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# Analysis of Automated Vehicle Accidents Across the U.S.

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# ANALYSIS OF AUTOMATED VEHICLE ACCIDENTS ACROSS THE U.S.

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A Project

Presented to the

Faculty of

California State University,

San Bernardino

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In Partial Fulfillment

of the Requirements for the Degree

Master of Science

in

Information Systems Technology

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by

Anissa Quintero

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## ABSTRACT

Car Accidents are a significant public safety hazard to everyone all over the world. Recently, car manufacturers have tried to implement Automated Driving Systems into their vehicles to help drivers and decrease the accident rate. This culminating project analyzed whether Automated Driving Systems have decreased or increased the accident rate in the United States using automated vehicle data collected by the National Highway Traffic Safety Administration. The analysis platform was built using RStudio and Excel. The research questions were: Q1: What amount of autonomous vehicle accidents occurred in each state between 2021 and 2022? Q2: What manufacturer and maker have been involved in the most accidents? Q3: What month/year have accidents occurred the most? Q4: What were the factors surrounding these accidents? Q5: What solutions can we implement to reduce autonomous car road traffic collisions? The findings and conclusions are: Q1: More accidents occurred in 2021 and most were in the state of California. Q2: The manufacturing company, Waymo LLC, and the maker, Jaguar, have been involved in the most accidents. Q3: Most accidents occurred in November of 2021 with 19 crashes in total. Q4: The factors surrounding these accidents were most crashes occurred on the streets and intersections, on dry surfaces, with a posted speed limit of 25 miles per hour, and during the daylight. Q5: Solutions we can implement to reduce autonomous car road traffic collisions are building more railroads and trains, to partner with national programs to release road traffic information and create enhanced data systems to make

necessary changes. Areas for further study include collecting data from other countries to further understand if they are also experiencing the same issues and what actions they have taken.

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# CHAPTER ONE

## INTRODUCTION

In 1884, the first working car was created in Germany by an engineer named Gottlieb Daimler. Another German engineer named Karl Benz created a similar version of the car at the same time (Fuller, n.d.). Even though the modern automobile was created in Germany, the technology started to spread rapidly in America by the 1930s. Automobiles became more established in the 1920s after World War II due to the mass production of cars by Ford Motor Company. Henry Ford created the assembly line which allowed for more production of cars at a lowered price. By the 1950s, there was over 25 million registered cars on the road in the United States alone.

With the rise of an invention came a new set of problems. In 1891, the first automobile accident occurred in Ohio. James William Lambert was driving a single-cylinder gasoline automobile when he hit a tree root that caused his car to swerve out of control and smash into a hitching post. He managed to escape with just minor injuries, but this accident was the beginning of many that would be similar or even more brutal than what Lambert experienced (Emeka, 2019).

Since this accident automobiles have evolved to become smarter and bigger for the average driver. Today, there are many different types of vehicles on the road that are 10 times more dangerous than the single-cylinder gasoline automobile which have led to larger and more extreme accidents. The largest U.S. accident ever recorded occurred on Sunday, November 4$^{th}$, 2002, in Los

Angeles, CA along the Long Beach freeway. This accident involved 216 vehicles and caused 41 injuries, but, thankfully, there were no deaths. This accident happened when a semi-truck crashed into the concrete center divider which started the long chain of accidents on both sides of the interstate (Brown Jr., 2020).

According to the Department of Transportation (DOT) and the National Highway Traffic Safety Administration (NHTSA), about 94% of all U.S. accidents happen due to human error ("Critical Reason for Crashes Investigated in the National Motor Vehicle Crash Causation Survey", 2015). Approximately 1.3 million people die each year due to road accidents. According to the World Health Organization (WHO), about 20 to 50 million people (about twice the population of Texas) suffer non-fatal injuries with many resulting in disabilities. These non-fatal injuries from car accidents can cost countries about 3% of their gross domestic product ("Road Traffic Injuries", 2022).

Road traffic incidents have a profound effect on socioeconomic statuses with 90% of deaths occurring in low- and middle-income countries ("Road Traffic Injuries", 2022). The World Health Organization has also discovered that injuries due to road collisions are the leading cause for death to children and young adults between the ages of 5 and 29 years old, and young males are more than likely to be involved in these accidents than females. From this information we can determine that there is a severe problem here in the United States, which companies have tried to solve.

Companies are always pursuing new and enhanced technology that would save lives. For the automobile industry, many companies have been competing to make autonomous vehicles. Innovative technology has emerged that has allowed car manufacturing businesses to create technologically advanced vehicles. With this technology, automobile companies are hoping that this would make the automobile travel safer for all individuals. But how safe is this innovative technology?

## Problem Statement

In 2016, the National Highway Traffic Safety Administration released data stating that there were 6,296,000 crashes that have been reported by police ("How Many Car Accidents Per Day In The United States", n.d.). That's about 17,250 car crashes a day nationwide. Car manufacturing companies are trying to reduce the number of accidents by implementing Automated Driving Systems in their vehicles. I believe governments should have a database keeping track of accidents that have occurred with this newly developed technology. Recently, the National Highway Traffic and Safety Administration have issued a General Order to collect data on the accident rate on autonomous vehicles ("Standing General Order on Crash Reporting", n.d.).

This culminating experience project investigates the accident rate and the types of accidents that occur in the United States of America for automated vehicles. Vehicles with this type of technology have been involved in accidents,

but at different times and under different circumstances. I wanted to research whether innovative technology has played a part with road traffic collisions.

To resolve all of this, I want to ask questions that will produce results that will show

1. What amount of autonomous vehicle accidents occurred in each state?
2. What manufacturer, make and model have been involved in the most accidents?
3. What month/year have accidents occurred the most?
4. What were the factors surrounding these accidents?
5. What solutions can we implement to reduce autonomous car road traffic collisions?

# CHAPTER TWO

## LITERATURE REVIEW

There is plenty of research done regarding road traffic accidents happening all over the world (Moosavi, 2021 & Nikam, 2020). Even though research has been done and have concluded that accidents are rising, not a lot has been done to decrease these numbers. With new technology being created and placed in new vehicle models every year, comes new distractions for drivers that will most likely cause more accidents. This has become very worrisome to everybody.

To try to understand why accidents are happening and how to prevent them, researchers began collecting data on crash reports from all over the country (National Highway Traffic Safety Administration, 2022). To further their research, the Department of Motor Vehicles (DMV) and the National Highway Traffic and Safety Administration began collecting data on crash reports from autonomous vehicles to see if this new technology is improving or worsening the problem.

Since 2021, the NHTSA have required automakers to report serious crashes within one day of learning about them and to report less serious accidents within 15 days of the following month. Automakers have reported nearly 400 accidents with automated driver-assisted systems. There have been five fatalities and six seriously injured (“Nearly 400 Car Crashes in 11 Months Involved Automated Tech, Companies Tell Regulators”, 2022). Of the 400 crashes, 108 of them were fully autonomous vehicles. In most of these crashes

the vehicles were struck from the rear, but there were no serious injuries (The Associated Press, 2022).

Even though many studies have been conducted over conventional vehicle accidents, there have not been many studies on autonomous vehicle accidents. Vehicles with this type of technology are being purchased every day and we need to be able to understand whether it is reducing the number of accidents or increasing them.

