Master thesis submitted to the College of Science and Engineering in partial fulfilment of the requirements for the degree of Master of Engineering (Civil) at Flinders University, Adelaide, South Australia

Thesis report

Autonomous public transportation potential benefits and applications

Master of Engineering (Civil Engineering)
Submitted by: - Jay Kayastha (2232984)
Semester: - 2, 2020 kaya0024@flinders.edu.au

DECLARATION

I hereby declare that Research entitled “Autonomous public Transportation potential benefits and application” has been prepared by me under the close guidance and supervision of Professor Rocco Zito. The study includes the author’s original work comprising the knowledge collected through various research and studies available on journals and online platforms. The various analysis that has been found previously through other research conducted on the related topic is mentioned with proper citation. The rest of the work besides the referenced information is the prime task of the author.

I declare that the work presented in this study has not been copied or theft from any other sources. This has not been previously included in any platform. I have attempted possible research and study from the available sources and brainstormed to bring the outcome as this work. I have obtained the relevant ethical approval for mentioning the references from trustable sources. I have acknowledged the obligations and rights of the participants.

Signature

Name: Jay Kayastha

Date: 8th Nov 2021

ACKNOWLEDGMENT

The proposed research entitled “Autonomous Public Transportation Potential Benefits and Application” is a research report submitted for a deep understanding of the existing issues and further possibilities of autonomous transportation. First, I would like to thank Prof. Rocco, Nicholas Holyoak, Branko Static for providing me with such a wonderful opportunity to conduct this research.

I would like to express my sincere gratitude towards my research advisor, for his precious time, continuous supervision, incredible encouragement, regular guidance, valuable suggestions and support, and continuous effort to make the research report more academic, systematic, and qualitative without which the present research report couldn’t be successful.

The appreciation goes to his valuable suggestion, guidance, encouragement, and support. The researcher’s sincere gratitude goes to all my advisors, the Department of Research for always being helpful, giving time and dedication, and being supportive throughout the research process.

I would like to acknowledge everyone involved in the research process who helped me in this research report directly or indirectly and I am also very thankful to all the helping hands for constantly supporting me by helping and contributing to the successful completion of my entire research study.

EXECUTIVE SUMMARY

The report looks at the background of autonomous transportation, explains its objectives, and goals provide a discussion of the methodology and limitations of the research, and finally reviews survey results that were conducted to collect insightful feedback from diverse participants. This report is prepared in an acceptable format and will guide the audience through every possible information you expect by the topic detail. The study shows that the demand for an autonomous vehicle in the present world is increasing day by day. The report ends with some findings and solutions to unsolved queries about the execution of autonomous transportation and its applicability in the real world. The author has listed out the literature review regarding this topic to ensure sufficient and relevant informationthrough this report. In the report, figure 1 shows the autonomous vehicle and figure 2 showsthe parking of autonomous vehicles, from that the author knew that it is not difficult to implement autonomous vehicles as public transportation.

From the study and research, the graph shows that most of the people feel safe in travelling the public vehicle and some of the people feel unsafe. And from the result, it was found that almost all people will be safe on the implementation of autonomous public vehicles. This report will guide you through every detail and aspect of it providing relevant references and critical evaluation about it. Autonomous transportation can bring many positive changes in society and create a remarkable impact on technological advancement. The report presents convincing research for the estimation and evaluation of autonomous transportation to be implemented in near future. The views of the citizens regarding autonomous vehicles are collected through a survey providing the trial opportunity to participants. An astute understanding is developed through a comparison of their ideas in the survey and strong concepts are put forward to overcome the acquired weaknesses.

TABLE OF CONTENTS

LIST OF FIGURES / LIST OF TABLES

1. INTRODUCTION

1.1 BACKGROUND

In this evolving world of technology, autonomous transportation is the one with greater potential (Alexandria Sage, 2016). This study is focused on the research topic “Autonomous Public Transportation”. In the thesis, the effectiveness of automated public transportation was analyzed and the view of people to automated transportation. The advantages and disadvantages of automated vehicles are presented in the thesis. Autonomous transportation refers to the transportation system which doesn’t require a driver and runs independently (Edwards, Perrone and Doyle, 2020). This idea can revolutionize the existing transportation system. It can create a different level of technological advancement in the world (Lam, Leung and Chu, 2014). Several new ideas have been approached for the improvement of the transportation system in the past few decades (Yu and Lam, 2019). People have been discussing and working on vehicles that run without fuels using other forms of energy (Yu, Lam and Lu, 2018). They are coming into practice and are giving providing good results. Autonomous transportation can be the goal of this sector (Salazar et al., 2018). The autonomous vehicle does not require fuel, the uses another form of energy like electrical energy. Most autonomous vehicles are electrical. The run with the help of electrical charge cost cheaper than fuel. This idea is focused on new technology usage, professional execution of transport systems, creation of sustainable transportation system, and overall ease of the transportation users and mobility (Adedjouma, Pedroza and Bannour, 2018). The picture of the autonomous vehicle is presented in figure 1. Figure 1 shows a vehicle that can be used for public transportation. Similarly, figure 2 and figure 3 show the parking area of an autonomous vehicle. The autonomous vehicle will be parked in a specific area only.

Figure removed due to copyright restriction

Figure **1**: Driverless vehicle (flexbus, 2021)

Figure 2 shows the parking of the autonomous vehicle. It shows the area where the autonomous vehicle gets parked.

1.2 TERMS AND SCOPE

The study will cover the analysis of autonomous transportation in the public domain, and its perspective among the public. The research will investigate autonomous public transportation in several sectors. The research uses a survey of the general public regarding their view of automation in the transportation sector and will also offer them to try autonomous public transport for their experience and provide their review after they have experienced the service. The ultimate purpose is to get quality output from the participants. The study extends to around 750 participants in a prior survey, then there was a trial which was followed by the post-survey in which around 250 participants took part (reference this!! Zito, Holyoak Flex Survey 2018-2020). So, the experience, and the thought process of these individuals are taken into consideration in this research. Extending from 2018 to 2020 the survey was conducted in Tonsley, Australia to collect the required information which was conducted by Flinders researchers, and they provided the survey results. The survey was a part of the FLEX study. The research includes the historical overview of autonomous

transportation, comparison and contrasting of different theories relevant to the automation of transportation, gap analysis of the research in this topic, and the survey results. The study will cover the response of the participants to the questions like their knowledge about the autonomous vehicle, how often they use public transportation, how safe do they feel when they are put in an autonomous system, their experience, and any change in perception after the ride in the flinders express, and so on. The study consists of the answers from the different age groups (from under 18 to over 65), as well as different genders. There is almost equal participation of males and females in the pre-survey, while the female participants are relatively higher in the post-survey. All the participants are contacted physically near the university area. So, the study analyzes the limited data to produce the results that can be assessed for the entire world.

1.3 IMPORTANCE OF THE RESEARCH

In the growing era of technology, it's necessary to work on the advancement of technologies that are currently being flourished. Autonomous transportation holds huge potential for evolution in the transportation system (Adnan et al., 2018). It can create a worldwide impact and affect the business and engineering sector immensely. The execution of this idea will require lots of dedication and hard work. Deep research is important to pave a path for proceeding toward its establishment. This research will help analyze the whole background and further advancement. This research will explore the upcoming opportunities and weaknesses related to autonomous transportation. Since this technology is already in use, this research helps in determining what further requirements are. This research unfolds advantages, disadvantages, vision, limitations, and suggestions required to take it further than its current position. This research gives clear ideas about every question arising in this field of work. It involves research from several sources and the information is presented with relevant references. The proposed research about autonomous transportation presents a clear path from the project background to the conclusion suggesting ideas for further planning and efficient execution. The research involves the positive and negative impact of autonomous vehicles on the individual, an organization, and on the global level. This topic is a global issue and has several ideas and research works from different parts of the world. This research integrates all of them and presents a piece of well-defined structured information with facts and examples. Research on this topic is a necessity because it has become an

interest in the field of transport systems and engineering (Jarratt and O'Neill, 2002). This approach is possible to create evolution in these sectors and change the whole system of mobility. It has an impact on normal citizens, any organization, and the worldwide transport system. The execution of autonomous transportation can change many existing negative impacts of transportation. It can reduce accidents, vehicle crashes, reduce the usage of fuel and decrease pollution. This proposed research will help to identify the threats and strengths of autonomous transportation. It is aimed at creating awareness about the situation revolving around autonomous transportation.

1.4 RESEARCH PROBLEM

There are various factors to be focused on to fill in the gaps between the present situation of autonomous transportation and the future we dream about it. Driverless cars are supposed to be a very efficient and effective evolution of technology, but it would possibly invite several disadvantages in case of inappropriate execution and technology management (KAMIJO, GU and HSU, 2015). The management system must be strong enough to overcome every trouble on the way of autonomous transportation development. This use of autonomous transportation must be proved trustworthy and secured to the citizens for its application in normal life (van de Poel and Royakkers, 2006). It will take several years and lots of effort to obtain this goal. What factors will help enhance the present condition of autonomous transportation? How will it affect the people within it and the others associated with it? What marketplace will it hold in the process of evolution? How will driverless cars change the pattern of the transportation system? How can manufacturing companies deal with upcoming struggles? What impact will it create on the environment system? How will it adjust in urban areas and with people with little technology knowledge? What quality of this system will attract the public to make it applicable? And what approaches can be taken in case of system failure?

1.5 RESEARCH AIMS

The research aims in exploring details of autonomous transportation. The execution of this idea has taken place in different parts of the world. Such vehicles are already with us. The research is focused on the impact of this system on the evolving transport system, its social values, and its effect on individuals who live within it. The objective of this research work is

to determine the level of authority that should be given to the technology i.e., whether autonomous transportation should be fully automated or remain under some human control. It also analyzes the effects these systems will create after they completely overrule the existing transportation system in the sector of environment conservation, vehicle accessibility, applicability, social acceptance, and digitalization. The research is based on concluding the transportation system's future relating to its impact on social and technological advancement. The idea of autonomous transportation and its execution can bring national and worldwide evolution. Every sector will be directly or indirectly affected by it. The objective of this research is to suggest benefits that can be obtained from autonomous transportation discuss some ways to enhance it address the issues it could create and provide suggestions for the upcoming problems.

The aims of the report are listed below:

- I am doing an investigation in exploring details of autonomous transportation.
- It aims to understand the benefit of using autonomous vehicles in the public transportation sector.
- It also aims at reducing the number of vehicles on the road by encouraging public modes of transportation.
- It aims to explore the application of autonomous vehicles in the public transportation sector.
- The objective of this research work is to determine the level of authority that should be given to the Autonomous vehicle.

Figure removed due to copyright restriction

Figure 2: Parking for AV

Src: https://www.vectorstock.com/royalty-free-vector/autonomous-car-parking-top-view-vector-19425875

Figure 2 shows the parking of the autonomous vehicle. It shows the area where the autonomous vehicle gets parked.

1.6 HYPOTHESES

The hypothesis of the research

- Autonomous transportation will take over the existing transportation system in a few years.
- The world transportation system will be completely different than it is now.
- The vehicles will drive autonomously, and the operators will do their work on programs and codes instead of working in the vehicle.

- This technology will enhance to a limit where it would be trustable and secured to be used by everyone.
- Autonomous transportation will solve different problems like traffic delays, traffic accidents, etc.
- The price of an autonomous vehicle will be more than the average customer is willing to bear.
- The least significant impact of the autonomous vehicle is legality. The majority of the people will be satisfied with the law. (Casley, Adam S. Jardim , & Alex M. Quartulli – , 2013)

1.7 EXPERIMENTAL METHODOLOGY

The research is conducted with the public through a survey approach. The results in the study include pre-and post-surveys that were considered as the baseline for the survey was conducted in Tonsley, Australia to collect the required information which was conducted by Flinders researchers, and they provided the result concerning the survey. The survey was a part of the FLEX study conducted by Zito and Holyoak, 2018.

Besides software like power BI and MS Excel was used to carry out the survey analysis. The data collected from the surveys are then combined by the Power BI and the author obtained the combined results of the survey. The pre and post-surveys are separated by the trial phase where the volunteers were allowed to experience an autonomous transportation system. Primarily, the survey methodological approach was taken to understand certain queries like, how familiar the public are with the notion of autonomous public transportation, how safe they feel in such an environment, how often they use the public transportation system as of now, and so on. The experimental survey approach includes both the quantitative and qualitative data that are collected from the volunteers of the survey. The approach also includes both types of questionnaires: open-ended, as well as close-ended. The research tries to observe the answers of the volunteers, before and after the trial and looks to figure out whether autonomous public transportation could be the notion that can take over the existing transportation in a few years or not.

This methodology paper section explains the use of automated transport systems in Australia for public transportation. Zito and Holyoak, 2018 have conducted two surveys one pre-survey

which was conducted to know how excited the public is for the automated transport and whether they would use it on the daily basis. And another survey was to study the public's response after the trial. It was more focused on the feedback (flexbus, 2021).

Automated transport system refers to a situation in which there is no need for any driver to drive cars for us, it will be fully automatic. The main concept is to eliminate the human interaction with the car as a driver. The vehicle should know where to stop it, and how to reach to destination safely. The study has been prepared on a basis of a survey that Zito and Holyoak, 2018 took that was undertaken to understand what common people think about the whole concept of automated transport and driverless vehicle (flexbus, 2021). Zito and Holyoak, 2018 have tried our best to follow all the small details to preserve the authenticity of the data. The author has followed well-proven methodologies to carry out the research. In this portion of the report, the insights into methodologies, tools, and technologies that Zito and Holyoak, 2018 have followed to carry out the research are acquired.

To conduct any kind of survey Zito and Holyoak, 2018 make some assumptions and based on that assumption's questions are set. Zito and Holyoak, 2018 also made a few assumptions before conducting the survey. Assumptions were important for us because they acted as the base of the entire methodology. For instance, Zito and Holyoak, 2018 assumed that those who are participating in the survey are not physically challenged. And because of thisassumption, Zito and Holyoak, 2018 did not prepare a different form for them, and Zito and Holyoak, 2018 did not prepare to include them in the survey. There were a few more assumptions that Zito and Holyoak, 2018 had made while conducting the survey. The authorhas made the following assumptions

- Participants have experience of such surveys

  Nicholas and Rocc have assumed that participants have already participated in surveys. Zito and Holyoak, 2018 made this assumption because most of the calling population were adults and they must have participated in a similar survey, even if they do not have any private transport.

- Participants have given their genuine feedbacks

The whole survey is dependent on the responses of the calling population. So, if they have lied to us then the author cannot trust the result of this survey. Therefore, to be able to rely on the results of this survey Zito and Holyoak, 2018 must trust the answers of participants. Hence, Zito and Holyoak, 2018 have assumed that the audience has given genuine answers.

- Participants have been using different forms of transports

  Zito and Holyoak, 2018 conducted a survey which was to study the feasibility of the use of automated transport and driverless cars. Therefore, Zito and Holyoak, 2018 focused on such masses who were actively using public or private transport. And in today's world, almost everyone uses at least one of them. Hence, Zito and Holyoak, 2018 made these assumptions that participants were using either public or private transport actively.

- Participants can speak/write/understand English

  The survey was conducted in the English language only. Also, the national language of Australia is English. Therefore, Zito and Holyoak, 2018 assumed that the participants are comfortable with writing and speaking the English language.

Zito and Holyoak, 2018 have used basic research to collect data and to make predictions about the craze issues around automated public transport. Here, Zito and Holyoak, 2018 have also used qualitative and quantitative methods – qualitative methods were used to understand what participants want to say through words. Questions related to qualitative were more person's preference oriented such as whether they would use the driverless car or not. On the other hand, the quantitative methodology is data-oriented, for example, the automatic transport on scale 5 will reduce traffic cognition. The survey and research are performed by visiting the field. The targeted audience of automatic transport is asked different questions to collect the data.

Data that are more data-oriented for example rate on a scale of 5 that automatic transports will reduce traffic cognition. Zito and Holyoak, 2018 have done field research for the survey that is they have physically contacted the targeted audience and conducted the survey. Zito and Holyoak, 2018 have used a random sampling method to collect data.

There are many ways to carry out market research. Zito and Holyoak, 2018 choose a survey as a research methodology under quantitative technique to understand the overall characteristics of the calling population. Zito and Holyoak, 2018 adopted it because quantitative techniques give the audience direct compassion for the result, a larger sample allows reputations of surveys and helps to test your hypothesis. The main purpose of it was to do proper market research for the driverless transport system. Zito and Holyoak, 2018 tried to understand what common community people think about automated transport, how optimistic they were regarding automated public transport systems, and whether they were willing to use them. The targeted population for it was anybody who was an Australian who took a ride on FLEX and was eighteen plus at the time when the survey was carried out. To conduct the survey, Zito and Holyoak, 2018 have used the flex survey data. There were two options whether to conduct it online or physically -it was done physically by meeting every person. The next was to decide whether the survey should be a questionnaire or interview-based since Zito and Holyoak, 2018 had chosen random sampling therefore it would not be very favourable hence, Zito and Holyoak, 2018 decided to make the survey a questionnaire survey. The big disadvantage of it was that the sample size remained below a thousand. Zito and Holyoak, 2018 also used a survey as the qualitative research methodology. Zito and Holyoak, 2018 had prepared a set of open-ended questions and those questions wereincluded in the same survey. In this way, Zito and Holyoak, 2018 have used both qualitative and quantitative approaches. The author used content analysis to analyze the data. It was used to analyze, describe common words, phrases used in the answers.

The questions in the survey were both close-ended and open-ended. Closed-ended questions were scale-based rating, binary answers, choose a single option from a list-types whereas open-ended questions were more focused on understanding persons own perspective in their own words. The questions were kept straightforward and were written in simple English so that people could understand them easily. To keep the validity and reliability of questions, Zito and Holyoak, 2018 carefully prepared them - Zito and Holyoak, 2018 made sure that only relevant questions were asked. The questions were precise and clear.

