforcement work group that will regularly network with developers and manufacturers. It is critical to safe guard this technology and the safety of our citizens by allowing law enforcement personnel to express concerns and recommendations to autonomous vehicle developers. By working together and understanding the technology it could provide beneficial opportunities for all involved as we continually strive to provide cybersecurity, infrastructure security, safer vehicles, safer roadways, and ultimately a safer environment for all.

Lieutenant Herbert Brown has 20 years of sworn law enforcement experience. He began his law enforcement career with the Florida Highway Patrol on February 16, 2001. In 2007, he was promoted to Corporal as a Traffic Homicide Investigator. In 2010, he promoted to Sergeant and served as a district supervisor in Orange County. In 2011, he became the DUI Sergeant in Orange County. He promoted to Lieutenant within the Bureau of Criminal Investigations and Intelligence, as the Homeland Security Coordinator from 2014 to 2016. He transferred to Fleet and Property where he served from 2016 to 2020. He currently serves as a Lieutenant within the Law Enforcement Information Technology Section. Herb completed his Associate's degree from Tallahassee Community College.

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Appendix A

Member Survey Questions

Introduction:

The Florida Highway Patrol is conducting research on autonomous vehicles and their future ramification on law enforcement. We would appreciate a few moments of your time and ask you to complete the following survey. All responses are anonymous and will assist the FHP moving forward.

The survey will route you to provide additional feedback on several questions depending on your answers. Please take the time to answer each question thoroughly, because your response will guide the final direction of this research project.

Demographic Information

1) How many years have you served as a Sworn Law Enforcement Officer?
   Answer Choices
   A. 0-5 years
   B. 6-10 years
   C. 11-15 years
   D. 16-20 years
   E. 21+ years

Subject Knowledge

2) As a Law Enforcement Officer, how soon do you think it will be before fully autonomous vehicles are traveling on our roadways?
   Answer Choices
   A. 1-5 years
   B. 6-10 years
   C. 11-15 years
   D. 16-20 years
   E. 21+ years

3) Do you anticipate a change in law enforcement responsibilities and operations once autonomous vehicles are implemented?
   Answer Choices
   A. Yes
   B. No
   C. No Opinion

4) How do you believe law enforcement responsibilities and operations will change?

5) Within the next 10 years will autonomous vehicles help decrease or increase traffic crashes?
   Answer Choices
   A. Increase the amount of traffic crashes
   B. Decrease the amount of traffic crashes
   C. No Impact

6) Should law enforcement officers be included in the development and testing of autonomous vehicles?
   Answer Choices
   A. Yes
   B. No
   C. No Opinion

7) How do you think law enforcement officers should be included in the development and testing of autonomous vehicles?

8) Will autonomous vehicles reduce law enforcement calls for service?
   Answer Choices
   A. Yes
   B. No
   C. No Opinion

9) By how much do you think calls for service will be reduced?
   Answer Choices
   A. Reduced by less than 10%
   B. Reduced by 11% - 20%
   C. Reduced by 21% - 30%
   D. Reduced by more than 31%

10) Would it be beneficial to you if your agency provides additional training on autonomous vehicles?
   Answer Choices
   A. Yes
   B. No
   C. No Opinion

11) What kind of training do you believe will be necessary?

12) Do you feel that public safety, first responders, and law enforcement members need to have a way to interact with autonomous vehicles during emergencies?

Answer Choices

A. Yes
B. No
C. No Opinion

13) How do you believe law enforcement and first responders should be able to interact with autonomous vehicles?

14) In your opinion, will the implementation of fully autonomous vehicles increase the safety of emergency personnel?

Answer Choices

A. Yes
B. No
C. No Opinion

15) How do you believe autonomous vehicles will increase the safety of emergency personnel?

16) With the pending implementation of autonomous vehicles, would law enforcement agencies need to strengthen their cyber crimes units to handle technology crimes associated with autonomous vehicles?

Answer Choices

A. Yes
B. No
C. No Opinion

17) What would be your recommendations to handle cyber crimes?

18) In your opinion, what is the most pressing issue related to autonomous vehicles that must be addressed by FHP in the future?