One study by the Transportation Research Procedia was conducted to analyze traffic accidents with autonomous vehicles in the State of California. They studied data collected between 2015 and 2017.

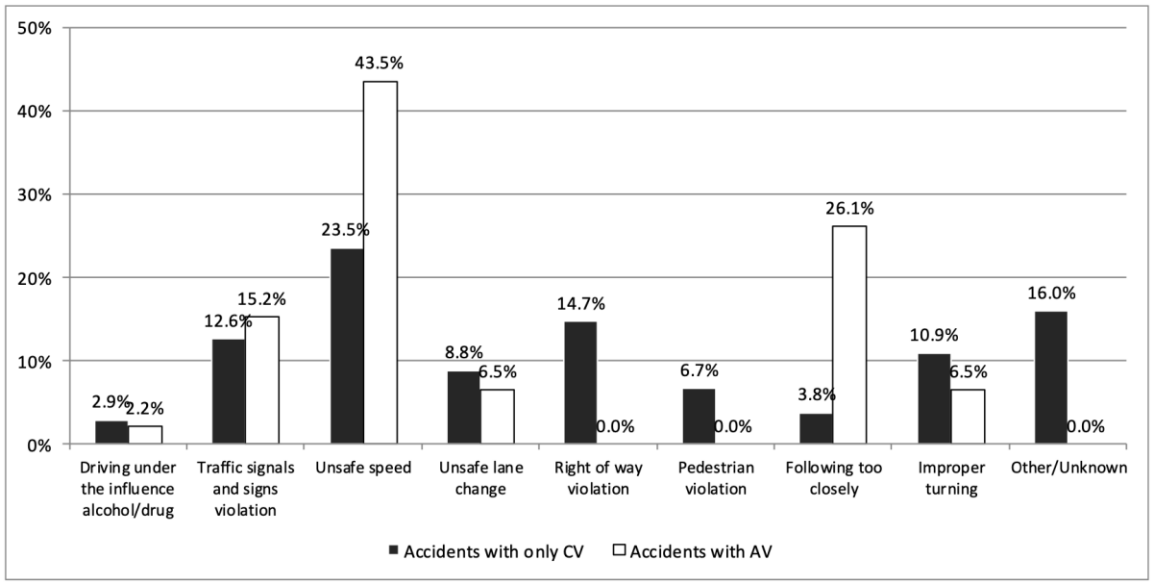


Figure 1: Accidents with AV and CV 1 (Petrovic, Mijailovic, Pesic, n.d.)

Figure 1 shows the different factors between combustion vehicles and autonomous vehicles. Autonomous vehicles have been involved in more

accidents at unsafe speeds than combustion vehicles. This culminating experience project will investigate at what speeds accidents occurred the most with autonomous vehicles.

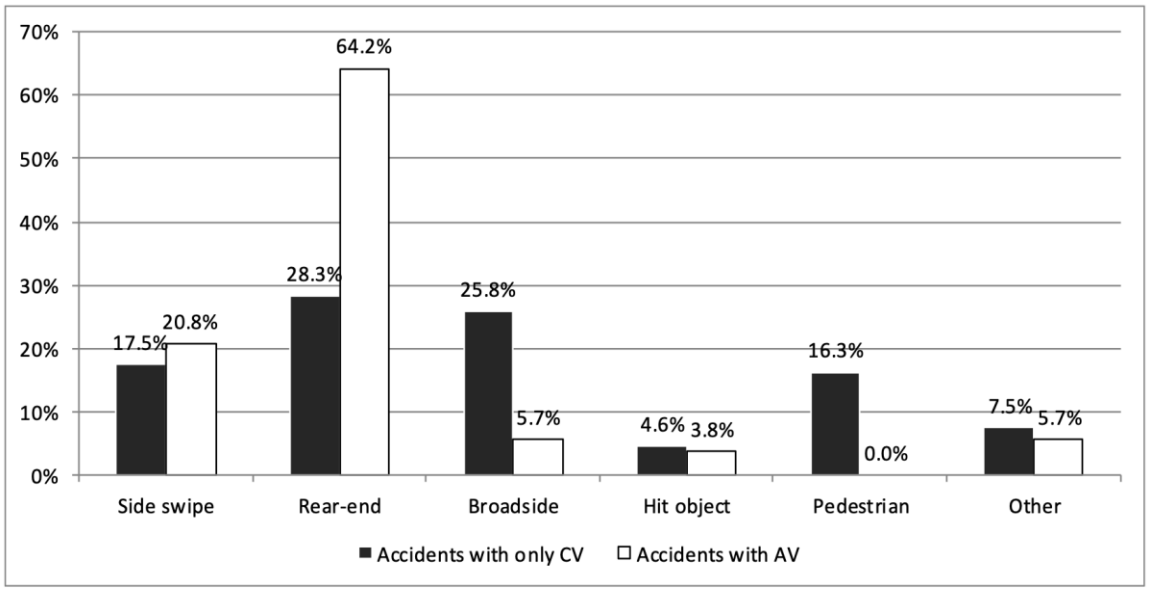


Figure 2: Accidents with AV and CV 2 (Petrovic, Mijailovic, Pesic, n.d.)

Figure 2 shows what areas the vehicles have been hit. Even though these factors are informative they don't include circumstances surrounding the accidents like the posted speed limit, whether the accident occurred during the day or night, etc. This project intends to analyze those factors.

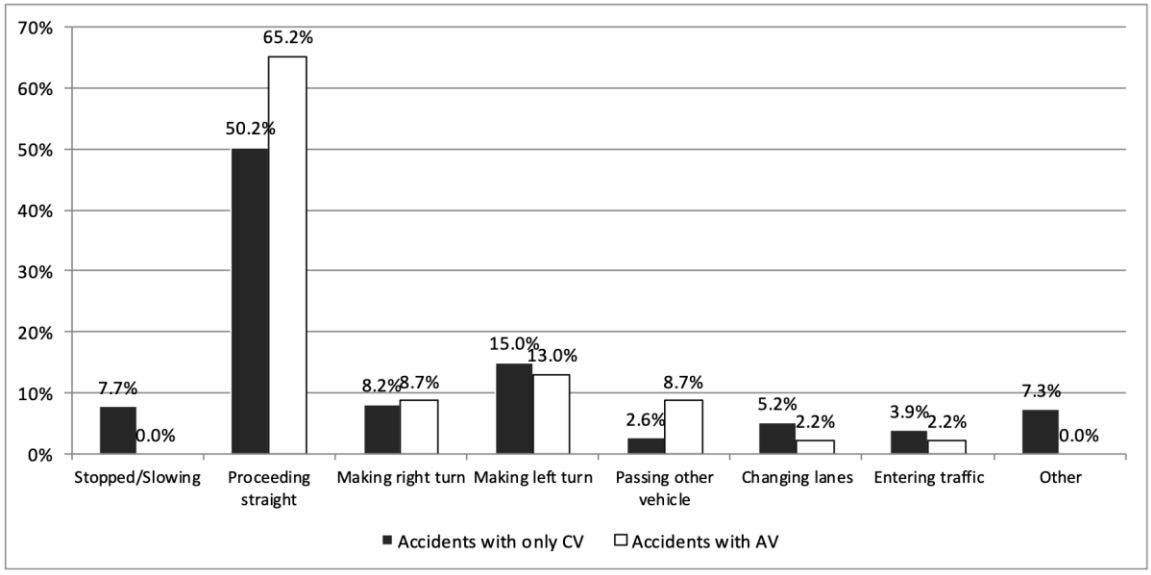


Figure 3: Accidents with AV and CV 3 (Petrovic, Mijailovic, Pesic, n.d.)