Zito and Holyoak, 2018 have selected the audience who had participated in similar surveys and fit in the criteria that they had set up. Zito and Holyoak, 2018 had asked a total of 19 quantitative questions and 40 qualitative questions. In total, Zito and Holyoak, 2018 asked

fifty-nine questions to the participants. 746 people participated in a pre-survey which was conducted before the trial having a ride on FLEX and 239 people took part in the survey which was conducted after the trial having a ride on FLEX. After the survey, the very next job was to analyze the data that were collected in the survey. But jumping directly to the analysis was not possible since Zito and Holyoak, 2018 used the survey as the research methodology. For that, Zito and Holyoak, 2018 had to process the data before the author could work over the data. The data processing step was important because the author had to filter out blank data and he had to set some outliner outliers. There were some optional questions so they may not be filled in. To process the data, the author used the descriptive statistics method for qualitative-quantitative survey questions to process it. Using the descriptive technique author calculated the mode, average, frequency of collected data was calculated. It summarized the data very concisely and mathematically. Qualitative data consists of language and not just numbers like in quantitative data therefore to process it, the author had to understand common words phrases and combine them to form meaning. The author had to use textual analysis to be able to process a huge number of responses. The author used the content analysis method as well to analyze the responses to qualitative questions. Content analysis is a research method used to identify patterns in recorded communication. To conduct content analysis, the audience systematically collects data from a set of texts, which can be written, oral, or visual. Content analysis helps in marketing and market research besides. It helped me in many ways such as – it helped us to find correlations and patterns in hypothesis, helped to understand the intentions of calling population, helped us to identify if the data was biased or unbiased, it also helped in analyzing the outcomes of the flow of information provided by the calling population through responses. The following advantages of content analysis made us follow it in the process –

- The author could conduct content analysis any time if the author has sources whenever the author wants because it is highly flexible.
- Content analysis is usually transparent and replicable because it follows a systematic procedure that can easily be replicated by other researchers making the result highly reliable and trustworthy
- The researcher cannot influence the results

In this way, the author carried out the processing of the huge number of data which consists of both quantitative and qualitative data and then he analyzed the data using content analysis to visualize data author used Power Bi software.

After collecting data and feedback, the author analyzed them. As the author has stated above that he has two different forms of data -qualitative and quantitative. Since, qualitative data are easy to visualize authors have platted different graphs and charts to study the data like pie charts, bar charts. Author categories the data based on gender, age groups, their preferences. For an instance, the author has used a bar chart to categorize data according to age groups – for instance, the author has grouped the data based on people of age grouping under 18 years. 18-24 of years, 25 to 34 years, and so on so forth till people age grouping 65 or more ageing. In this way, the author knew the average age of the audience who took part in our survey. the author has analyzed the data separately for pre-survey and post-survey.

Analyzing the data was not easy, the author used a few tools that helped us figure out the results author used Microsoft Excel to store the data, pdf then these data were used to draw different charts. The author was able to perform mathematical operations, he was able to use data visualization tools to draw different charts and figures, Microsoft's Excel let him print reports as well which ultimately help our team to understand the results. Moreover, the author has used Power bi – a tool that is used as a business analytics tool.

There are some limitations of our research methodology, some of them are listed below –

- Could not include a physically challenged audience

  Zito and Holyoak, 2018 were not able to include persons who were blind or was deaf because Zito and Holyoak, 2018 could not prepare themselves to include them in the survey. Zito and Holyoak, 2018 might have to prepare questions separately for such an audience which they could not do.

- Could not include people across the country in the survey

  The survey was conducted with only selected persons. Zito and Holyoak, 2018 could not include a large mass covering the entire Australia because of fewer resources and time.

In this way, Zito and Holyoak, 2018 researched by following scientific and already proven methodologies, tools, and techniques so that the results and outcomes of our research will be reliable and authentic.

1.8 STRUCTURE OF THE STUDY

The structure of the study comprises a literature review, methodologies of the research, results, discussion, and conclusion. These sections include specified information on the topic. The literature review includes the historical background of the project and a comparison of methodology and approaches. Scopes and limitations are discussed in this segment together with an evaluation of areas of weaknesses and strengths.

Stating the limitations and knowledge gaps is also shown in the literature review. The literature reviews are extracted from trustable sources and demonstrated with relevant self-knowledge. The research mentioned in the reference is appropriate for the deep understanding of stated information. The methodology explains the process of research carried out which includes applied knowledge, evaluation, research sources, and the assumption formulated during carrying out the project. It gives the vision of when, where, and how the research was performed. The details of the types of equipment and experimental procedure used in the research process are also justified on methodology.

After the well-defined explanation of methodology, the result of the experiment is mentioned. The result section presents the key findings of the research in an understandable view with the use of charts, diagrams, and graphs. The results presented are summed up with data to make it more convincing. Similarly, the discussion section provides a critical evaluation of the data from the findings. It involves cognitive ability and evaluation. This section provides the debate between different possible outcomes and assists in finding out the best further approach. Finally, the conclusion section contains the summary of the main findings, discussion, and suggestions. It sums up the whole research objective and provides answers to the research problems and questions. The conclusion statements are relevant to the research objective, aim, findings, and discussion.

Figure removed due to copyright restriction

Figure 3: Parking for AV

Src: https://lance-eliot.medium.com/parallel-parking-ai-ho-hum-challenge-for-driverless-cars-but-maybe-not-a28b75babbd7

Figure 3 shows the parking of the autonomous vehicle. It shows the area where the autonomous vehicle gets parked.

2. LITERATURE REVIEW

2.1 HISTORICAL BACKGROUND

Autonomous transportation, or driverless vehicles, has been a hot topic in the field of technology as well as in the automobile sector (Kaur and Rampersad, 2018). With the increasing interest in automation, the world is robustly changing into the implementation of the concept to automobiles/vehicles. Currently, electric-powered vehicles are getting more and more popular (Katona and Juhasz, 2020). Since the early 1920s, there have been frequent experiments on self-driving cars. The 1920s marked not only the boom of the population but also marked the growth in the reliance on automobiles (Tom Sitton, 2001). An electrical

engineer from the U.S. Army, Francis P Houdini, established a firm called Houdini Radio Control, which experimented with a radio-controlled “American Wonder” on the streets of NY City. The early 1920s initiated the concept of remote-controlled assets that could be implemented for transportation purposes.

Moving onto the 1930s, the earliest depiction of the automated cars where they were guided by the radio-controls, and the cars moved through the electromagnetic fields in the roadway. This was exhibited by the then renowned designer Norman Bel Geddes in his creation Futurama (Christina Cogdell, 2000).

The real-world implementation of autonomous transportation was during the 1950s. A company named General Motors, from the 1950s to the 1960s, launched a series of guided cars called firebirds which would allow the cars to run over the automated highway. In the meantime, RCA labs pioneered the development of autonomous cars (Weber, 2014). In 1953 they created a miniature car that was guided by the wires arranged on the floor of their lab. This idea was enough to trigger the experimental mindset of the then Department of Roads of Nebraska, which tried the automated miniature car in the real-world highway setup/installations (scitepress, 2021). Then in 1954, General Motors built a couple of car models which were fitted with the tools and equipment to simulate the automatic steering, brake controls, along acceleration controls of the vehicle. But this idea grew up in its feasibility and in 1957, a complete system was demonstrated by the RCA labs along with the help of the Nebraska State government. The experiment was carried out on a public highway within a 400-foot strip length of roadway. The experiment was carried out with the help of detector circuits, which were buried under the road pavement, to guide the car. These detector circuits were used to check the presence and velocity of the car moving over it. The best-case experiment was carried out in 1960 on June the 5th when the RCA lab allowed the reporters to drive their cars for the test purpose. By then it was expected that these cars would be commercialized by 1975 (Joseph C., 1960).

We can date back to the 1960s, to get track of the electronic embedded devices' entry in this field. (ben Lutkevich, 2021). Ohio State University ran a project to create driverless cars, which they stated would be ready for the public roads by the 15 years from 1966. Similarly, during the same period, UK’s Transport and Road research lab-tested Citroen DS, a driverless car,

which was guided by the magnetic cables buried underneath the roadway (Yan, 2015). This was tested in an 80 miles/hour track, and the results were astonishing, as they were found to be more effective than the ones that were man-driven by people in terms of the constancy in their speeds and the directions provided by in any weather conditions. This project had the mission to be repaid by the end of the century.

Later, in the early 1970s, Stanford came up with its Artificial Intelligence Lab Cart, which was a small robot fitted with wheels (TAYLOR KUBOTA, 2019) first the vision-guided van was the Mercedes-Benz robotic van, which was tested to gain a 39miles/hour of speed on the streets in Munich, Germany in a traffic-less condition testbed with no other vehicles. Amused with this success, later (Exceptional Unconventional Research Enabling Knowledge Acceleration) EUREKA carried out a Prometheus Project to create autonomous vehicles (from 1987 - 1995) (DBpedia, 2021). By utilizing the Lidar, autonomous robotic control, and computer vision DARPA instantiated a Land driven Vehicle project in the US during the same decade. The Defense Advanced Research Projects Agency (DARPA) is a research and development arm of the United States Department of Defense in charge of developing future military technology.

The contemporary base or the concept of autonomous vehicles was first given a try by Carnegie Mellon University in 1989 when they used neural networks for steering and controlling autonomous vehicles (Sproule et al., 1998). In terms of legalization, US congress first passed the bill regarding Automated Transportation in 1991. In this bill, it was instructed to present the automated vehicle along with the highway system required for it by 1997. The Federal Highway Administration along with some automobile companies demonstrated extensive series of automated vehicles including cars, buses, trucks, etc. in 1997, and invited the other car-making companies for their system's demonstrations. In that demonstration now big companies like Toyota and Honda participated.

In 1994, VaMP and Vita-2 (twin robot vehicles) were tested for 620 miles roads on a three-lane highway having normal traffic with speeds up to 81 miles/hour (Jeff Sorensen, 2021). However, this test was checked intervened at times by human interventions. In the same period, Carnegie Mellon University and S-class Mercedes Benz developed and tested semi-autonomous cars with 98.2 per cent and 95 per cent autonomous nature respectively (Daily et al., 2017). Later in 1996, Albert Broggi (University of Parma) instantiated a project ARGO,

in which his vehicle ran with an autonomous of 94 per cent. This vehicle used a couple of low-cost black and white video cameras, and the stereoscopic vision algorithm for getting information about its surrounding environment. All these practices and experiments of creating autonomous vehicles for transportation were being tried and tested by several companies, and universities.

In 1999, the first driverless vehicle: Park Shuttle was launched (Shoemaker and Bornstein, 2000). This automated people transporter used the magnets (the artificial reference points) that were buried in the road surface to validate and verify the position of the vehicle. In the same year couple of pilot projects were started in the Netherlands, which carried the public members. These vehicles were fully autonomous and did not require any safety driver or, steering wheels on the vehicle. Thereafter we entered the 21st century. It is stated that the US-funded three different efforts from the military side, Demo I, II, and III, out of which the Demo II project, came up with the ground vehicles which could transport miles in the off roads, by avoiding the obstacles in the Route (Katona and Juhasz, 2020b). These vehicles used the multimode perception capability. It was based upon stereo vision (by using the CCD video along with the FLIR sensors), laser scanner, and remote sensing imaging radar. DARPA has been running challenges for the experimental engineers to come up with autonomous vehicles to solve the issues of traffic congestion and accidents, since 2004. The Darpa Grand Challenges did more than drive the invention of autonomous vehicles—they fostered a community that now leads the industry (Davis, 2017).

January 2006 was the date on which the UK's Foresight think tank and the Royal Academy of Engineering came up with the research that RFID –tagged automated cars will be running on the roads of the UK by 2056 and driverless trucks by 2019 (Engholm, Pernestål and Kristoffersson, 2020). In this race of developing autonomous vehicles, Google also introduces its first vehicles got enrolled in 2009(Alexandria Sage, 2016). Historically, many top companies OEM vehicle companies: General Motors, Volkswagen, Audi, Ford, Mercedes Benz, Toyota, Volvo, Nissan, Volvo, and so on are carrying out the process of developing and testing the driverless automobile system (ben Preston and Jeff S. Bartlett, 2021).

By 2010, a research vehicle Leonie became the first licensed autonomous vehicle to run on the German streets and the highways (Allgemeine Informationen, 2019). Similarly, in 2011,

two driverless cars were developed by the Freie Universitat Berlin, which could drive in through the inner-city traffic of the city by detecting the traffic lights and the roundabouts(Freie Universitat Berlin, 2011). Moving ahead, Nevada passed a bill for autonomous cars in 2011, and in 2012 Google's self-driving cars were tested in Las Vegas. With time many states and countries have now given the license for the testing of autonomous vehicles. (Paul, College, and Thomas, 2021).

Tesla came up with the update on their software and equipped their car with the systems allowing autonomous driving. They also claimed that their autonomous vehicle is aligned with the current regulations of the states. The Autopilot of Tesla is not yet fully autonomous as it cannot identify the pedestrians and the cyclist in its path. Google, in July 2015, announced that the automated vehicles in the test run faced 14 minor accidents. Tesla claims it has all the sophisticated hardware systems to guarantee safe automated driving. It uses 8 cameras, 12 ultrasonic sensors, a radar facing in front of the car, and sophisticated analytical processing. Walking through the history of automated transportation, this concept was under scrutiny when on 2016 May 7th a driver was killed in a crash when he was driving in the Autopilot mode of the Tesla Model S electric car. If we look at the public service utility of automated cars, Singapore since 2016 has launched the self-driving taxi portal and service. Similarly, Switzerland is the first country to run the world's first electric automated bus service for its public (Wicki and Bernauer, 2018).

In recent years, there has been the formulation of the laws regarding automated transportation by the EU and Automate Lane Keeping System regulation in 2020 (European Commision, 2019). Several countries have launched self-driving buses publicly (Thor Benson, 2020). The recent ones are the Honda's Legend Hybrid EX which was provided with the safety certification from the Japanese government. And, German transportation minister has announced that by 2022 Germany will be the first country to automate vehicles in the streets (DPA, 2020).

The idea of Autonomous transportation has been an attention-seeking topic to many transportation companies, engineers, and programmers all around the world (Choi and Ji, 2015). There is various research being carried out on this topic (Lin et al., 2020). The new robotics and communication technology has influenced our lifestyle and it includes the

transportation sector too. The rising vision of autonomous transportation will possibly decrease road accidents, vehicles crash, fuel consumption, air pollution, traffic jams and enhance the transportation system maintenance while making it more accessible (Liu et al., 2019). Even after having lots of benefits, the idea has not taken a large-scale production market due to the high costs. This notion is being worked on to initiate applicable use (Bagloee et al., 2016a). Automated transportation is seen on the highways of the US and many other nations in the world already. The evolution of this system is widely being discussed. The focus is on future impacts from this method of transportation. The authority that the technology should get for the execution of this idea is an important topic to be discussed, it can either remain under some human control or fully function alone (Hancock, Nourbakhsh and Stewart, 2019). Such transportation can be commanded to deploy medical kits, oxygen masks, and satellite phones in places close to the victim. They lack location accuracy to some extent. The autonomous vehicle has the potential to cover up to 40% of the transport driven in Europe by the year 2030 (Bernard et al., 2011). After the year 2040, the new cars sold in urban areasof the United States will be autonomous cars over 70%. Autonomous transportation can be the backbone of sustainable mobility solutions (Salonen and Haavisto, 2019). This shows the extending future scope of autonomous transportation.

2.2 ADVANTAGES/DISADVANTAGES

Autonomous transportation offers various benefits to an individual or for a public transport purpose. It is a sustainable mobility solution because it carries many passengers which otherwise would have individual vehicles causing more fuel consumption. It achieves sustainable mobility solutions by using the amount of energy consumption. The execution of autonomous transportation on large scale can lead to safer roads, less congestion, reduction of road accidents, vehicles crash, pollution, and fuel usage (Fagnant and Kockelman, 2015). Autonomous vehicles are easily accessible as the schedule is fixed and are found at the bus stop at the exact time it is scheduled. These vehicles can be a great tool for handicapped and old-aged people who can’t drive on their own. (Bagloee, Madjid Tavana, Mohsen Asadi , & Tracey Oliver , 2016) This evolution can help to reach the goal of technology in transportation systems by providing sustainable means of transportation. The objective of the application of technology is to reduce human work by replacing it with autonomous technological approaches. The concept of autonomous transportation ensures less human work and

efficient outcomes (Gavanas, 2019). Results from the trial in Berlin-Schöneberg, Germany indicated that the acceptance and use of autonomous vehicles in public transport is influenced by their perceived usefulness, ease of use, and social influence. (Nordhoff et al., 2017) These vehicles benefit in many ways than the existing transportation system does.

78 per cent of Americans report that they fear riding in an autonomous vehicle (Salonen and Haavisto, 2019b). They don't feel safe to even share the road with a driverless vehicle. The trust issues generated by it can be regarded as its disadvantage. The knowledge gap has created this problem. The concept of such a transport system not being reliable has formed negative ideas about autonomous transportation (Butler, Yigitcanlar and Paz, 2020). The technology can't ensure proper security and autonomous vehicles are vulnerable to being hacked. (Saeed Asadi Bagloee, SpringerLink, 2016) The hackers can create great destruction by taking over the control of such a transportation system. This can be harsh and disturbing; the hackers can also seize the personal information and monitor the details of the owner (Varian, 2002). The autonomous car requires expensive parts such as sensors, modified vehicle parts, and software to be operated inside it and hence are very expensive to be afforded by normal people. This disadvantage is estimated to be reduced in 10 years by applying affordable tools and making them reasonable for normal people. This advancement can affect the economic rate of the nation as every task is performed by the machine which used to be an employment opportunity for people. The drivers need to seek new jobs for their living. This literature review on automated transportation is primarily revolving around self-driving vehicles, and the evolution of automated vehicles, rather than the public transportation system. There was not much literature on the automated vehicle that is used for public transportation.