Appendix B

External Agency Survey Questions

Introduction:

The Florida Highway Patrol is conducting research on autonomous vehicles and their future ramification on law enforcement. We would appreciate a few moments of your time and ask you to complete the following survey. All responses are anonymous and will assist the FHP moving forward.

The survey will route you to provide additional feedback on several questions depending on your answers. Please take the time to answer each question thoroughly, because your response will guide the final direction of this research project.

Demographic Information

1) How many years have you served as a Sworn Law Enforcement Officer?
   Answer Choices
   - **A.** 0-5 years
   - **B.** 6-10 years
   - **C.** 11-15 years
   - **D.** 16-20 years
   - **E.** 21+ years

2) How would you describe your Agency?
   Answer Choices
   - **A.** Local (e.g. City/Town/Village Police)
   - **B.** College or University Police
   - **C.** County (e.g. Sheriff's Office)
   - **D.** State or Provence (e. g. Highway Patrol, State Fire Marshal, State Police, etc.
   - **E.** Federal
   - **F.** Special (e.g. Tribal Police, Railroad Police, Airport Police, Port Authority Police, Inspector General, etc.)
   - **G.** Other

3) How many sworn officers does your Agency have?
   Answer Choices
   - **A.** 1 - 100
   - **B.** 101 - 250
   - **C.** 251 - 500
   - **D.** 501 - 750
   - **E.** 751 - 1000
   - **F.** 1001 - 2000
   - **G.** 2001 or more.

Subject Knowledge

4) Has your Agency investigated a traffic crash involving an autonomous vehicle?
Answer Choices
- **A.** Yes
- **B.** No
- **C.** Don't know

5) How many crashes involving autonomous vehicles has your Agency investigated?
Answer Choices
- **A.** 1 - 5 crashes
- **B.** 6 - 10 crashes
- **C.** 11 - 15 crashes
- **D.** 16 - 20 crashes
- **E.** More than 21 crashes

6) Does your Agency currently have a strategic plan addressing autonomous vehicles?
Answer Choices
- **A.** Yes
- **B.** No
- **C.** Don't know

7) As a Law Enforcement Officer, how soon do you think it will be before fully autonomous vehicles are traveling on our roadways?
Answer Choices
- **A.** 1-5 years
- **B.** 6-10 years
- **C.** 11-15 years
- **D.** 16-20 years
- **E.** 21+ years

8) Do you anticipate a change in law enforcement operations once autonomous vehicles are implemented?
Answer Choices
- **A.** Yes
- **B.** No
- **C.** No Opinion

9) How will law enforcement operations change?

10) Within the next 10 years will autonomous vehicles help decrease or increase traffic crashes?

Answer Choices

A. Increase the amount of traffic crashes
B. Decrease the amount of traffic crashes
C. No Impact

11) Will autonomous vehicles reduce law enforcement calls for service?

Answer Choices

A. Yes
B. No
C. No Opinion

12) By how much do you think calls for service will be reduced?

Answer Choices

A. Reduced by less than 10%
B. Reduced by 11% - 20%
C. Reduced by 21% - 30%
D. Reduced by more than 31%

13) Does your agency provide specific training to investigate autonomous vehicle crashes?

Answer Choices

A. Yes
B. No
C. Don't know

14) What kind of training does your Agency provide?

15) In your opinion, what is the most pressing issue related to autonomous vehicles that must be addressed by law enforcement agencies in the future?

Appendix C

Table 1
Levels of Vehicle Automation

SAE Automation Category	Vehicle Function
Level 0	Human driver does everything.
Level 1	An automated system in the vehicle can sometimes assist the human driver and conduct some parts of driving.
Level 2	An automated system can conduct some parts of driving, while the human driver continues to monitor the driving environment and performs most of the driving.
Level 3	An automated system can conduct some of the driving and monitor the driving environment in some instances, but the human driver must be ready to take back control if necessary.
Level 4	An automated system conducts the driving and monitors the driving environment, without human interference, but this level operates only in certain environments and conditions.
Level 5	The automated system performs all driving tasks under all conditions that a human driver could.