Figure 3 shows what the vehicle was doing when the accident occurred. This chart doesn't state whether the accidents occurred on streets or intersections. This project is intended to expand and focus more on the accident rate with autonomous vehicles.

Their results concluded that autonomous vehicles are more than likely to be rear-ended, side-swiped, hit by continuing to go straight or by passing another vehicle, hit when traveling at unsafe speeds, or following too closely to other vehicles (Petrovic, Mijaillovic, Pesic, n.d.).

Going off this study, the research conducted in this project goes further into the trends that will help understand what factors are contributing to these accidents. At the time of the study there was still little data to go off on to conclude a significant answer. With increasing autonomous vehicles on the

roads, we want to see whether enough data has been produced to determine whether accidents have been decreasing or increasing, and what can be done to further reduce these numbers.

# CHAPTER THREE

## RESEARCH METHODOLOGY

This chapter is a brief explanation of the data being used, what approaches are being taken to analyze the data, and the methodologies taking place to gather my results. To answer the questions that were proposed in the problem statement, the study will be focused on three significant parts. The first part will be focused on the general information of automated vehicle road traffic collisions like the number of crashes and the state that experienced the most and least road accidents.

The second part will take a closer look on the factors that led to the road accidents. Innovative technology is being introduced every day with the intention of making our daily lives simpler. This culminating experience project will investigate whether innovative technology has helped decrease or increase the number of road accidents in the United States.

The third part of this study will address solutions to these problems. Whether action can be taken nationally or locally, everyone can do their part to make our roads safer. With innovative technology being implemented in our vehicles every day, our lawmakers need to begin looking to see if there are any precautions or rules that should be introduced to help guarantee the safety of their citizens.

## Data Sources and Collection

The data is collected from manufacturing company reports that cover automated vehicle accidents between late 2021 and early 2022 (“Standing General Order on Crash Reports”, n.d.). These sources include information about the circumstances surrounding autonomous vehicle accidents. Characteristics that are featured in the collected sources are manufacturing details, location of these accidents, and accident distribution across the country. The data collected was cleaned and analyzed.

## Data Set Description

The NHTSA also contains data for the crash rate of autonomous vehicles. They have created a Standing General Order that requires identified manufacturers and operators to report vehicle accidents that are equipped with automated driving systems. The driving systems being collected in the data are either ADS or Level 2 ADS. ADS are vehicles that are currently being tested on public roads in limited capacities. Level 2 ADS have speed and steering inputs when ADS is engaged but still require a human driver to stay fully aware of the drive.

Table 1: Data Set Description for ADS Reports

| # | Attribute | Description |
|---|---|---|
| 1 | Report ID | This is a unique number for the accident report. |
| 2 | Report Version | |
| 3 | Reporting Entity | This section names the manufacturer of the vehicle. |
| 4 | Report Type | This section indicates the day-to-day reporting of the accident |
| 5 | Report Month | This section indicates the month the accident occurred. |
| 6 | Report Year | This section indicates the year the accident occurred. |
| 7 | Report Submission Date | This section indicates the day the accident occurred. |
| 8 | VIN | This section indicates the VIN number of the vehicle. |
| 9 | VIN-Unknown | This Section indicates the vehicle reported in the accident does not have a VIN number. |
| 10 | Serial Number | This section indicates the serial number of the vehicle. |

| | | |
|---|---|---|
| 11 | Make | This section indicates the make of the vehicle. |
| 12 | Model | This section indicates the model of the vehicle. |
| 13 | Model-Unknown | This section indicates whether the report does not contain the model of the vehicle. |
| 14 | Model Year | This section indicates the year the vehicle was built. |
| 15 | Model Year-Unknown | This section indicates the year the vehicle was built is unknown. |
| 16 | Same Vehicle ID | This section indicates the vehicle ID. |
| 17 | Mileage | This section indicates the mileage of the vehicle. |
| 18 | Mileage-Unknown | This section indicates the vehicle mileage is unknown. |
| 19 | Driver/Operator Type | This section indicates whether the vehicle was operating remotely or in-vehicle. |

| | | |
|---|---|---|
| 20 | ADS/ADS Version | This section indicates whether an ADS system is installed in the vehicle. |
| 21 | ADS/ADS Version-Unknown | This section indicates whether the vehicle involved did not contain an ADS system. |
| 22 | ADS/ADS Version CBI | This section indicates whether the vehicle involved contained a CBI version installed. |
| 23 | ADS Equipped | This section indicates whether the vehicle was equipped with an ADS system. |
| 24 | Automation System Engaged? | This section indicates whether the ADS system was engaged at the time of the accident. |
| 25 | Operating Entity | This section indicates the company operating the vehicle. |
| 26 | Operating Entity-Unknown | This section indicates whether the operating entity is unknown. |
| 27 | City | This section indicates the city the accident occurred. |

| | | |
|---|---|---|
| 28 | State | This section indicates the state the accident occurred. |
| 29 | Roadway Type | This section indicates the type of road the accident occurred. |
| 30 | Roadway Surface | This section indicates whether the road was wet or dry. |
| 31 | Roadway Description | This section describes the condition of the road. |
| 32 | Posted Speed Limit (MPH) | This section indicates the speed limit posted. |
| 33 | Lighting | This section indicates whether the accident occurred during daylight or nighttime. |
| 34 | Weather-Clear | This section indicates the weather was clear at the time of the accident. |
| 35 | Weather-Snow | This section indicates there was snow during the time of the accident. |
| 36 | Weather-Cloudy | This section indicates the weather was cloudy during the time of the accident. |

| | | |
|---|---|---|
| 37 | Weather-Fog/Smoke | This section indicates the weather was foggy or smokey during the time of the accident. |
| 38 | Weather-Rain | This section indicates whether it was raining during the time of the accident. |
| 39 | Weather-Severe Wind | This section indicates whether there was severe wind at the time of the accident. |
| 40 | Crash With | This section indicates whether the vehicle crashed into another vehicle or object. |
| 41 | Highest Injury Severity | This section indicates the severity of the injuries if there were any. |

The data collected by the NHTSA through the General Order contains reported accidents between 2021 and 2022. All vehicles are either equipped with Automated Driving Systems or prototypes. If the NHTSA finds any defects in these vehicles, they take the appropriate action to ensure the unsafe vehicle is not released on public roads.

## Tools

### Microsoft SQL Server 2019

Microsoft SQL Server is a relational database management system. According to techtarget.com, it supports a wide variety of transaction processing, business intelligence and analytics applications in corporate IT environments.