2.3 KEY THEORIES AND METHODOLOGIES

Several authors, theories, and methodologies have been put forward in this almost century-long history of automated public transportation. Major theories that are used to guide the concept of driverless vehicles include, the Theory of Planned Behavior (TPB), Unified Theory of Acceptance and Use of Technology (or UTAUT), The Diffusion of Innovation Theory (DIT), the theory of Traffic Flow in the automated Highway systems, and several of other machine learning theories that provide the no-human basis for the vehicles to run. Several

methodologies can be used to understand and implement automated transportation. Generally, the vehicles we run are with no automation at all, and everything depends completely on the derive himself. Some of the vehicles have been developed which require the driver's assistance but some features are automated. Similarly, partial automation and conditional automation are also major implementation methods, where almost half of the functionality is automated, or the automation is based on certain conditions. Very few vehicles have been able to achieve high and full automation, which provides complete automation services.

There are automated guided vehicles (or AGVs) that have been used for material handling purposes in the manufacturing systems and the warehouses. The general methodologies in automated transportation can be classified into mathematical (based on exactness or the heuristics values), meta-heuristic methods, simulation-based studies, and artificial intelligent supported approaches (Fazlollahtabar and Saidi-Mehrabad,2015). One of the famous methodologies for automated driving is Consensus Safety Measurement Methodology (NIST, 2019). Similarly, the Quality assurance methodologies are used for the implementation of the automated vehicle, which is achieved via simulation-based validation and verification approach(Wotawa et al., 2018). Historically several techniques and methodologies based on mathematical analysis and simulation-supported trials have been performed to bring realize the automated transport system among the public and serve them. The methodologies that combine the empirical experiments, as well as the theory-based models, are increasingly used to construct the fundamental working diagram for driverless vehicle traffic (Shi and Li, 2021). The early stage of driverless transportation was marked by the paper and calculation-based theories, however in recent years the practical development and testing of the vehicles have been done predominantly, and the private sectors have been implementing the theories and methodologies proposed in the past.

2.4 CONTRASTING METHODOLOGIES AND APPROACHES

Understanding the several methodologies and theories is the key to the successful implementation of the automated vehicle. One of the earliest theories was the Theory of Reasoned Action, proposed in 1980, which currently is known as The Theory of Planned Behavior. The approach suggested by this theory is used to predict the behaviour of an

individual to get engaged in a particular activity at a given time and place. This theory describes and illustrates the ability of any individual to exercise self-control. The behavioural intention of an individual is the key asset of this theory. This approach predicts the outcome of certain behaviour and provides a subjective evaluation in terms of the impacts caused by those outcomes/results. The behaviour of the vehicles and the road conditions can be predicted with the help of TPB. Actual control of an entity over its behaviour is illustrated through six different constructs: attitudes, behavioural intention, subjective and social norms, perceived power, and behavioural control. TPB however is limited in the way it assumes that the entity has gained the resources to perform a behaviour of desire, rather than considering the intention. The distinguished variable factors like a threat, mood and past experiences are not considered either. The behaviours are treated as a linear decision-making procedure and have no considerations for the changes with time (Ajzen, 1991). The other theory, the Unified theory of acceptance and use of technology explains the intentions of the user using the information system. This overcomes the limitation of the previous theory of planned behaviour, as it considers the intention besides the desire. The key constructs of UTAUT are the performance and effort expectancy, influence from the social factors, and the facilitating conditions. The facilitating condition construct is the determinant of the behaviour while other constructs are the usage intention or behaviour determinant. The UTAUT is a collage or the consolidation of the constructs from other previous models. Earlier approaches like the theory of planned behaviour, theory of reasoned action, the motivational model, technology acceptance model, the model of the PC use, and so on, explained the usage behaviour of the information system. Despite it being the consolidated version, according to Bragozzi, the model is bound to create a chaotic situation as it revolves around 41 of the independent predicting intentions variables and around 8 of the independent predicting behaviour variables. The automated transportation ideas have been historically based upon the theories that explain the why, how, and the rate at which the technologies can spread. The conceptualization of automated transportation into the commercial markets was analyzed using the Diffusion of Innovation theory. Diffusion is the spread of technology and innovation over the period. The distribution of the innovations is defined by some major elements: the idea itself, the channels that are used to communicate, the timing of the innovations, and the social aspects that influence the spread of the technology and ideas. One of the drawbacks of the diffusion theory is the quantification complexity, and the innovation bias (Rogers, 2003).

The latest of the theories that are more significantly explain the interactions among the vehicles, their mobile components, and the infrastructure, mathematically is the theory of traffic flow in automated highway systems. The infrastructure comprises the elements that are needed for the operational tasks, like control devices, markings, and so on. These theories are indispensable for every model as well as tools that are deployed for the design and functional operation of the streets and the highways. In the 1930's the initial study for the traffic flow started, which included the probability theory application for describing the traffic in the road (Gartner, Messer and Rathi, 2008). Traffic flow theory guides the activities such as entry, exit, moving forward, and so on. A flow model is created that depicts the space and time occupancies of the vehicle engaged. This theory provides the base for the study of traffic congestion, Traffic Management Center feedback, and traffic rules.

The most significant development in the field of automated vehicles has to be machine learning algorithms. These algorithms do gather the data from its surrounding environment with the help of a vision camera, or other sensors attached. These data are analyzed and interpreted to decide what to do next, what will the next move? Such ML algorithms allow the vehicles to learn from their experience and can outperform human beings.

2.5 SCOPE AND LIMITATIONS OF THE RESEARCH

This research runs over the huge potential and scope of automation in the field of public transportation. Whilst the benefits of automation in public transport there are severalimpacts of the system on the behavioural aspects of the society as well. I am doing an investigation into the most efficient use of public transportation. The scope of the research islimited to analyzing the survey for the years 2018 – 2020 as the main dataset and the literature review. . The survey and research, which were conducted using the prescribed methodology, have given us a greater understanding of the autonomous transportation system. Zito and Holyoak, 2018 gathered public feedback on the transportation system as wellas their preferences. Zito and Holyoak, 2018 held trial sessions to examine their reactions andunderstand what they liked and didn't like about the experience. For the pre-survey, a total of 747 replies were obtained. The amount of data and the precise datasets for the research purpose need to be collected within a limited period. The major constraint on the project research is the sample size taken. As well there is a constraint of time frame to collect and

summarize the datasets to be used for the analysis. Flex bus project may have common experiences from a narrow sphere of thinkers, a large number of diverse volunteers may have been considered. More importantly, the geographic location of the participants has an impact on the research results, as some may have a greater understanding of transportation automation while others may be completely oblivious of the notion. If the selected mass of individuals belongs to either of the categories heavily in a small sample size, the results will be skewed.

The duration for such a project needs to be spanning several years to understand the gradual growth of the interest in the field of the upcoming generations (Yan, 2015). Another parameter that weakens the research somewhat is the geographical constraint. Focusing the evolution and surveys on the Australian individuals and some belonging to the US prevents from gaining vast insights on the research concept. But it should be considered the research was carried out based on the minimal budget allocation. The research team was not able to reach out to different locations and collect and get access to different and diverse literature and articles. The statistical hypotheses that provide the results based on the smaller sample size are found to be less accurate as compared to the ones based on the larger datasets(Biau, Kernéis and Porcher, 2008). The safety parameter is included in the project research, along with other parameters like user experience, travel time, fuel efficiency, personal perception, knowledge, and so on. Autonomous vehicles have been used increasingly in recent years.

2.6 EVALUATING AND CRITIQUING THE LITERATURE

The main research problem is to understand the history of automation in public transportation and analyze the current scenarios of its acceptance among the public for public transport applications. The paper depicts investigate the research made on fully autonomous transportation in the current lifestyle of the world currently. The areas and the sectors where automation can be regulated are studied. Another research scenario is to understand the laws and legal conditions of autonomous vehicles.

The research is carried out to analyze the state of autonomous transportation in the evolving world, in terms of measurement, achievability, relevance, and time-boundary. What are the changes that are increasing with time and influence the transportation field? The purpose of the research is planned to be achieved via well-set secondary research based on the aims

described. A systematic literature review is the main basis for the study. It is equally necessary to get understand the way technology, social aspects, and legal considerations are changing to incorporate autonomous transportation. To carry out such extensive research author analyze the probable merits and impacts of the autonomous transportation system. The research presents the measure of the change that this system rings into life, as in it brings about successful or failed results. The responses of the participants are taken as the motivation for the research. I am doing an investigation to evaluate the way autonomous transportation can be implemented or applied. The study focuses on public transportation, where the locals can move from one place to another through fully automated vehicles. The degree of application of this system is set to be measurable.

The well-specified boundaries within which this research was carried out were the time-bound and the participant's selection. As stated earlier in the review the participants selected for the survey were limited by the regional, geographic, as well as age-group factors. Similarly, the limited weeks were allocated to carry out the survey and prepare the study. These factors have significantly impacted the result of the research. Likewise, the budgeting of the research was minimal for the computer/laptop, travelling, participant refreshment. The monetary expenditure was $900 in the research phase.

The time frame this research covered was of 52 different weeks. The objectives were divided as follows:

1. Analyzing the present world status of autonomous vehicles or transportation.

The collection of data for this purpose was done in the first week of the research timeline. Then the analysis of the collected data was carried out in the second week, followed by the findings and conclusions in the third and the fourth week. So, data collection is limited by the timeframe of only one week. Zito and Holyoak, 2018 could have extended and invested more in the data collection, as the statistical and ML models require a large amount of data for the analysis purpose.

2. Evaluation of the benefits of the proposed system implementation

The data collection to list the benefits of the researched system was done for the fifth and sixth week of the research timeline. Here, Zito and Holyoak, 2018 have increased the period to gather more precise information. For the analysis weeks, seven to nine were utilized. Relatively, this objective was fulfilled by extending the timeframe than in the first goal.

3. Evaluation of the autonomous transportation application

A single week was allocated for the collection of the data for this objective. The remaining five weeks were utilized for summarizing the findings, and conclusions, and combining the findings of all three objectives.

Based on this research, automation can be considered still a new concept among the users, and the risks of this system are significant if we look into the severity due to crashes (Saeed Asadi Bagloee, springer , 2016). Though more people are informed about automation systems, and they agree to implement such a system, it is still a matter of concern when it comes to the security and reliability aspects. There is a common agreement that automated public transportation oozes has huge potential to enhance the efficiency of the roads and highways, minimize the accidents that are resulted due to the traffic on the road, boost productivity, and overall reduce the hazardous impact on the environment in the process(Bagloee et al., 2016b). Certain disagreements arising in this field are regarding the topics of safety, chances of the automated system being hacked easily, unemployment issues, and perhaps the pollution increment due to the heavy use of such vehicles as they are simply the driving tasks. Similarly, other general issues include privacy concerns, data protection, as well as autonomy, and so on (Ryan, 2019). Despite the continuous controversy and debate around the topic of self-driving buses, cars, etc. the evaluation on the potential of the technology is ever-growing. Still, no research or literature suggests that there will a level 5 automation until up to several decades. The vehicle performing all the automated tasks is seemingly not possible as of now.

The research evaluated the legal, social, personal, economic, as well as ethical issues that have prevailed in the past years, and that may surround the automated transportation systemin the coming years. Post some of the highly publicized deaths, that was caused due by the failure of automated cars, for instance, the Tesla S accident of 2016, people have been sceptical about the successful utility of automated transportation, as they do not feel safe enough to leave the safety of their life and health on the hands of a machine which is highly susceptible to the technical / hardware/software / overall system failure (Brown and Baressi,2016). As public transport is used by many people and the people does not want to feel unsafe. Even a small malfunctioning will result in death or a severe accident. Concerns are also raised regarding the safety of pedestrians, as the literature suggests that the automatedcars used algorithms that possessed a certain level of bias towards dark skin colour. In recent

years it has been found that the algorithms have been made better to a certain extent, but still there prevails another danger of such automated vehicles being more risk-prone when they drive for longer miles, versus the vehicles which are driven for longer miles by a human driver (Johnsen et al., 2017). Mode transition has been a major issue, historically, in the field of self-driving vehicles. Such vehicles find difficulties in tackling the sudden distractions, maintaining situational awareness, and performing high workloads while taking over other vehicles.

Major disagreements on this topic arise in the technical aspects, as there is a heavy chance of the system being hacked, manipulated, and used for mischievous purposes (The Economic Times, 2021). More underlying issues are data and vehicle security. In the past it was found that many manipulative activities did happen with such systems, so later the manufacturers and engineers planned to turn back the system to a stopping position (which will be a safe state for the automated vehicle), and override the individual tasks running within the system, in case any suspicious activities were detected. The current stakeholders of the automated transportation demand for the transparent use and implementation of Artificial Intelligence (AI), and this demand has slowed down the development process. The vehicles need to have a good hardware and software update facility, and for which they need to have access to the 5G technology. The automated vehicles need to be populated with information such as their precise position at any given point of time, and the information on their surroundings (Kumar, Gollakota and Katabi, 2012). For this purpose, automobile companies and the ICT, giants have been investing heavily.

2.6.1 ADVANTAGE OF LIKERT SCALE SYSTEM

The system of the Likert scale is used mostly by the surveyor to know the opinion of the people by providing the different options. The same system is applied here. The supervisors have provided 5 options to the people and the people will provide their opinion out of these5 different options. This is the universal method of data collection and it will be easy for the surveyor to collect the data and it will be easy for the people to provide their answers. It will be easy to make the graph, create a conclusion with this method. (SmartSurvey, 2018)

2.7 LIMITATIONS

The policies of the government have been one of the limits of implementing self-driving vehicles, and much more so of making them public. One of the limitations of the implementation of the self-driving vehicle and more so of making them public has been the policies and the government. The technological protocols of the manufacturing companies need to align with that of the government (NAP, 1993). The policies and the regulations in place have been too stringent that is blocking the development of the autonomous transport system. Transportation automation is heavily affected by economic as well as geographic considerations (Muro, Maxim and Whiton, 2019). The cost that is required to develop and implement such a mode of transportation needs to be high (Groover, Mikell, 2002). As well as the infrastructures that are required to support them are high-cost incurring (Bösch et al., 2018). In addition to the physical features and resources, laws, and policies to adjust with automated transportation needs to be adopted by the nations (National Conference of State Legislature, 2018). The local attitude of the people in different countries also affects automated transportation growth globally (NAP, 1988). Economic stability is key for the broad flourishment of automated transportation.

The main disagreement around the automated transportation system is the scenario of jobs, and employment it creates if it gets accepted in a broader spectrum (SMITH and ANDERSON, 2014). Job security will come under threat. The transportation system includes public drivers to delivery drivers, anyone who depends on the driving to be their profession, the traffic, and others. The job that deploys this all manpower will be replaced by automation in the transportation sector. According to the literature, there have been some protests and some petitions made by the transport unions, and workforces against the implementation of automation in the transport field. Several accidents related to automated transportation in the past have created negative publicity among the mass population. So, providing trust against the concerns like hacking crashes, and others have become very significant. Since automated transportation is a relatively newer perception, it has been hard to accept in a flow. The data collected by this system needs to be safe and secure. Talking about acceptance, several articles suggest that the road traffic and transportation legalities of different locations vary significantly, which also can act as an underlying barrier for automated transportation.

This literature review was carried on several other case studies, articles, theories, etc. The studies and research have been carried out to date, but certain concepts and ideas have not been explored as extensively as they could have been. Automated transportation is expected to achieve a higher level of automation in the upcoming times. Less simulation and the driving simulator are expected in the SAE level one automation in transportation. Similarly, several questions are prevailing about the effects of the traffic systems, which are to be answered. These questions can be like, the utility of the traffic policies, road management, obstacles detection in the traffic in the automated transportation system. It has been tough to evaluate and predict the effects of the higher level of automation because the transportation system is just a simulation and the vehicles are not yet on the roads, which means there are just the analytical results presented in front of us, and no exact or real-time scenarios. There is still key research to be done in relevance to automated transportation, along with the structures of the traffic system, and the authorities that may govern and regulate it (M G et al., 2016).

2.8 SAE LEVEL OF AUTONOMOUS

An autonomous vehicle can drive itself from a beginning stage to a foreordained objective in autopilot mode utilizing different in-vehicle advances and sensors, including versatile voyage control, dynamic directing, non-freezing stopping mechanisms, GPS route innovation, and lasers. According to a methodology created by the Society of Automotive Engineers, vehicle autonomy is frequently classified into six categories. (SAE). Level 0 - no automation; Level 1 - hands-on/shared control; Level 2 - hands-off; Level 3 - eyes off; Level 4 - mind off; and Level 5 - steering wheel optional are the SAE levels.

SAE Level 0: Most vehicles out and about today are Level 0: manually controlled. The human gives the unique driving assignment even though there might be frameworks set up to help the driver. The SAE (Society of Automotive Engineers) level system is a classification system for passenger and commercial vehicles. SAE level 0, can also create a huge impact on public transportation systems. In public transportation, this level is necessary as it makes driving safer and more secure. A model would be the crisis slowing down system since it doesn't drive the vehicle, it doesn't qualify as robotization. Autonomous vehicles are self-driving anddo not rely on a human's mental state or conduct. Since the public transportation industry isalways in the focus of much discussion and controversy. Level 0 depends totally on the driver

to play out all longitudinal and sidelong errands, like speed increase or controlling. The driver is in finished control of and liable for the demonstration of driving. While not highlighting any type of computerization, the framework will give a few alerts. These could be, for instance, path flight or forward crash admonitions. As they just illuminate the driver through alarms and notices, they fall under Level 0. As a result, it adheres to a set timetable and itinerary while maintaining the specified pace. It will also be automated, and every safety precaution will be taken to decrease the number of collisions.