### RStudio

RStudio is an integrated development environment for the software program R (RStudio, 2022). It is an organized interface that allows the user to view graphs, data tables, R code, and output all at the same time (Kent State University, 2021). RStudio comes with an import feature that allows users to import CSV files, Excel files, SAS files, SPSS files, and Stata files without having to write code to do it.

### Microsoft Excel

Microsoft Excel is a software program that uses spreadsheets to organize data and numbers that have been collected or formed by formulas and functions. It is mainly used to perform financial analysis, but it can also create graphs from data that has been manipulated from other programs like SQL Server.

Data Cleaning

The data sets collected have over 3 million records that needed to be cleaned to analyze it. The anomalies in the data set include:

- Null records
- Missing days
- Redacted information

One of the first steps taken to complete this research study was to begin cleaning the data. To address the anomalies, data cleaning was performed below:

- Null records

  All null records were removed from both data sets, and some were replaced with the values needed.

- Missing Days

  The days are not included in the data set for U.S. Accidents. This missing information was deleted and only included the year and month they occurred.

- Redacted information

  In the data set for autonomous vehicle accidents, some information was redacted from the public due to the information being too critical to share. Most of these columns were deleted because they were not useful.

# CHAPTER FOUR

# DATA ANALYSIS AND FINDINGS

## Autonomous Vehicle Accidents

This research analysis also involves the study of vehicles with autonomous driving functions on the road and the many attributes tangled in the car accidents they have been involved in. The manufacturing companies are currently the only businesses with prototypes and working vehicles on public roads. The goal for this study is to understand if this certain technology has reduced or increased accidents on the road in the United States of America. We can see the results of this analysis below.

### Reporting Manufacturing Accidents

Figure 4 shows which manufacturing companies with ADS systems installed in their vehicles have been involved in the most car accidents. This graph is labeled from greatest to least to give a better visual of which company has been involved in the most accidents. The color scheme of this chart helps separate each result from one another. The height of each section indicates which manufacturing company has experienced the most accidents with this technology.

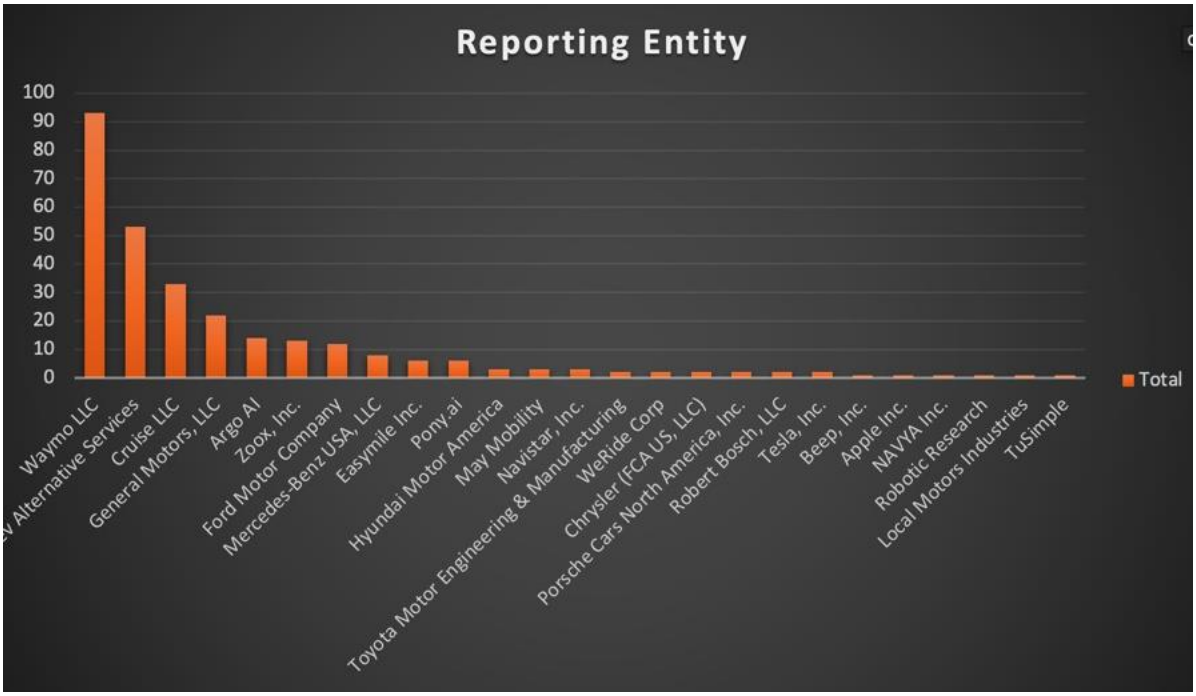


Figure 4: Reporting Manufacturing Accidents (2021-2022)

In this figure we can see that the manufacturing companies Waymo LLC, Transdev Alternative Services, Cruise LLC, and General Motors LLC have experienced the most accidents with this new technology. Waymo LLC have been involved with the most accidents with 93 crashes in total. Transdev Alternative Services experienced the second most accidents with 53 crashes. Cruise LLC came in third with experiencing 33 crashes. General Motors LLC came in fourth with 22 car accidents.

Number of Accident by Make

Figure 5 shows which make of car has been involved in the most accidents. The height of each section explains which make has been involved in the most accidents.