SAE Level 1: Level 1 implies hands-on or shared control. We can further elaborate it as Driver Assistance. Since public vehicles have a rest and motion phase continuously there is a need for a much control system in running and stopping areas This is the most minimal degree of automation. The vehicle includes a solitary computerized framework for driver help, like controlling or speeding up journey control. Versatile journey control, where the vehicle can be kept at a protected distance behind the following vehicle, qualifies as Level 1 because the human driver screens different parts of driving like directing and slowing down. At this level, the vehicle just controls or mediates to control the speed or guiding of the vehicle, however not both simultaneously. While the driver can't surrender control of the vehicle, Level 1 frameworks help for certain driving assignments. An illustration of such a work is versatile voyage control, where the vehicle will guard a set speed and distance between the vehicle ahead via consequently applying the brake when traffic eases back and continuing its unique speed when traffic clears. Street traffic is the cause of concern for all manually controlled vehicles so an autonomous system can aid that as well.

SAE Level 2: level 2 is illustrated as hands-off. This level is meant for a partial driving assistant or partial driving autonomous. One of the clearest examples of this level in public transportation is the increased automation when entering or exiting a highway, changing lanes, or merging into one. Climbing to Level 2, the driving errand is divided among the vehicle and the driver. The vehicle for the most part assumes control over the two essential driving elements of sidelong and longitudinal control. This can be accomplished, for instance, by consolidating versatile voyage control with path keeping. For this situation, the driver is permitted to briefly take their hands off the wheel. In any case, the driver needs to have consistent situational mindfulness and screen the general climate. The vehicle can handle both directing and speeding up/decelerating. Here the robotization misses the mark

regarding self-driving because a human sit controlling everything and can assume responsibility for the vehicle whenever. Tesla Autopilot and Cadillac (General Motors) Super Cruise frameworks both qualify as Level 2. When changing lanes, for example, a Level 2 system would simply stay in the same lane, even if it was authorized to overtake a very slow vehicle.

SAE Level 3: Level 3 is given as Eyes off. It is further illustrated as conditional driving automation. Level 3 vehicles mainly are composed of environmental detection capacities and can settle on informed choices for themselves, for example, speeding up beyond a sluggish vehicle. But—they require human supersede. The driver should stay ready and prepared to take control assuming the framework can't execute the assignment. At Level 3, the vehicle can speed up beyond a sluggish vehicle, observing its environmental elements, switching to another lane, and controlling the guiding, choke, and slowing down. All the driver needs to do is continue to focus and be prepared to reclaim control when the vehicle calls for it. Level 3 automation, particularly in public transportation, allows you to take your hands off the wheel and your eyes off the road, but the driver must remain vigilant. As a result, the driver is calmer in some situations, such as when driving in traffic, which is a common occurrence in public. Most car manufacturers limit the use of such a traffic jam pilot function to specified controlled-access highways and when traffic is relatively slow, such as below 40 miles per hour.

SAE Level 4: this level is meant for the mind off. It is called high driving automation. In most cases, these autos do not require human input. However, a human can still override the system manually. Level 4 vehicles are capable of self-driving. However, unless legislation and infrastructure change, they can only do so in a confined region, typically an urban environment where top speeds average 30 mph, as is the case with public transportation. Geofencing is the term for this. As a result, the majority of Level 4 vehicles on the road today are designed for ridesharing. At Level 4, the collaboration among humans and machines brings down as the vehicle's capacity increments. Guiding, slowing down, speeding up, and observing the climate are removed from the driver's hands, just as switching to another lane, turning, and flagging. This means in this automation driver of the vehicle may sit back and relax, possibly even read a book, while the car drives responsibly and safely on the highway

and possibly even city streets. The vehicle can still ask the driver to take control, but if no response is received, the car will come to a safe stop on its own.

SAE Level 5: This level is meant as a steering wheel optional. This is full driving automation. Autonomous vehicles can replace human drivers. They could eventually reduce the number of cars on the road and make transportation more efficient. Since the technology is still new, we're not sure what other effects it will have on our society. Here we find autonomous driving. Level 5 vehicles don't need human attention. The dynamic driving assignment is disposed of. Level 5 vehicles will not have guiding wheels or speed increase/slowing down pedals. They will be liberated from geofencing, ready to go anyplace and do anything that anaccomplished human driver can do. There's no requirement for a guiding wheel, no requirement for brakes, and no requirement for pedals. The independent vehicle controls generally driving undertakings under all conditions, including the observing of climate and IDof complicated driving conditions like the occupied person on foot intersections. Similarly, inpublic, these vehicles can play out a blend of a few errands at the same time, regardless of whether versatile journey control, pedestrian detection, collision warning, traffic sign acknowledgement, path takeoff cautioning, and many more.

Modern automobiles include technologies such as lane-keeping, speed controls, and emergency braking. Those characteristics are only termed driver aid technologies since they still require human driver control, whereas fully autonomous vehicles can easily operate without human intervention

3. LITERATURE GAP

3.1 GAP STATEMENT

This literature review on automated transportation is primarily revolving around self-driving vehicles, and the evolution of automated vehicles, rather than the public transportation system. There was not much literature on the automated vehicle that is used for public transportation.

3.2 GAP ANALYSIS

There has been very minimal research on the topic “Automated Public Transportation” itself, so the literature review presented here has been innovative research to summarize the topic despite all these knowledge gaps. Automated transportation involves several components integrating, automated transportation systems, self-driving vehicles, road infrastructure. There has been extensive research on self-driving vehicles, however, the amount of research in the context of the automated system, and the infrastructure has been carried out at little or no level. The roads, traffic system, port management, and the infrastructures to support this concept are yet to be taken into cons in the research (Bagloee et al., 2016). The existing research covers the idea of cars, trucks, and such vehicles which can drive without the driver’s presence, but they ignore the overall system linked to it, which is needed when these vehicles go into mass adoption of the public domain. There exist several research gaps on the topic of legal, political, environmental, economic, social, and safety-related concerns of automated public transportation (Lam, Leung andideration Chu, 2014). Other gaps in the knowledge in the research of automated transportation are the utility fields of the concept, how automated transportation can be used in the public circle, how automated transportation will revolutionize the transportation industry, and the use and impact of artificial intelligence in this sector. AI has the potential to improve traffic efficiency, relieve traffic congestion, free up driver time, make parking more convenient, and boost car- and ridesharing. AI may minimize fuel consumption caused by cars idling when stationary, as well as enhance air quality and urban planning, by assisting with traffic flow. There has been no research about the overall implementation of automated transportation at the public level, however, some research is presented in terms of the private use of automated vehicles (Azad et al., 2019). No sufficient research has been made on how automated transportation is going to change the lives of the public, and the policies, rules, laws, etc. about this system are unclear (Piao etal., 2016). The main field that is supposed to influence automated transportation is artificial intelligence, but the field has been researched separately in a wide range, however, AI in relevance to automated transportation has not been researched that much. There is a certainknowledge gap on how it works. And what would be the results and consequences? This literature review is completely based upon the implementation of unique and new solutionsin this field. This literature review tries to make use of academic research and the community-based mining of information and knowledge (Montes et al., 2017). The lack of past research on the topic can be taken as a limitation. The literature review is done through the qualitative

research approach, to obtain the knowledge and condition of the barely researched sector: Automated Transportation. It included a few available case studies research, research on the history of the system, interpretation from what has been understood, and so on. The ideas and concepts that have been touching the concept of automated transportation were explored, for a deep understanding of the system. Due to fewer studies in this field, the research done includes the observation, and analysis of the different sites, people, etc. along with the comparisons and explanations to develop some techniques to analyze the obtained data (Madigan et al., 2017). In general, the data collected through the surveys are analyzed to get deeper insights into automated transportation and how it has influenced the people till the data, and how it could in the future.

This research addresses the fact that how people think about this system and their perspective of automated transportation. The knowledge of the public on this topic, and their willingness, as well as a sense of reliability, are presented by this research. There needs to be far more extensive research on automated transportation, and people need to be made aware of the overall concept of automated transportation, which is beyond driverless vehicles. Despite the research being bounded by the time, geographic, age groups, and experience-like limitations there has been presented a general outcome of the people, automation, and transportation as an integrated part.

4. RESULTS

4.1 RATING SYSTEM USED IN THE SURVEY

The survey was performed by Zito and Holyoak, 2018 by using the concept of the Likert scale system. I have discussed the Likert scale system in the literature review.

The rating was given from 1 to 5 where each number means the following:

1- Strongly disagree
2- Disagree
3- Neither agree nor disagree
4- Agree
5- Strongly agree

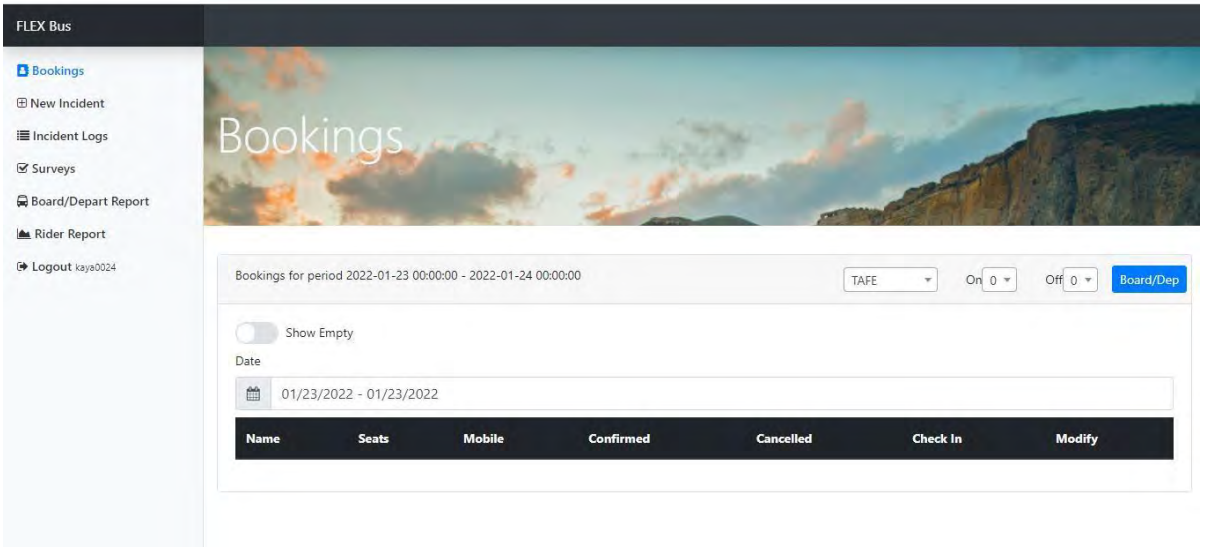

Figure 4: Booking Page

Src: https://flexbus.flinders.edu.au/chaperone/rider_report

The image shown in figure 4 and the link provided as the source of the figure is used to collect the data for the survey.

4.2 PRE-SURVEY

The survey and research were started in June 2018 and ended in March 2020 with the application of the defined methodology have brought us to a clearer better perspective about the autonomous transport system. The research was conducted by Prof. Nicholas Holyoak and Prof. Rocco Zito. Nicholas has collected the ideas from the public and their choices about the transport system. Some of them want to stick with driving their cars by themselves while many people are looking forward to experimenting with driverless cars. Rocco conducted trial sessions to observe their experience and learn what they like and dislike about it. The research was conducted among a diverse group of people in a wide range of age group that ranges from below 18 years to above 65 years, see Figure 5. A total of 747 responses were received for the pre-survey.

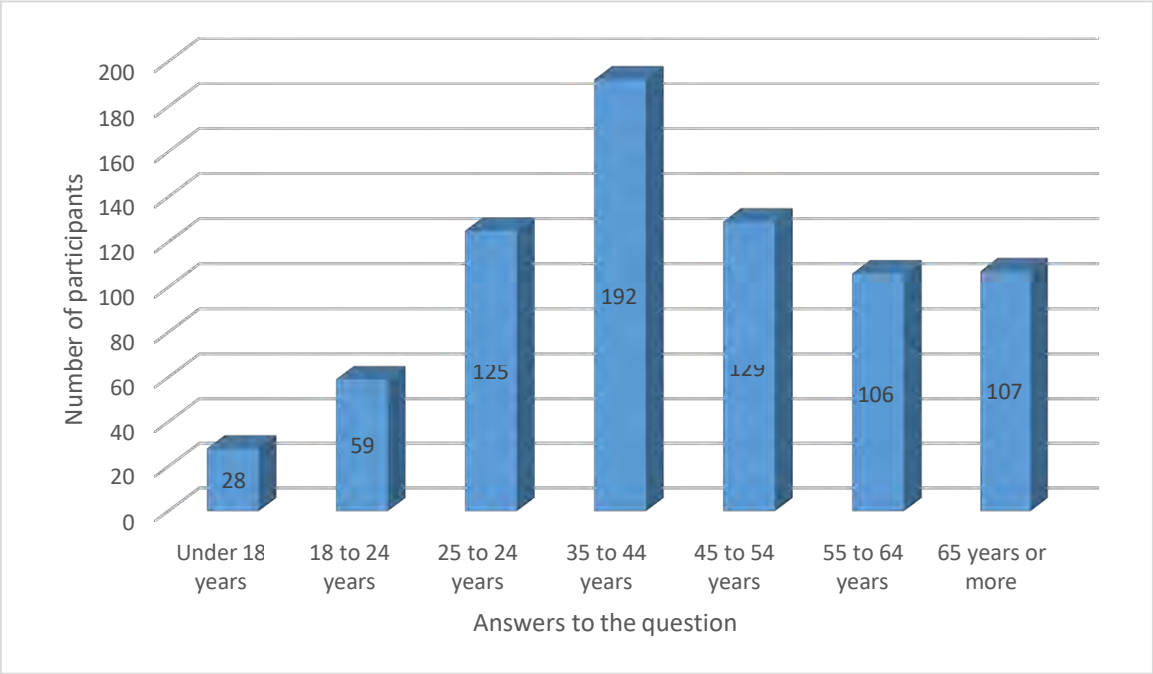

Figure 5: Demography (age group) of the participants

The participants were requested with the question about their age group as “Please select your age group”. The answer helped analyze the age group and their perception of the autonomous transportation system. The question was significant to gather the data of how the responses to the other questions in the survey, and the after-trial experiences have fluctuated among the different age groups.

Figure 5 shows that the under 18 participants were 3.75% of the total people involved in the survey which in number is 28. 59 participants i.e., 7.91% were between 18 to 24 years, 126 participants i.e., 16.87% were 25 to 34 years, 192 participants i.e., 25.74% were 35 to 44 years, 129 participants i.e., 17.27% were 45 to 54 years, 106 participants i.e., 14.19% were 55 to 64 years, and 107 participants i.e., the remaining 14.32% were 65 years or above. This suggests that there was a good age diversity in the survey.

Another initial question in the survey was “What is your gender?”.” The answer to this question was utilized to analyze the effect of gender on the way an individual takes the concept of the autonomous transportation system, as gender is supposed to manipulate the psychological status of the person.

The result of the survey shows that the number of female participants was higher than the rest of the participants. There were 55.42% female, 42.44% male, and the rest of them which is 2.14% didn't prefer revealing.

The result of the survey was that the concept of the autonomous vehicle was known to 94.38% of the participants involved in the research. 5.22% were unknown about its concept while 0.4% were unsure about their ideas.

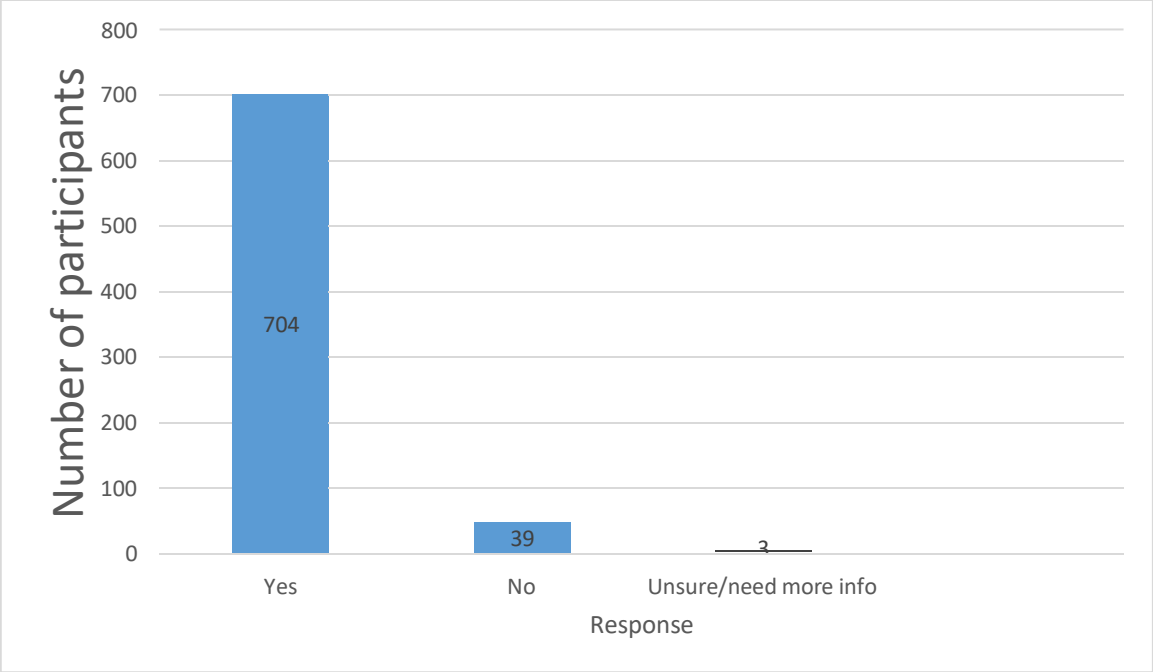

Figure 6: Do participants know about AV?