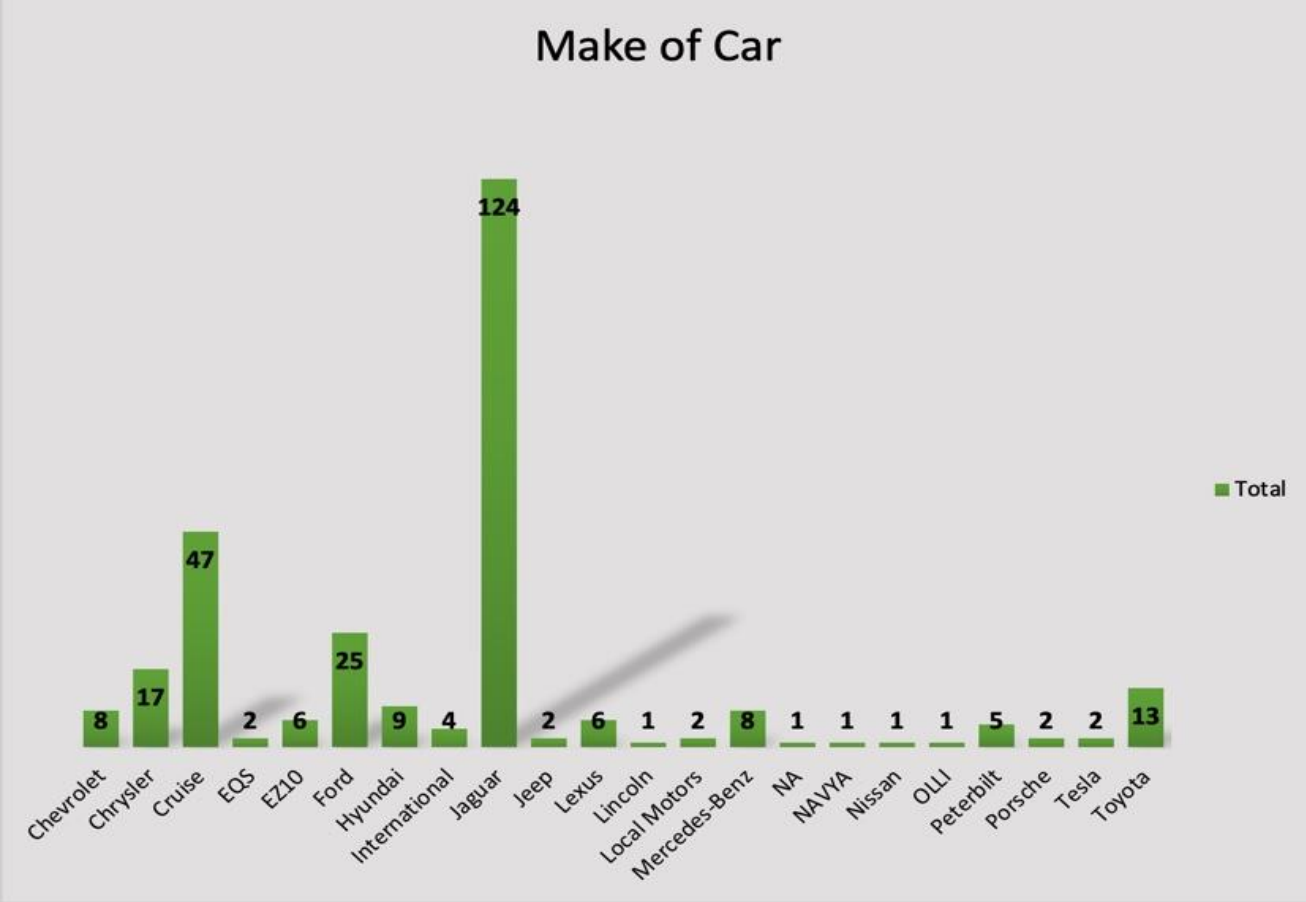


Figure 5: Number of Accidents by Make

In this figure we can see that Jaguar, Cruise, Ford, and Chrysler are the top four makers that have experienced the most accidents. Jaguar came on top with 124

crashes. We can then see a significant drop to 47 crashes from Cruise. Ford came in third with 25 crashes. Chrysler came in fourth with 17 crashes.

Number of Accidents Monthly for 2021

Figure 6 shows the accidents per month for 2021. For this graph, a line chart is used to show the increases and decreases throughout the months. Unfortunately, we do not have data covering the entire year of 2021 because the General Order was not issued until June (NHTSA, 2022).


Figure 6: Number of Accidents Monthly for 2021

In this figure we can see that many accidents have occurred throughout the last couple of months for 2021. In August, 11 car accidents with the ADS systems in

use have occurred. In September, we can see a significant rise to 17 car accidents. We see a slight decrease in the month of October with 14 car accidents, but it then rises to the most accidents recorded in 2021 to 19 crashes for the month of November. For the last month of 2021, we see a huge decrease to 10 car accidents in the month of December.

Number of Accidents Monthly for 2022

Figure 7 shows the accidents per month for 2022. For this graph, a line chart was used to show the increases and decreases in accidents throughout the year. Because we are still in 2022, this chart only goes up to the month of May.


Figure 7: Number of Accidents Monthly for 2022

The chart begins with January having the least number of accidents which then rises in February. There is a big increase in March but then we can see a slight decrease in April. There's another increase again in the month of May with 18 crashes in total. The month of May has experienced the most crashes.

Number of Accidents Reported Yearly

Figure 8 show the number of autonomous vehicle accidents in 2021 and 2022. The color scheme indicates which amount of the pie chart belongs to what year with the year 2021 being blue and 2022 being grey.

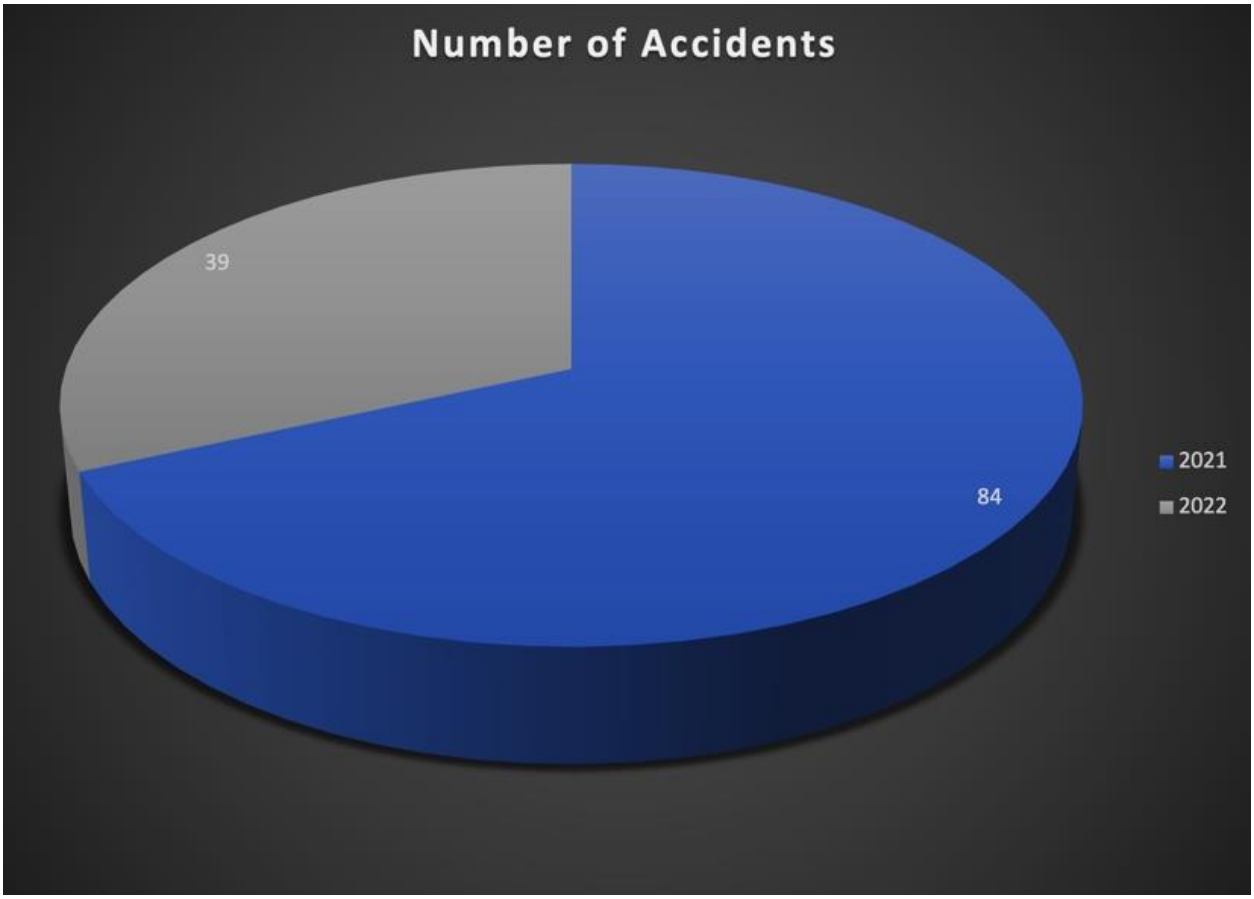


Figure 8: Number of Accident Reported Yearly

This figure shows that more accidents with ADS systems involved happened in 2021 with 84 crashes in total. For the year of 2022 the data only goes up to the month of May and for the year of 2021 the data wasn't collected until the month of August. We can only confirm that 39 crashes have occurred so far in 2022.