The participants were asked, "Do you know what an autonomous vehicle is??"." The answer obtained from this question was shown in figure 6 and it was significant to understand the participants and their familiarity with autonomous vehicles. If more participants are familiar with this concept that would help to proceed and gather their actual experiences and perspectives. Since the unaware participants cannot provide the actual assessment of how they take and think about the AVs.

The survey has revealed the frequency of people travelling in public transport in a week on average. It is found that 42.70% travel on public transport less than once per week. Unsurprisingly 22.09% never travel in public transport, 15.26% claim to travel 1 to 2 days per

week, 6.69% travel 3 to 4 days per week, 7.63% travel 5 to 6 days per week, and 5.62% travel in public transport every day. Since more participants were familiar it meant that they had some understanding of the AV, either through some experiences or through the readings or movies.

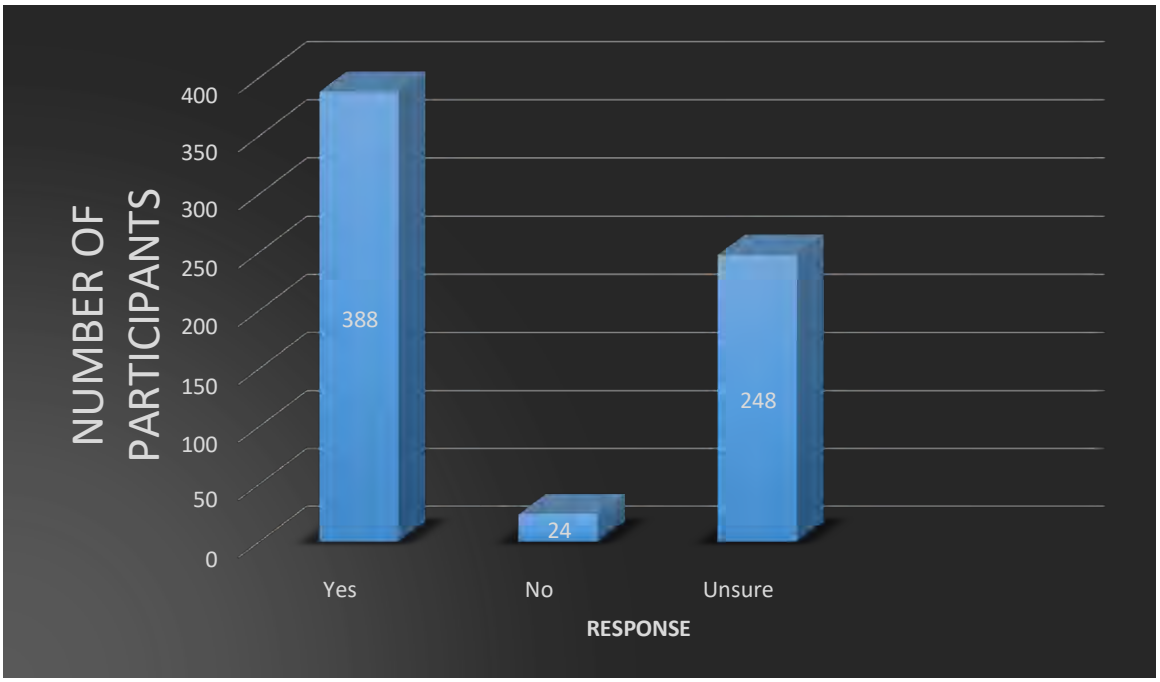

Figure 7: Do participants feel safe?

The survey also asked "Would you feel safe as a passenger in a vehicle that drives itself" to the participants. This was aimed to understand the level of security and the trust among the people about autonomous vehicles. If the people do not feel safe it is worthy to consider the drawbacks earlier.

The pre-survey before the trial session answered the query regarding safety about the autonomous transport as less vulnerable. Figure 7 shows that 58.85% claimed to feel safe as a passenger in the vehicle that drives itself. Only 3.63% of the participants were not positive toward this question while 37.52% were uncertain and asked for more information to decide whether they feel secure or not.

As more people responded that they feel safe, we could estimate that majority of them have got good experience of the autonomous systems and have used them in their life.

4.3 POST SURVEY

A trial session was conducted before the next survey which brought new insights for the subject. 239 responses were collected for the post-survey.

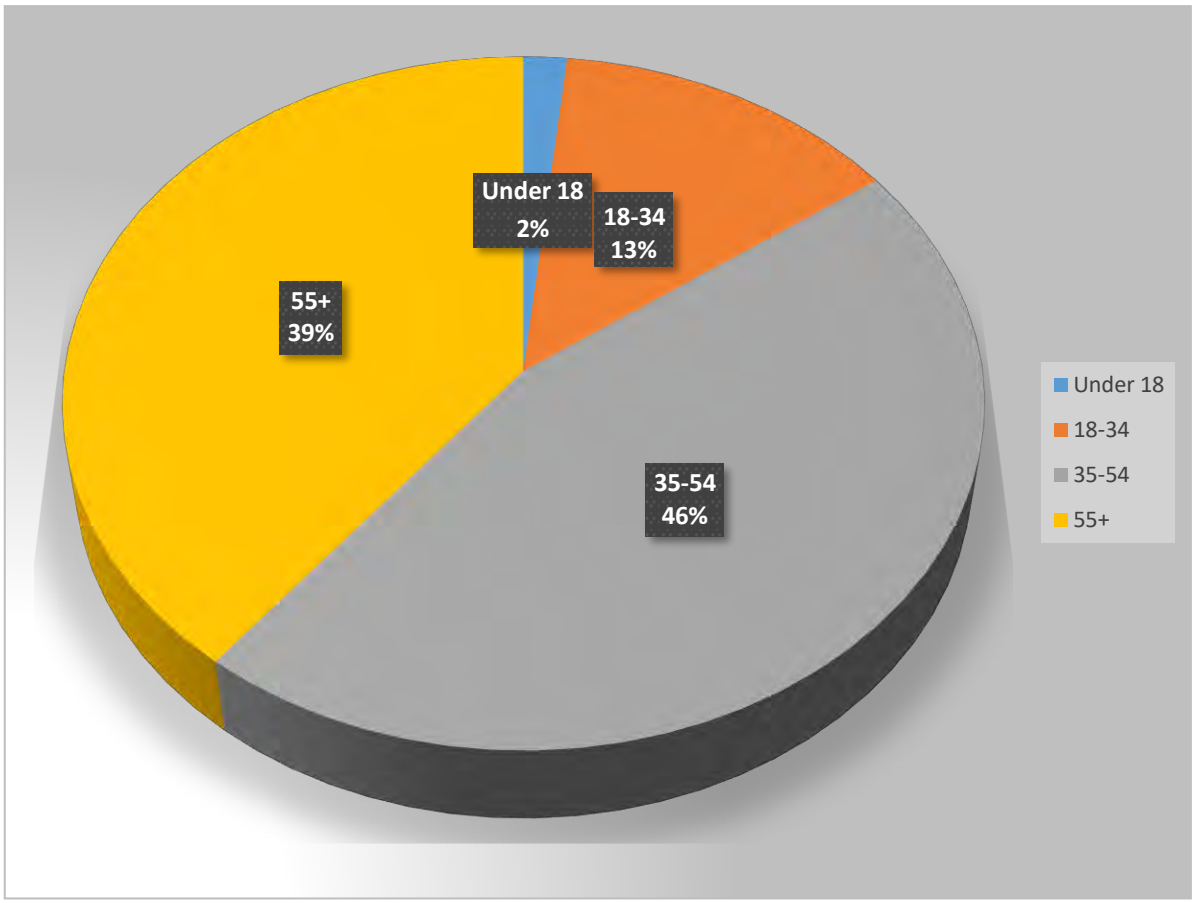

Figure 8: Age group

Again, as in the pre-survey, Zito and Holyoak, 2018 asked the participants, “Please select your age group:”. This was taken with the same purpose to understand the perspective and the participation based on the age groups.

For this post-survey, as shown in figure 8, the participants under 18 years were the least in number and only 1.67%. 13.39% were 18 to 34 years, 45.6% were 35 to 54 years, and 39.33% were 65 years and above. As the graph suggests there were more aged participants than the younger ones. This is because the aged ones were found keen to experience this system, however, the younger ones are theoretically more familiar with such ideas and just wanted to observe.

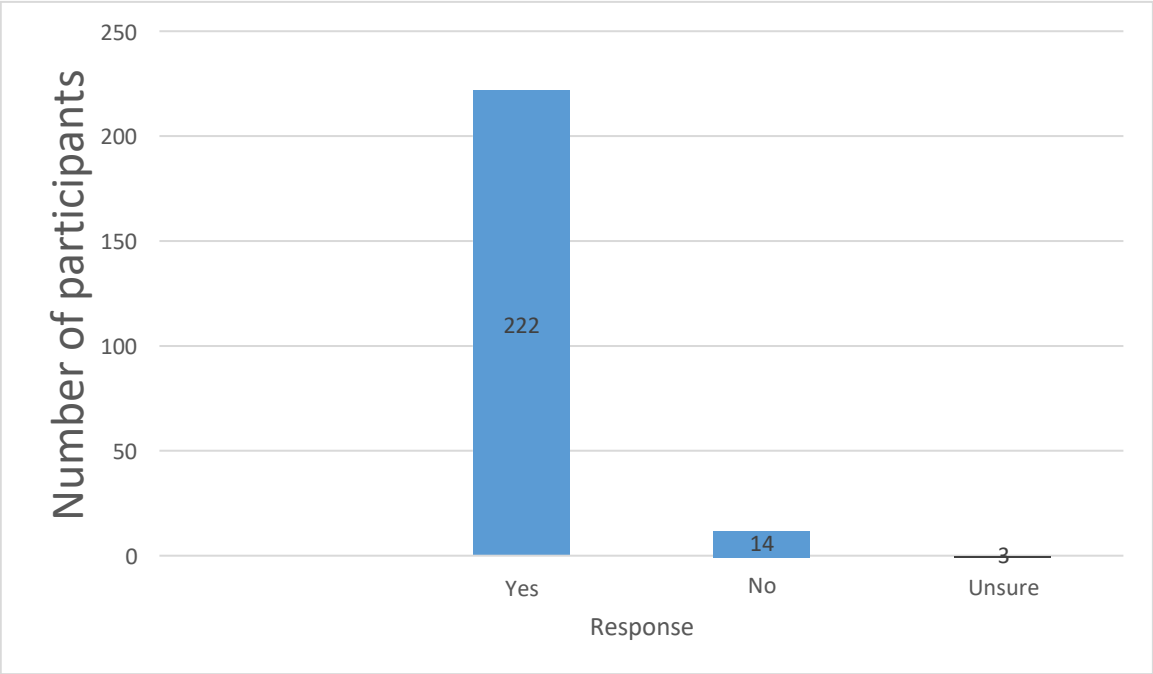

Figure 9: Did participants know about AV before?

“Had you heard of driverless vehicles before participating in the trail?”. This question was put among the participants of the trial to know if they have had any sort of knowledge or idea of the vehicle they are going to travel on.

As shown in figure 9, 92.89% of the participants who took part in the trial had heard about the driver-less vehicle before participating in the trial. 1.26% were unsure about the information and the rest 5.86% had never heard about autonomous transportation before the trial. Most of them had heard of the AV, they said they knew about the AVs through movies and sci-fi books.

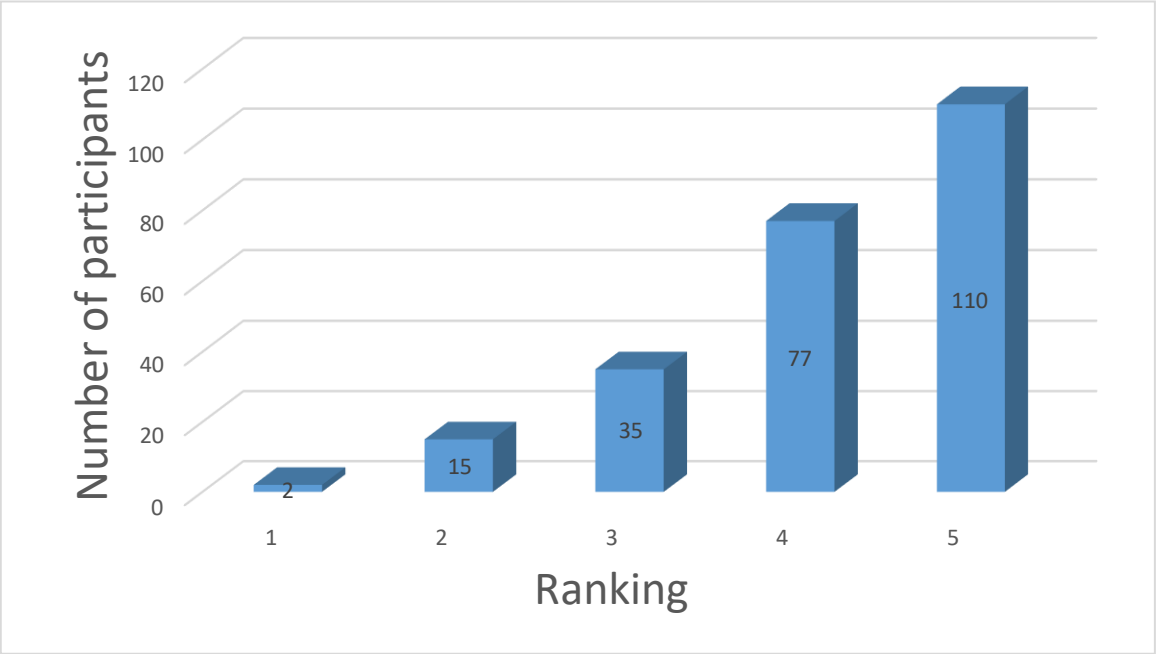

Figure 10: Experience of participants

Following the conclusion of the trial session, the participants were asked "How would you rate your experience participating in the flinders express autonomous vehicle?" This was the critical question, as the answer to this would determine the prospect of the AVs. If more people like this system, it would be an encouragement for the AVs, otherwise there need to be more amendments to the system.

The surveys participants rated their experience on participation in the trial. As shown in figure 10, most of them rated 5 and the least response was for the least rating i.e., 1. Only 2 participants i.e., 0.84% rated 1, 15 participants i.e., 6.28% rated 2, 35 participants i.e., 14.64% rated 3, 77 participants i.e., 32.22% rated 4, and rest of the 110 participants i.e., 46.03% out of the survey rated 5 to their experience participating in the flinders express autonomous vehicle. This meant that the participants had a good trial session, and enjoyed everything of the AVs, be it the speed, direction control, or the obstacle escape. The speed was maintained low throughout the trial session.

About travelling on the driverless vehicle, the participants responded on how happy they felt about it. The result shows that 3 of them which is 1.26% rated 1, 9 of them which is 3.77% rated 2, 51 of them i.e., 21.34% rated 3, 86 participants i.e., 35.98% rated 4, and 90 participants i.e., 73.66% rated 5.

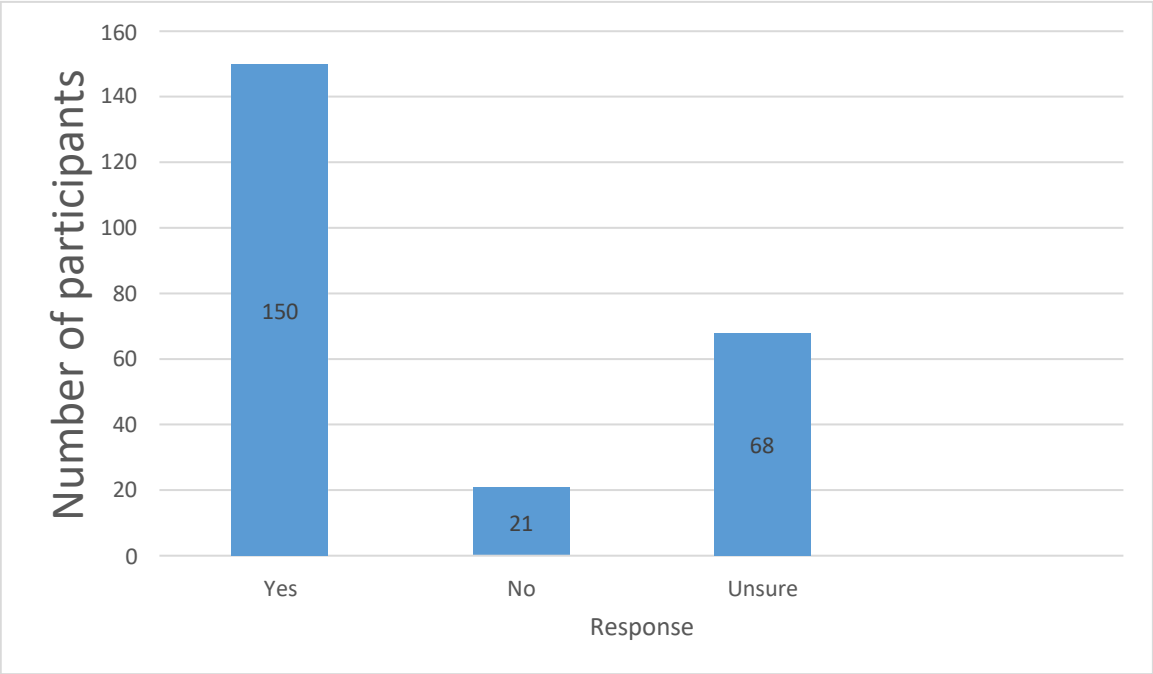

Figure 11: Do participants feel safe as a passenger in AV?

Another question was "Would you feel safe as a passenger in a vehicle that drives itself?" The answer would be handy to analyze how safe the participants felt while they were in the AV. The security and safety-related experience are what this question seeks to be answered.

For this question, as shown in figure 11, 150 participants which are 62.76% of the total participants claimed that they felt safe as a passenger on autonomous transportation as it was driven at a smooth speed, while 21 participants i.e., 8.79% expressed that they are insecure about the driverless vehicle as they had no control in case of any disaster scenario. The remaining 28.45% which comprises 68 participants were not sure about it. Combined research was performed to conclude the queries that came in the way of discussion about autonomous transport.

Zito and Holyoak, 2018 asked the average public transport usage record to estimate the applicability of autonomous vehicles in near future. The participants in this survey have the highest response in travelling on public transport less than once a week which was claimed by over 300 participants. The result shows that around 210 participants claimed that they never make use of public transportation. 130 participants responded as using public transport 1 to 2 days per week, 110 travelled about 3 to 4 days per week, participants travelling 5 to 6

days per week were around 80, and 6 to 7 days were quite like the data of participants travelling 5 to 6 days per week i.e., around 80. The participants travelling on the public transport every day was the least in number which is around 40.

4.4 COMPARISON

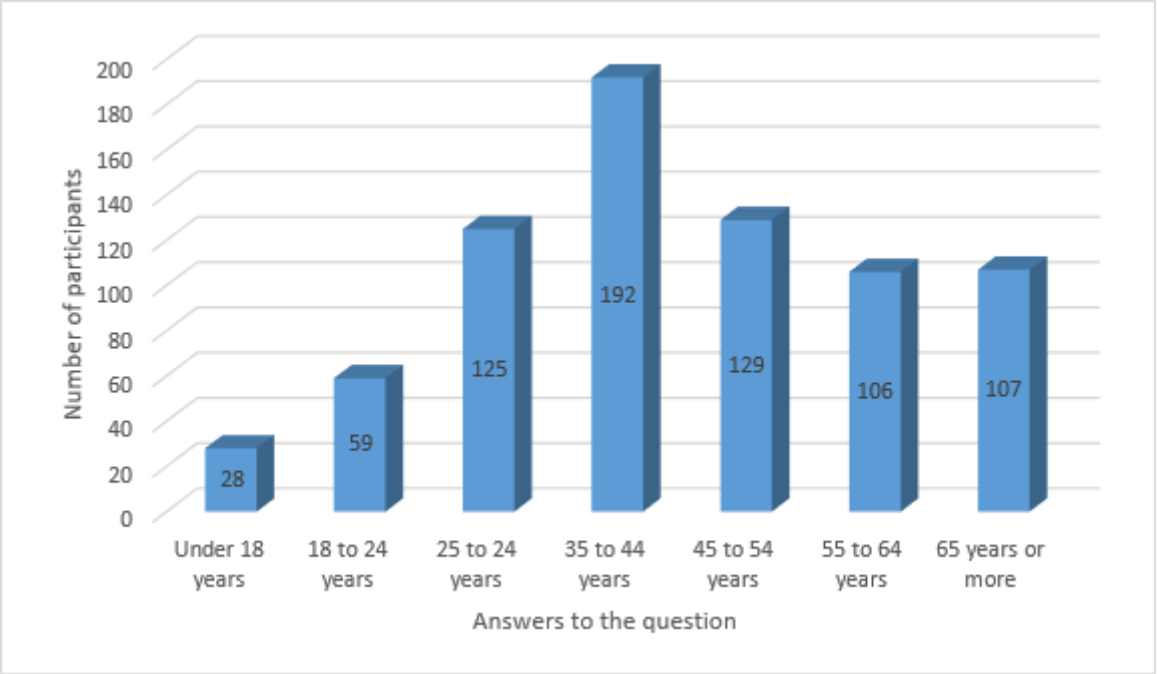

Figure 12: No. of participant

In the graph, as shown in figure 12, the under 18 participants were 3.75% of the total people involved in the survey which in number is 28. 59 participants i.e., 7.91% were between 18 to 24 years, 125 participants i.e., 16.76% were 25 to 34 years, 192 participants i.e., 25.74% were 35 to 44 years, 129 participants i.e., 17.29% were 45 to 54 years, 106 participants i.e., 14.21% were 55 to 64 years, and 107 participants i.e., the remaining 14.34% were 65 years or above.

For the post-survey, as shown in figure 8, the participants under 18 years were the least in number and only 1.67%. 13.39% were 18 to 34 years, 45.6% were 35 to 54 years, and 39.33% were 65 years and above. As the graph suggests there were more aged participants than the younger ones. This is because the aged ones were found keen to experience this system, however, the younger ones are theoretically more familiar with such ideas and just wanted to observe.

.

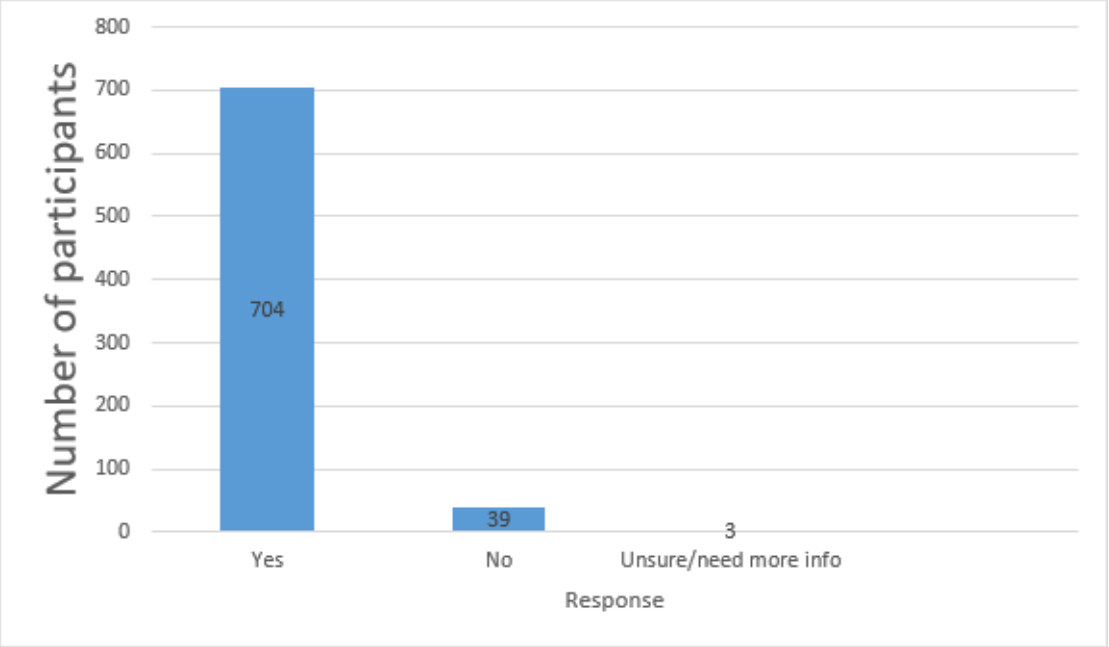

Figure 13: Do participants know about AV?

As per figure 13, the concept of the autonomous vehicle was known to 704 i.e.,94.37% of the participants involved in the research. 39 i.e., 5.23% were unknown about its concept while 0.4% were unsure about their ideas. As shown in figure 9, 92.89% of the participants who took part in the trial had heard about the driver-less vehicle before participating in the trial. 1.26% were unsure about the information and the rest 5.86% had never heard about autonomous transportation before the trial. Most of them had heard of the AV, they said theyknew about the AVs through movies and sci-fi books.

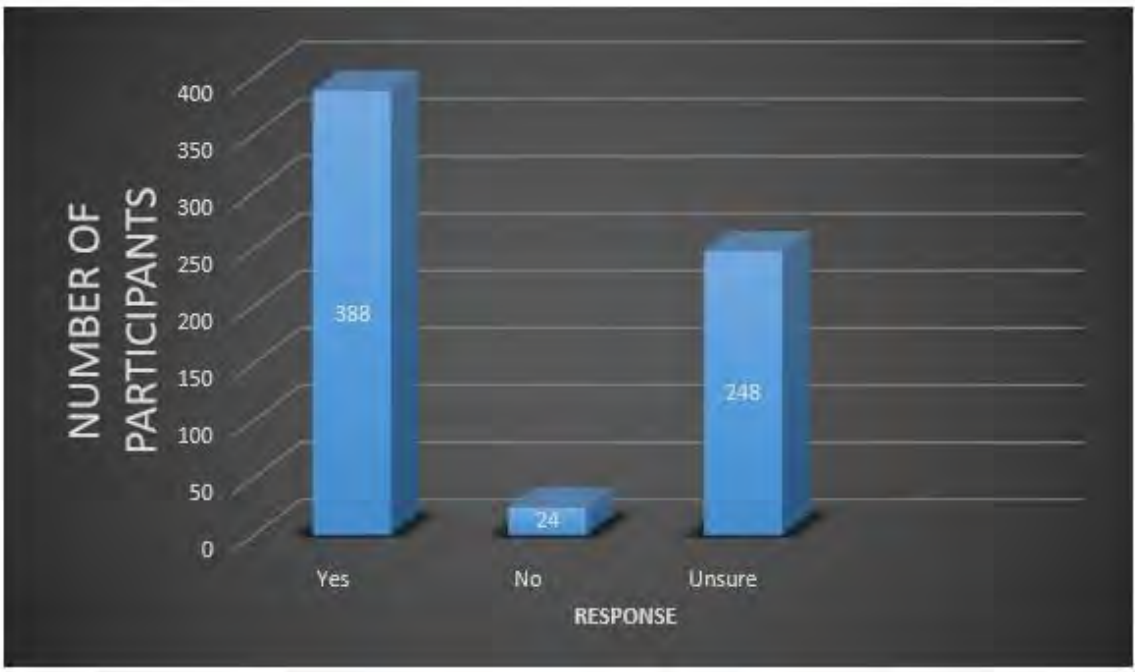

Figure 14: Do participants feel safe?

According to figure 14, the pre-survey before the trial session answered the query regarding safety about the autonomous transport as less vulnerable. 58.79% claimed to feel safe as a passenger in the vehicle that drives itself. Only 3.64% of the participants were not positive toward this question while 37.58% were uncertain and asked for more information to decide whether they feel secure or not. But as shown in figure 11, 150 participants which are 62.76% of the total participants claimed that they felt safe as a passenger on autonomous transportation as it was driven at a smooth speed, while 21 participants i.e., 8.79% expressed that they are insecure about the driverless vehicle as they had no control in case of any disaster scenario. The remaining 28.45% which comprises 68 participants were not sure about it.

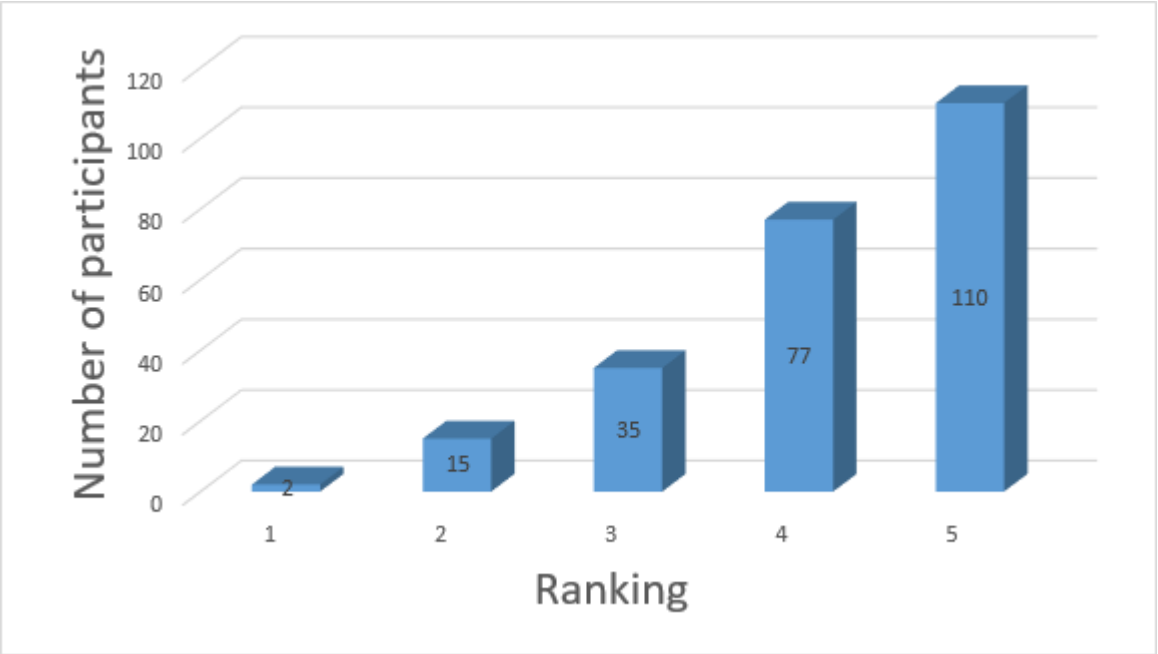

Figure 15: Experience of participant

As shown in figure 15, of them which is 1.26% rated 1, 9 of them which is 3.77% rated 2, 51 of them i.e., 21.34% rated 3, 86 participants i.e., 35.98% rated 4, and 90 participants i.e., 73.66% rated 5.

4.5 COMBINED

The survey was done in two parts where a questionnaire was presented to the participants. Then the participants were given a ride in AV and again the questionnaire was done. the survey provided enough information to show that Autonomous public transportation has many benefits and applications is implemented in real life.

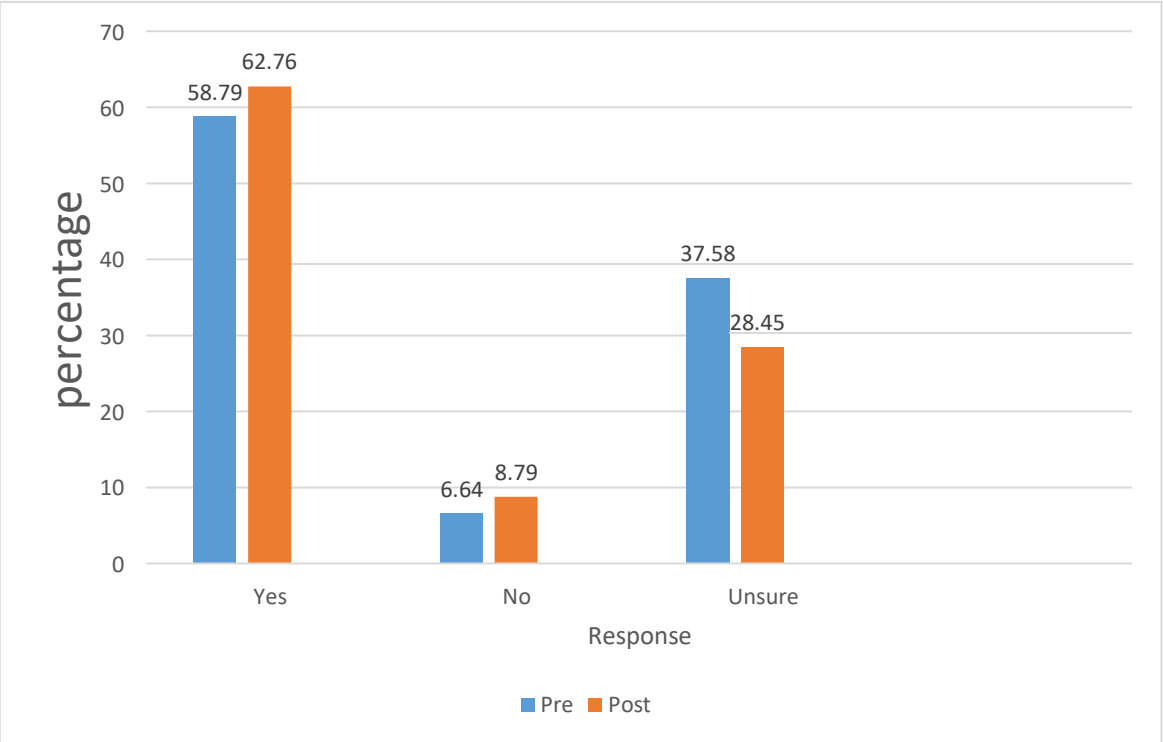

Figure 16: Did participants know about AV

"Have you heard of the notion of an autonomous vehicle?" was questioned in the pre-survey, and "Had you heard about driverless vehicles before participating in the trail?" was asked in the post-survey. Both questions are designed to elicit information on our participants' awareness of the AV. Figure 16 shows that most individuals have heard about self-driving cars. So, the problem isn't a lack of information about AV identification. Because most peoplewere already aware of it, the big concern was whether it would work in public transit. As a result, the survey report considers people's

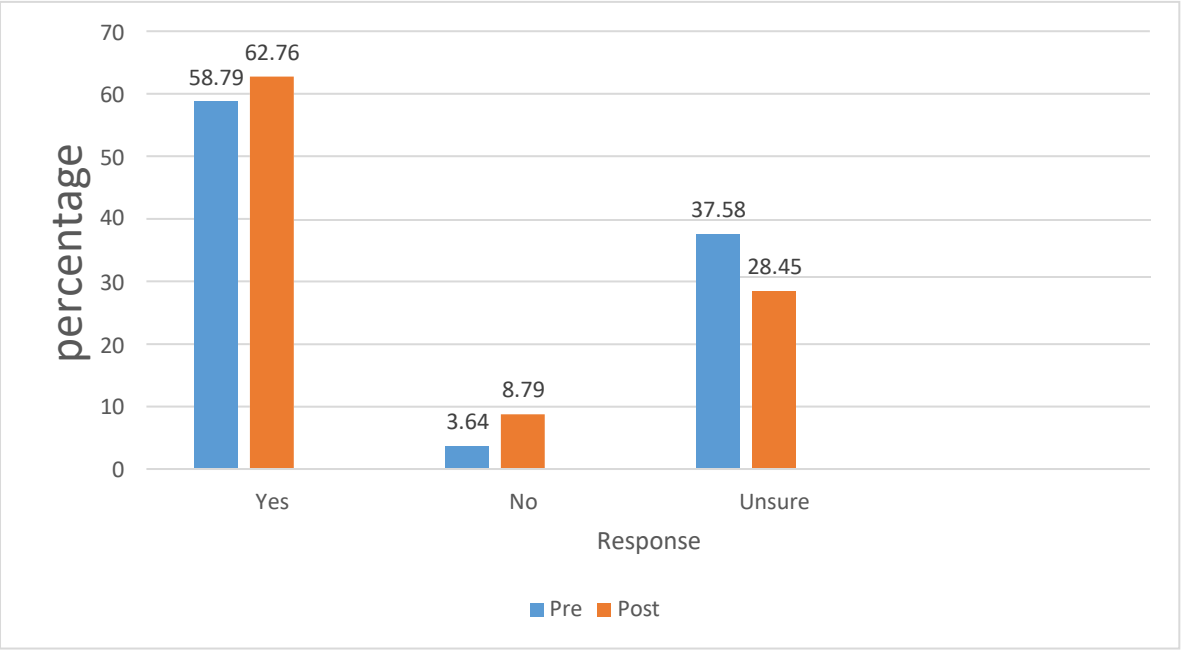

Figure 17: Safety of participants

Zito and Holyoak, 2018 asked the participants, "Would you feel secure as a passenger in a self-driving vehicle?" to get a sense of how safe they think such systems are. The responses gathered aided in determining the current degree of safety and confidence that AVs provide to the general population, as well as what changes are necessary.