Number of Accidents by State

Figure 9 shows the number of accidents that have happened in each state with recorded crashes involving vehicles with ADS systems. The map shows which

states have been reporting car accidents with the NHTSA. The color scheme indicates which state has experienced a certain number of accidents. It has not been explained whether the states that any data do not have experienced any car accidents with ADS systems recorded yet, but the states with color have recorded accidents that have been collected by the NHTSA.

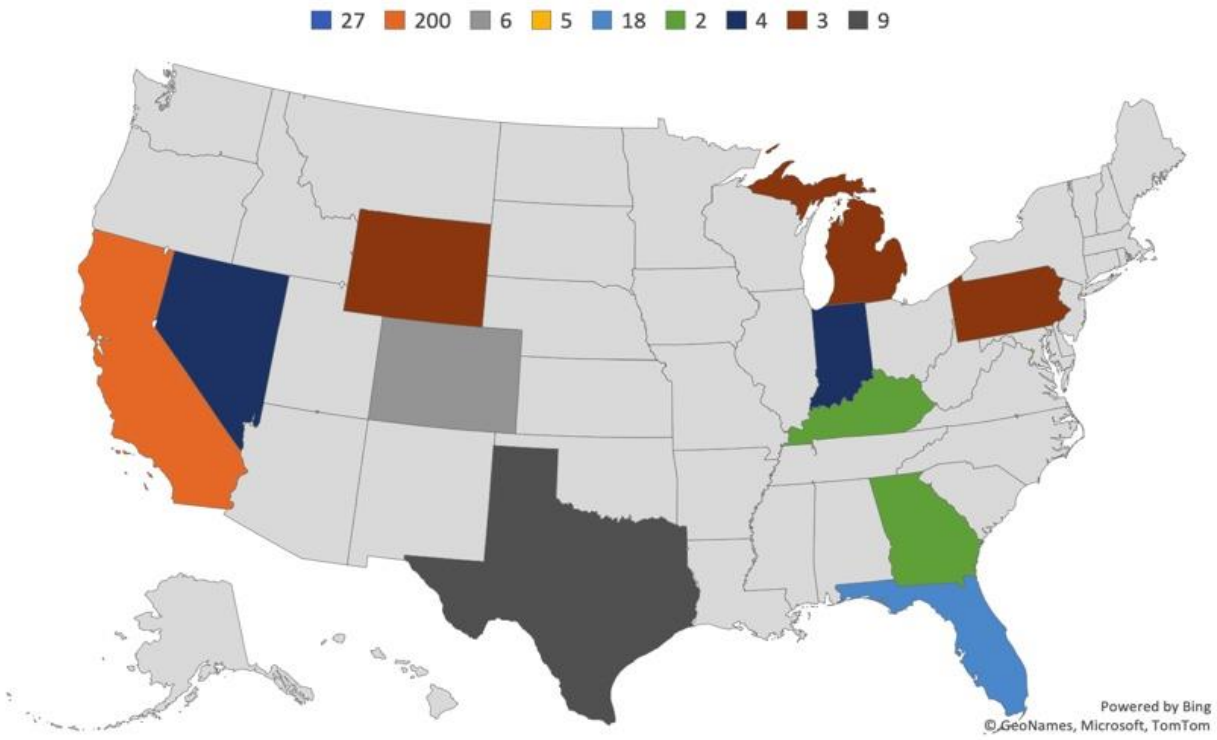


Figure 9: Number of Accidents by State

This map shows what states have experienced a certain number of accidents. Some states have experienced the same number of car accidents and others

have experienced a much bigger number of car accidents. The states with least number of car accidents with ADS systems involved are Georgia and Kentucky with 2 crashes in total. The state with the greatest number of car accidents with ADS systems is California with 200 crashes in total.

Roadway Type

Figure 10 shows which roadway type experienced the most accidents. Each section is separated by a different category.

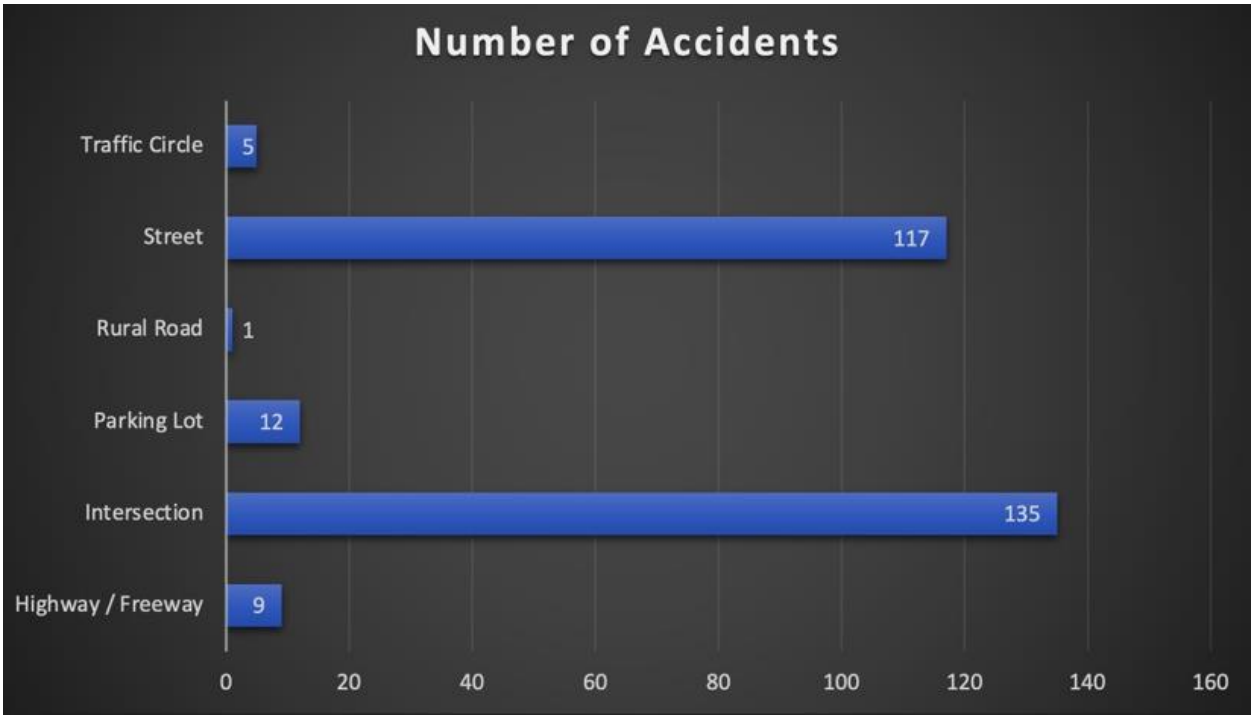


Figure 10: Roadway Type

This graph shows that most of the accidents with ADS systems occurred on intersections and streets. A minority of car accidents have occurred on traffic circles, rural roads, parking lots, and highways/freeways.