Figure 17 shows that most respondents felt safe in the self-driving car because they trusted the machines' and programs' performance. They claimed that frequent monitoring of the system's operation provided them with peace of mind. Some people obtained clarity after experiencing some confusion, but the majority of individuals in the sceptical category were still unable to achieve clarity regarding the autonomous vehicle's safety. According to the research, people are comfortable with autonomous vehicles and understand how they function.

4.6 AUTONOMOUS PUBLIC TRANSPORTATION POTENTIAL BENEFITS AND APPLICATIONS

After performing the literature and survey analysis of autonomous public transportation was more clarified. There are many benefits and applications of autonomous vehicles in public transportation. These were identified from the literature and FLEX survey and are listed below which are further justified by the survey analysis.

4.6.1 LESS TRAFFIC CONGESTION

Public vehicles provide mass transportation for multiple populations at a time. Assume that six persons go in a private automobile. Then there will be six automobiles generating traffic. Suppose six people use a private vehicle. Then the number of vehicles will be six causing traffic. If all six people use public vehicles transport it reduces the number of vehicles straight to one on the road significantly. In this manner, if more people start using public transportation and autonomous vehicle the problem related to traffic will be mitigated (Calvert, Schakel and van Lint, 2017).

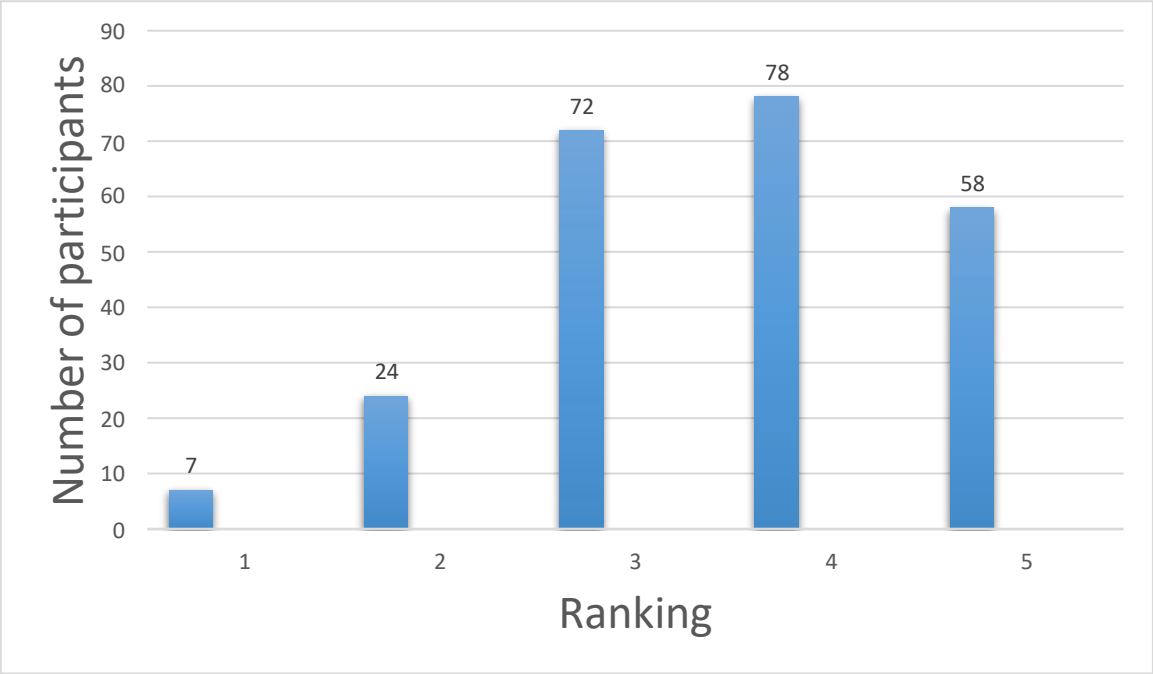

Figure 18: less traffic congestion

Participants were asked to assess decreased traffic congestion on a scale of 1 to 5. Figure 18 shows that the majority of them (32 per cent) scored autonomous transportation as a 4 on a scale of 0 to 5 for the topic of whether it would help to reduce traffic congestion. They discovered that if numerous participants were transported to the ride by a single autonomous vehicle, the number of cars on the road would be reduced. The majority of the young participants responded that they would prefer such automated and planned systems over personal automobiles, which are more expensive and time-consuming. As a result, the introduction of self-driving public transit reduces the number of private automobiles.

According to the study results, the majority of individuals agree with the advantage. Only 7% of participants evaluated automated transportation as a 1 on a scale of 0 to 5. Approximately 87% of participants give it a rating of 3 or above.

4.6.2 IMPROVED TRAVEL TIME RELIABILITY (MORE CONSISTENT JOURNEY TIMES)

When employed for public transportation, autonomous cars will follow a predetermined path. It will also have a set speed and stop. The driverless car will eliminate any mistakes and adhere to the timetable more closely. It will immediately increase the dependability of trip time and give a constant journey time.

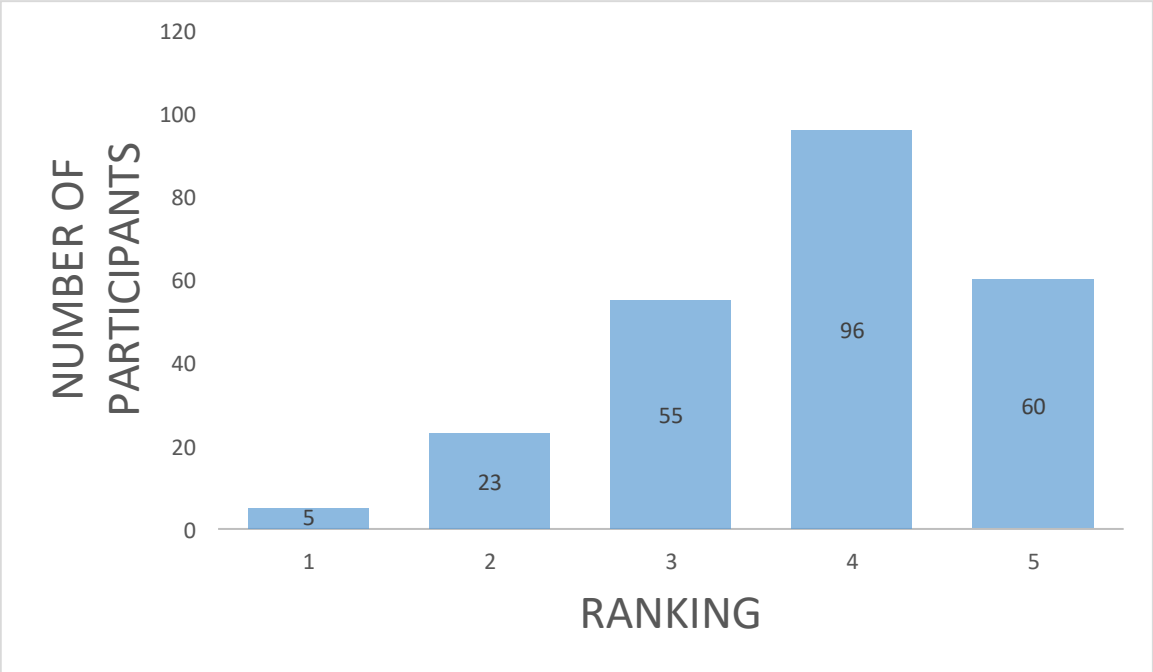

Figure 19: Improved Travel time

The participants were asked to rate the improved travel time they experienced in the survey.

Figure 19 shows that most of them (40%) gave a rating of 4 out of 5. The participants were quite amazed at the accuracy and the punctuality of the autonomous vehicle during the trial. They found the starting time, route stops, and everything was precise. Every age group and gender participant agreed on one thing that they can rely on the AVs for the consistent journey. However, few raised the doubts regarding how it will handle the unforeseen situations, and manage the unexpected route obstacles to meet the preprogrammed timetable.

Many people agree that the autonomous vehicle will benefit people by improving travel time. Only 5 participants gave it a rating of 1.

4.6.3 FEWER CRASHES

Autonomous vehicles are self-driven and don't involve the mental condition and behaviour of a human being. So, it follows a fixed schedule and route by maintaining the provided speed.It will also be automated, and all the safety measures are required to reduce crashes. So, fewer crashes would be observed.

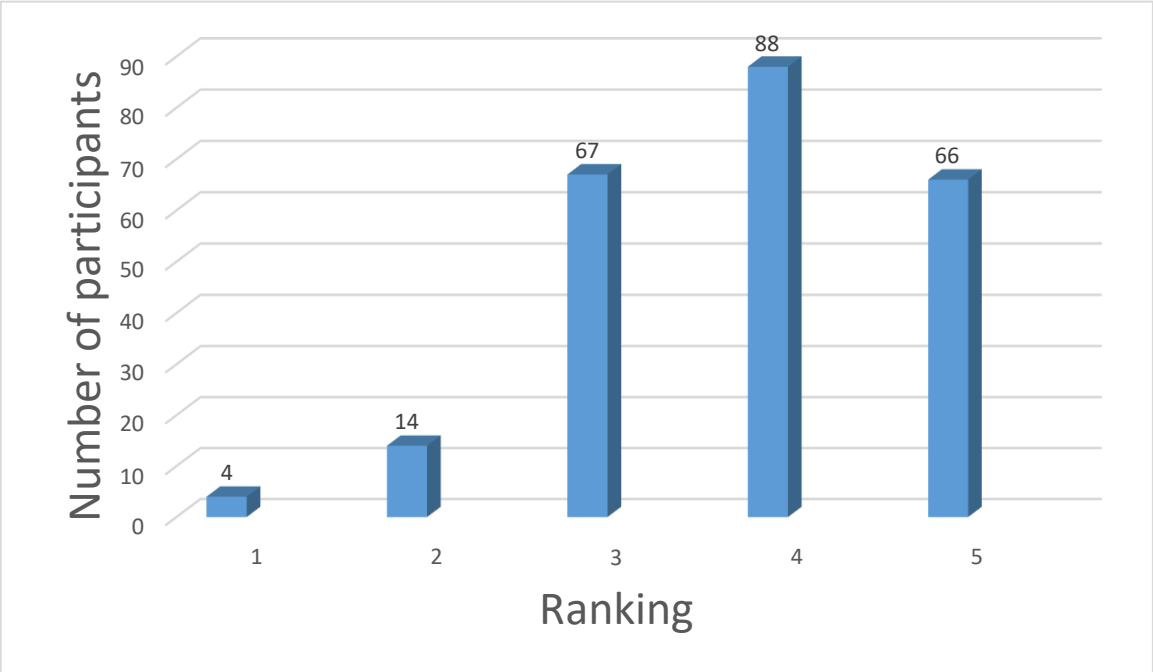

Figure 20: Fewer crashes

After the trial, we were asked to rate the fewer crashes, the figure 20 shows that most (38%) of the participants rated this benefit with a scale of 4. The participants expected that the automated vehicles would always follow the programmed schedules and timings. And hence there will never arise the chance of collision between the vehicles. The speed of vehicles is also another factor that might reduce the number of crashes. As the car driven by a man can vary on its speed, direction, etc. depending on the mood, and health of the driver, there is no chance of a man's behaviour-altering any aspect of the automated system. Until and unless everything is on its schedule chances of crashes are zero.

Only a few (4 out of 239) disagree with the provided point and rated 1. The majority of people believe that using automated vehicles will drastically reduce the crashes observed in the roadway.

4.6.4 REDUCED SEVERITY OF CRASHES

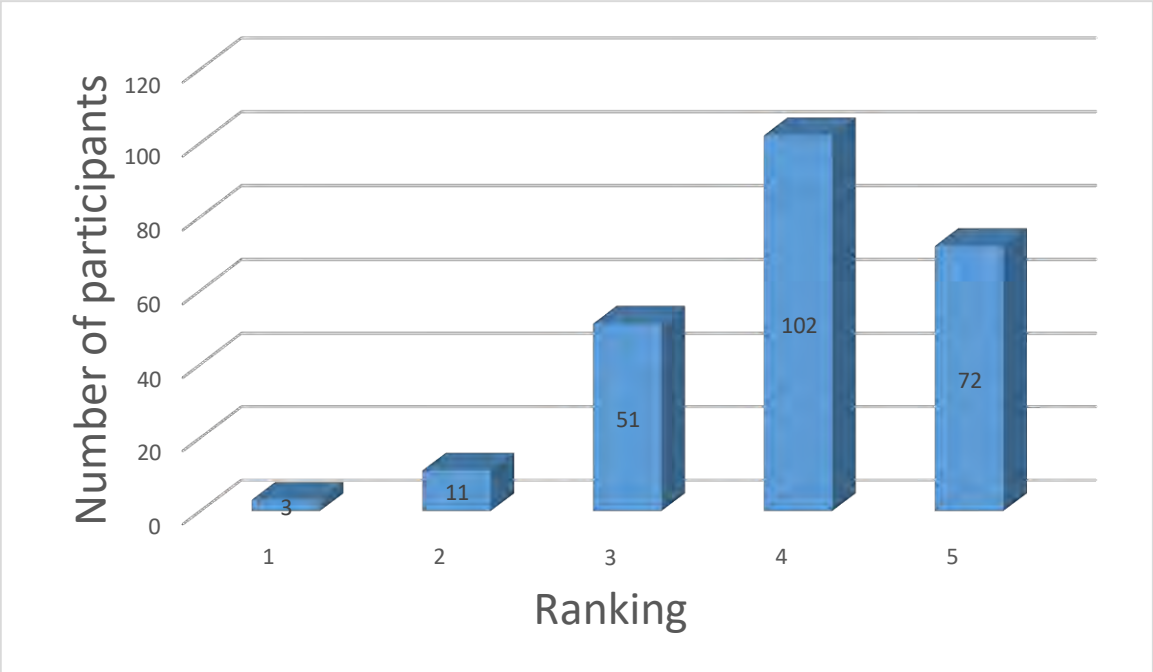

Figure 21: Reduced severity of crashes

Moreover, the survey also provided that the severity of crashes is also reduced using an autonomous vehicle.

Zito and Holyoak, 2018 asked the participants to rate the reduced severity of crashes in automated vehicles.

Figure 21 shows that (42%) of the participants rated 4 for the benefit that the automated vehicles will help to reduce the severity of the crashes, followed by the 30% rating 5, and 21% rating 3. Only 3 individuals rated 1 and 11 individuals rated 2. The major reason for this was highlighted to be the number of passengers the vehicle carried. If the vehicles crash a smaller number of people are supposed to be affected. As public transportation carries many people at a time, the severity of crashes should be reduced as much as possible. The number of passengers is few in AVs. Also, due to the maintained speed and schedule of AV, the severity of crashes will be reduced which is justified by most of the participants of the survey.

4.6.5 LESS NEED FOR PUBLIC PARKING IN TOWNS AND CITIES

The use of Autonomous vehicles as public transport will drastically reduce the need for public parking. The number of vehicles will be dropped after using AV as public transport which will reduce the parking space. In addition to it, public parking should not be easily assessable anymore. As AV moves on its own, it can travel and park on itself and return to receive the passenger.