Roadway Surface

Figure 11 shows whether the surface of the roadway where the accident occurred was wet, dry, snowy, or icy during the time of the accident. The color scheme separates the results of each category.

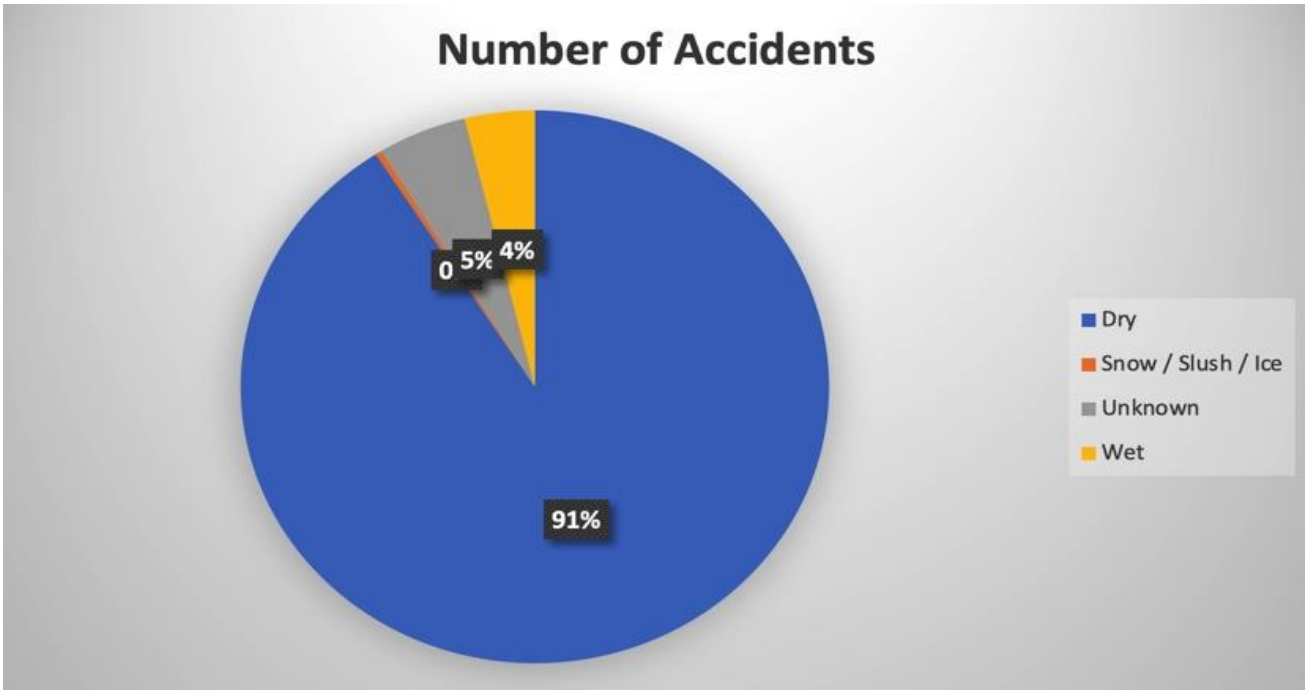


Figure 11: Roadway Surface

In this chart we can see that the dry category takes up 91% of the chart which means that most car accidents occurred on dry road surfaces. We also know that 5% of the car accidents are unknown whether they occurred on wet or dry surfaces, and only 4% of the accidents occurred on wet surfaces.

Posted Speed Limit

Figure 12 shows the speed limits where accidents have occurred the most. Each section is separated by the speed limit that was posted at the time of the accident.

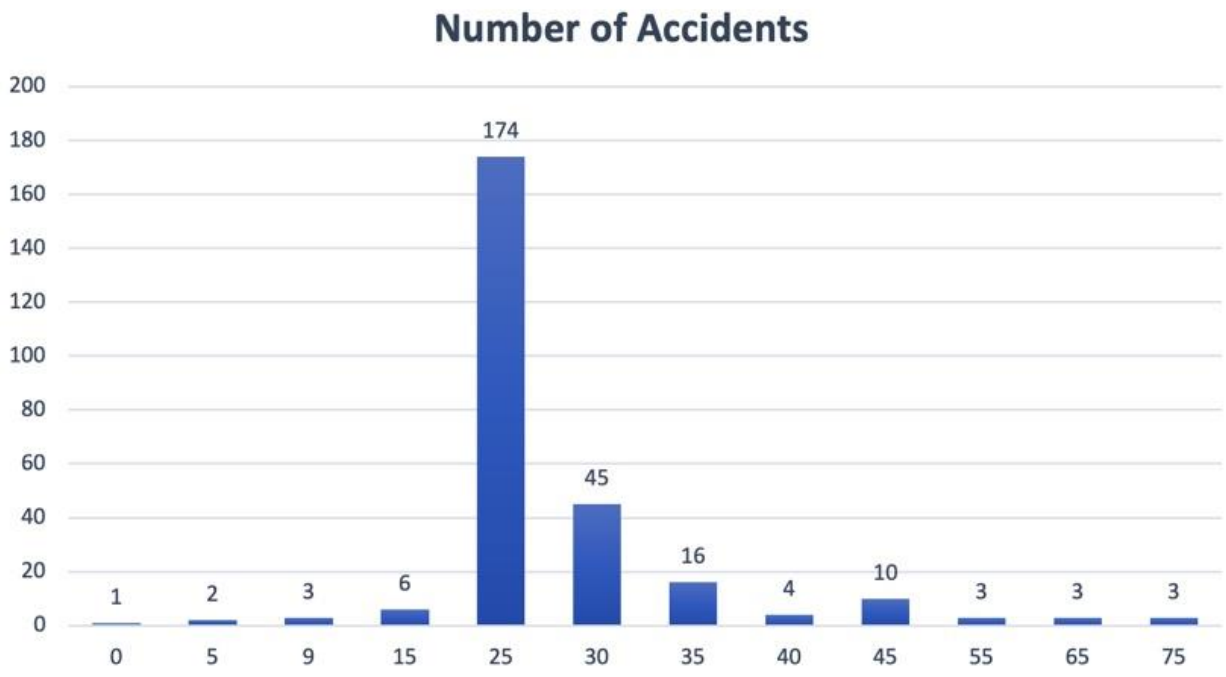


Figure 12: Posted Speed Limit

In this graph we can see that car accidents have occurred the most when the speed limit was posted at 25 miles per hour with 174 crashes. There is a significant decrease to 45 crashes in total when the speed limit is posted at 30 miles per hour. The highest number of car accidents occur when speed limits are posted between 25 to 45 miles per hour.

Lighting

Figure 13 shows a certain percentage of car accidents with ADS systems that were involved in certain lighting. The options that are displayed in this chart are dark-lighted, dark-not lighted, dark-unknown lighting, dawn/dusk, and daylight. The color scheme separates each lighting option in the chart.

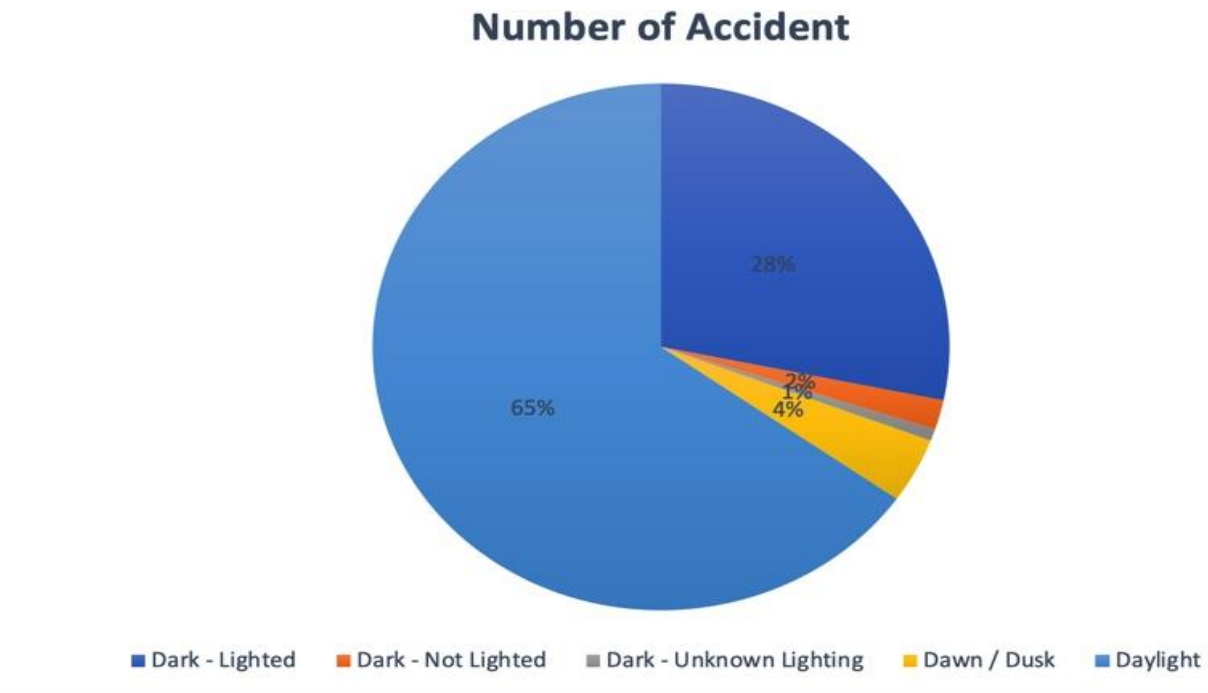


Figure 13: Lighting

In this chart we can see that 65% of car accidents have occurred during the daylight, 28% have occurred during the dark but it was still somewhat light outside, 4% have occurred when it was dawn/dusk outside, 2% have occurred when it was dark outside and it was not somewhat light outside, and 1% occurred when it was dark, but it is unknown whether any light was present outside.

# CHAPTER FIVE

# DISCUSSION, CONCLUSION AND AREAS FOR FURTHER STUDY

## Discussion

From the results that were gathered we can see that the vehicles with ADS systems have experienced several accidents. Most of the accidents have occurred during daylight, on dry surfaces, on a posted speed limit of 25mph, and on intersections. California is the state that has experienced the most automated vehicle accidents. Waymo LLC is the manufacturing company that has experienced the most accidents and the make of car that has experienced the most accidents are Jaguar. Unfortunately, the data collected does not contain enough information to understand whether this technology has helped decreased or increase the accident rate. There is not a single year of collected data to examine and compare to other years. More data needs to be collected to fully understand how this new technology has affected drivers. Nevertheless, accidents are still occurring daily, and we can still take precautions to avoid them.

From Figure 8, we can see that most accidents occur in states that are more populated. We can also see from Figure 12 that most accidents occur during the day. To reduce car accidents across the U.S. recommendations were made to implement more railroads especially in more populated areas. Other recommendations made to reduce the accident rate are national programs to promote safe driving, safe driving behavior, safer vehicles and roads, safer pedestrians, educate safe driving, and data systems.

The state of California is one of the most populated states in the country. In figure 1-4 we can see that California had the most accidents in the U.S. between 2016 and 2020. To help combat against high accident rates and overpopulated roads, the California high-speed train project was created.


Figure 14: High-Speed Train

https://www.railway-technology.com/wp-content/uploads/sites/13/2016/04/Image-2-California-HSR.jpg

The reason to build trains instead of expanding airport capacity or constructing new roads was because high-speed lines are economically,

environmentally, and socially profitable (California High-Speed Rail Network, 2021). This project will be the first high-speed train system being implemented in the U.S. This high-speed train will connect California citizens from San Francisco to Los Angeles within 3 hours at a speed of 220 mph and is expected to be operational by 2028.


Figure 15: California High-Speed Rail Map

https://www.railway-technology.com/wp-content/uploads/sites/13/2016/04/Image-3-California-HSR.jpg

Even though creating high-speed trains can be a main way of reducing car accidents, there are other precautions that can be taken. One way to reduce car accidents is by partnering with national programs to release road safety information to educate and raise awareness to drivers on how to drive more safely. These programs can spread awareness on seatbelt safety, the issues with speeding and intoxicated driving. We as drivers need to understand the dangers of driving recklessly and take it upon ourselves to practice safe driving to protect our public roads.

To keep track of the accident rate in the United States, we need to have enhanced data systems to collect the necessary information needed to make changes. Our government needs a reliable database that can inform policymaking. Reliable databases are also useful to understand new trends that are affecting drivers on the road. These new trends can be new technology being implemented into our vehicles every day. Lawmakers and leaders need to have a good understanding of what technology is useful or harmful to the everyday driver. It's because of studies with informational data that has allowed lawmakers to understand that texting while driving has caused drivers to lose focus and create unnecessary accidents. Therefore, texting while driving is now illegal.

## Conclusion

Road accidents are a serious public safety issue. The analysis from this research study has shown that accidents are occurring from autonomous

vehicles nationwide. Now that technology is becoming more advanced, we are starting to see new vehicles with more technological functions on public roads. These functions are meant to help drivers be more responsible on the road and keep our roads safer.

By analyzing the dataset, we can establish which roadways accidents have occurred the most, what speeds have these accidents occurred the most, which states have experienced the most accidents, and which months have accidents occurred the most. The analysis of this study has confirmed that it is too early to tell whether these new technological functions are helping improve driver safety on the road or making it worse. Finally, this study has recommended that our government implement high-speed trains to reduce the number of vehicles on the road, to implement national programs that will educate drivers on road safety with automated vehicles, and to establish databases to collect data and inform policymakers to make appropriate changes needed to ensure the safety of drivers on the public roads.

## Areas for Further Study

This study has accumulated a lot of data on the accident rate in the Unites States, but we still don't see any data from other countries. It is in our best interests to study this innovative technology worldwide. With the collected data we can analyze and understand the effects it has in other countries and what measures and actions they have taken to better their roads. It is better to get a clear visual of the changes autonomous vehicles have had on roads worldwide.

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