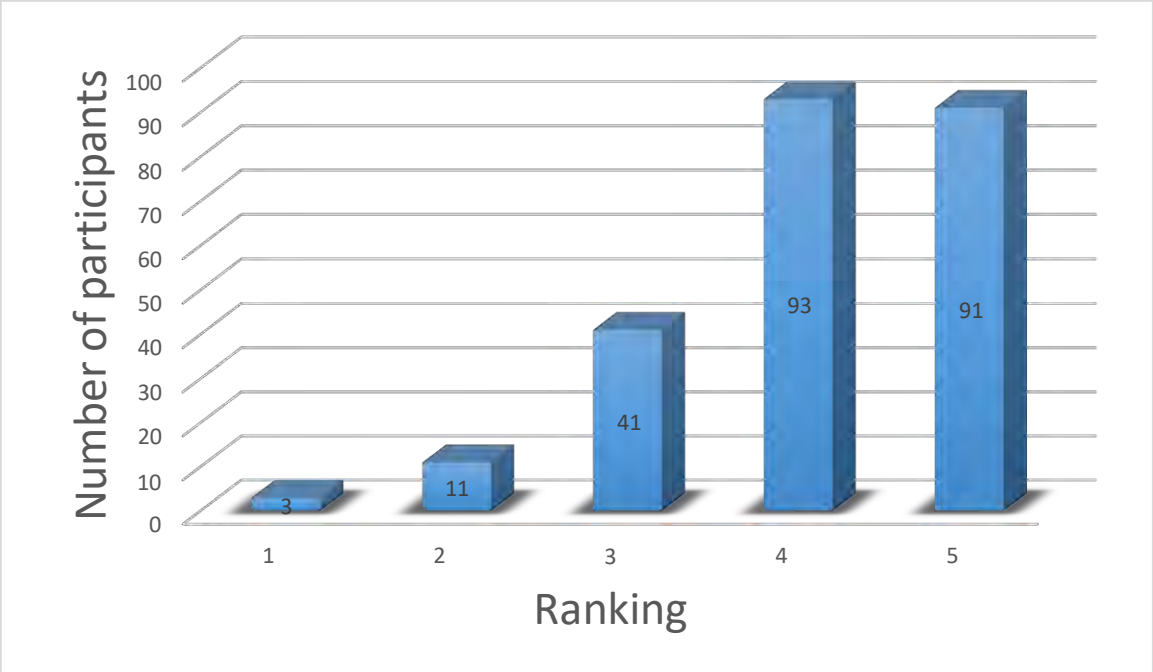

Figure 22: Less need for public parking in towns and cities

The survey was taken by asking the participants to rate how they think the AV will provide less need for public parking in towns and cities. The survey also justifies the statement as most of the participants provided rankings of 4 and 5 showing less public parking will be required in towns and cities after using Autonomous Vehicles. Figure 22 shows that 39% provided the ranking of 4 and 38% provided the ranking of 5, while 17% provided the ranking of 3. As you can see in figure 24, only 3 individuals have ranked 1 and only 11 have ranked 11. Many of the participants were driving their vehicles, if there would be automated vehicles, they would prefer it. The individuals can get several benefits like time-saving, less traffic congestion, and no parking issues. The automated public transportation will manage itself, and the passengers need not care about any of the issues related to space and parking.

4.6.6 SAVING THE TRAVEL TIME

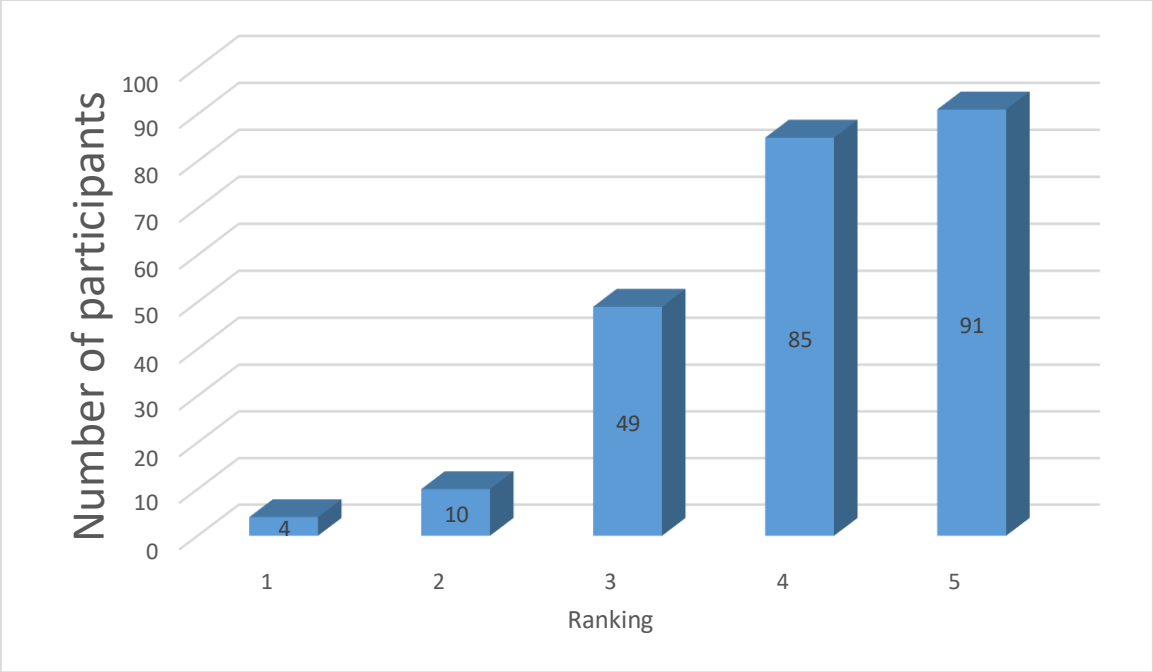

Figure 23: Saving The travel time

There was a question asking the participants to rate how AV saves travel time.

Figure 23 shows that the maximum (3) number of the participants provided the ranking of 5, followed by 35% providing the ranking. Only four individuals provided the ranking of 1. The working males stated that they were amazed by the driverless vehicles, as they do not have to take care of the system at all, and that driving time now can be invested in performing other tasks.

The people who drive private vehicle needs to give time to driving. The travel time will be fully scheduled. But using Autonomous vehicles will add those times to the passenger. The time they spent driving can now be used for something productive. Most of the survey participants provided a ranking of 5 which shows it is one of the most beneficial aspects of using Autonomous vehicles for public transportation.

4.7 COMPARISON OF PEOPLE SAFETY IN AUTONOMOUS AND PRE-POST-RIDE

In the present time, the autonomous car has a higher rate of accidents in comparison to the self-less car. The injury in the accident of autonomous cars is less severe. From the study, it

was found that 9.1 autonomous car gets accident per million miles driven. But, in the case of self-less cars, only 4.1 gets accidents per million miles driven. The autonomous car is in danger of fire in comparison to other vehicles. The Lithium-Ion battery used in the autonomous vehicle is highly combustible. In 2018, a 2012 Tesla model S appeared to spontaneously catch fire while it was being driven in West Hollywood, CA. There were no injuries in this incident but note that there was no collision that sparked the fire. (Law, 2022)

During the study, the author along with the supervisors performed a survey to analyze the opinion of people after having experience in autonomous vehicles. It means the pre-ride experience and post-ride experience of autonomous vehicles. From the study of data, it was found that elderly people, unemployed, poor, females do not like autonomous vehicles. Their mindset has changed after riding the autonomous vehicle. They feel the autonomous vehicle is insecure in comparison the to vehicle with drivers. The result shows that the people with high income per annum are positive towards autonomous cars. The monthly fuel cost also changed the opinion of the people riding autonomous vehicles. People with high monthly fuel costs can easily shift towards autonomous vehicles. (Shi, Zhen Wang, Xiaopeng Li, & Mingyang Pei, 2021)

5. RISK ASSESSMENT

The research was carried out by assessing certain risk factors that could appear during the study, survey, and trials. The topic and the methodology of the research was as such that the risk was assessed to appear in terms of social sectors, legal aspects, economic aspect, and the health as well as safety aspects. There was a general sense of how the society or the community is going to take this experiment. And how the participants would behave and react towards this research and the trials. Active participation was always a major concern, as the quality of the survey results depended on the answers given by the participants. There were the risks of the number of participants, and the quality of the response they would provide. The greater the number of participants more the results can be assured, and the better the data given by the participants the trustworthiness of the survey outcomes will increase. Similarly, the participants who volunteered for the research were taken to the automated transport experience without any proper paper works and standard legal activities. As of now, several legal complexities are hovering around the autonomous system, which could affect

the research aim and objectives. There is an unclear legal framework of autonomous public transport in the country, so this risk of committing offence unknowingly was always there. Or there even could be a chance of some participants misusing the opportunity to carry out criminal or illegal activities, which could leave the researcher and the university liable for the consequences.

Social and legal were minor considering the risk assessed related to the economic losses. There could be financial harm to both the parties: the participant, and the researcher or the university. The participant was provided with the opportunity to experience autonomous transportation. There was the risk of damage to the vehicles, the system, or some aspects of the participants. Economic harm could be significant for such a research purpose. So, all the systems were checked for their proper functioning before the trial. One of the major risks while carrying out such machine-reliant research is the health and safety of the involved individuals. There could be any malfunctioning triggered by the trial, physical injury due to system failure, or some serious damage to the participant's body. As the historical incidents of automated transportation suggest the potential severity of the failure of the machine, then it is under no control of human beings. Some common risks of the survey-based research are the participants themselves as the results completely depend upon their number and response of them to any question. This risk has the highest likelihood. The research generalizes the analyzed output of the inputs obtained from the small sample of the population to the global fraternity.

6. DISCUSSION

The research collected information from the public of diverse sectors about autonomous transportation. This collected data has assisted in estimating further process of its development and improvement. Many individuals are aware of the notion of autonomous mobility, yet a much bigger proportion are unaware of it. Many people are aware of the concept of autonomous mobility, but a significantly larger number are not. The research presents the fact about a huge number of people travelling on public transport in their daily life (Montes et al., 2017). This helps in the estimation of the applicability of autonomous transportation and its use in the future. Around 40% of the survey participants were doubtful about the security of autonomous vehicles. Normal people are not confident about this

immense technological revolution. The security concern is doubtful for normal people. After this conclusion, the trust issue can be worked on to create a healthy approach toward autonomous transport execution. After the trial session organized for the participants of the survey, the rate of people expressing positive feedback toward autonomous transportation over the existing transport system is increased. The participants rated their trial experience where most of them gave it 5 out of 5. However, there is no response on the excellence of it which directly means that the people are interested in it but they lack proper information to completely have faith in it.

Some feedbacks were totally against autonomous transportation. A person responded saying there would be no fun in a vehicle if one couldn't drive. Some people believe that the transition to driverless vehicles won't be easy considering from a technological perspective and social acceptance. Many people preferred manual cars over autonomous cars. They suggest there is no place for driverless vehicles or all vehicles becoming driverless in near future. They are not sure about what to expect but according to their response, we can easily observe that they are curious about what this technology can offer. This research has helped collect feedback from people having different perspectives. It has helped in figuring out the pros and cons of the existing state of autonomous transport systems. The problem in sharing roads with manual cars can create a negative experience. A participant claimed of seeing no benefits of autonomous vehicles unless all the transport system is automated, and the system is maintained accordingly. The driverless vehicle is not a matter to worry about, we live around advanced technologies and this revolution in a transport system will be one of them. Yet the integration of driverless vehicles with everything else in the environment seems to be troublesome. Computers are programmed by human beings and are not infallible. Automated transportation systems are only as good as the people designing and programming them. Human beings are unpredictable and so is the natural world. There are so many variables and unexpected things that happen on our roads, it's hard to imagine that any computer or sensors no matter how advanced would be able to deal with them all. Autonomous vehicles can be vulnerable to natural disasters and unpredictable events or circumstances. On the other hand, they can be much safer and more efficient during the rest of the time. The other advantage that an autonomous vehicle can flourish is sped control, the vehicles can be programmed to follow a discipline that can overcome the problems we face on the road due

to personal carelessness. This will become possible when all drivers switch to driverless vehicles, and we will rebuild our roads for new types of transport. Considering opinions about this topic and answers in this survey and being completely positive about the need for driverless vehicles for our society in a foreseeing future, many people don't feel completely safe in driverless vehicles at this stage of technology development. A novel idea is approached in the survey which is about the integrated plan for living and transport and greenhouse gas reduction. Autonomous vehicles can be eco-friendly and reduce greenhouse effects. Manual vehicles are responsible for creating sound and air pollution which can be gradually decreased by executing autonomous transportation. This evolution will seize the employment of drivers working in this sector. This will impact future employment. It is concerned about job losses over time but that is normal with technological change. an autonomous vehicle is likely to cause fewer road accidents. This revolution in the transport system is an interesting topic for the students studying the future of transport since it holds great potential in mobility. The execution of this technology is beneficial. However, humans should still learn how to drive and get experience driving to take over in any emergency case. Communication between vehicles will allow better traffic management and far fewer crashes. A theoretical 100% autonomous vehicle society could reduce crashes down to statistical insignificance. Automation is most useful when coupled with some driver control. Being able to take a vehicle off the map and being able to control it for certain actions like towing a trailer into place will remain important while allowing automation to take charge for such tasks as long-distance driving.

The major doubt is seen in the security concern of this project. Evidence of how autonomous vehicles behave in collisions would increase public confidence in these types of transport systems and provide a clear vision about their security. The control reliability must be fully researched & proven. Autonomous transportation can be accessible, reduce car parking, traffic congestion, and human error in crashes. It is great for visually impaired and blind people. Getting the legal framework sorted to enable automated transportation systems to be part of our society is another wise step toward its wide use.

Finally, the research has created a space for public opinion and their expectations with autonomous transportation. Many of them were claiming negative aspects while some were extremely positive toward this project. However, we can observe almost everyone was

curious about its execution and impact on daily life. The queries about the control system, social acceptance, environment conservation, vehicle accessibility, applicability, employment, and digitalization have been answered throughout the survey. Overall, the researchers created a clear view of further possibilities and the impact of autonomous transportation on the audience. The research has explained the security doubts and ways of improving them.

The study was adequate to a point, but it did not contain all of the necessary information owing to constraints. The constraints can be addressed visualize a broader picture and estimate. The poll was conducted with a varied group of people, although there were not many of them. More individuals can be involved in this initiative to ensure a successful conclusion. Similarly, there is a time restriction. To be completed, such a job needs a significant amount of time and work. To acquire more precise findings, the time limit might be extended.

7. CONCLUSIONS

The paper as a whole provides a clear vision of autonomous mobility. We have concluded the possibilities, limitations, future strategy, and probable issues with autonomous public transit transportation. The project's objectives are met thanks to an excellent survey done by Zito and Holyoak, 2018. Autonomous transportation is a revolutionary approach toward the advancement of the transportation field and mobility (Kadry, 2021). With the continuous change in every field with the advancement of technology, the transport system also requires advancement that can adapt with society and is applicable for use on large scale. The project has developed a clear pathway for the further proceeding of autonomous public transportation considering every aspect of its impact. Autonomous transportation is likely to invite various issues in the technological domain as well as social acceptance.

Apart from the application, process, and potential, the research's main discovery is the issue that people are scared of the major finding of the research except for the applicability, procedure, and potential is the issue which people are afraid about. The security concern is an important factor that would possibly affect the existence of autonomous transportation. The vehicles can be programmed according to the traffic rules and requirements to meet the expectation of daily travellers. However, it cannot handle any exceptional cases such as

natural disasters and road accidents. Such vehicles can't be computed for such unexpected situations. But in future, it can handle any type of accident because of huge upgrades in system and technology. This weakness has developed a sense of fear in many people although they are interested in its execution. The companies developing autonomous vehicles must consider this to establish trust with the people. The best approach author can suggest is the establishment of the autonomous vehicle which can be controlled by human effort in case of any emergency and unexpected conditions.

Similarly, autonomous transportation seems costly due to the use of several systematic tools, experts required for its establishment, its maintenance cost, and overall features (Engholm, Pernestål and Kristoffersson, 2020). This can be a barrier to be afforded by normal people. As discussed during the survey, the execution of driverless vehicles will be more efficient if the roads in near future will only have autonomous vehicles being driven on them. It means the autonomous vehicles must take over the manual vehicles in a few years of their operation to maintain other infrastructure relating to it. This will ensure systematic management of the vehicles. However, if this vehicle turned out to be extremely expensive, it's impossible to be afforded by most of the citizens. Therefore, the company must be aware of this fact too for the establishment of a successful autonomous transport system.

The application of self-driven vehicles will create a revolution in technology and a huge social impact (Bösch et al., 2018). The other factors such as traffic rules and passenger facilities will also take a turn together with it. People must be aware of its features, use, and settings. It can be very helpful for physically disabled and old citizens since they don't have to drive by themselves. Autonomous vehicles are expected to have an immense impact on the life of every individual after it is fully adjusted and brought into use. The companies establishing autonomous vehicles must keep the security concern into consideration to gain the trust of the public and improve according to the feedback they get from them. It will help in problem-solving and creating a wholesome travel experience.

8. FUTURE WORK

Based on this study we can analyze some of the future research possibilities regarding the field of autonomous public transportation. The paper research can be used as a guide to where to go or where not to go looking into the findings of the research and survey results

(Muro, Maxim, and Whiton, 2019). As the results of the study suggest that the huge number of people use public transportation in their day-to-day life, it could be an important area to implement the autonomous system. The research can be specifically focused on the impact of autonomous public transport in the lives of the public, on how their lives are influenced if public transportation becomes the future. The most significant outcome of the study was that there are serious concerns about the security of the autonomous system. Therefore, it can be an important research topic going ahead in this sector. Proper security analysis via the experimental approach can be performed. If the future of autonomous transportation in the public sector is to be assured the in-depth research and satisfying results of the system must be the main aim. So, the research should, in the future, include methodologies, surveys, and experiments to clarify the trust issues of the system among the public. Since, the post-survey results showed the percentage of people taking autonomous public transportation positively has increased, which clearly shows the lack of knowledge and uncertainties among the public. Future works should be done to aware make the public aware of the automated system transportation, and if possible, expand the experimental approach of the research to more such people. The result showed that there is a lack of quality and trustworthy information of the autonomous public transportation among the general people to have complete faith in it (Piao et al., 2016). So, in the future, the research should focus on proper and decisive outcomes that can be understood by the common people. As the literature review also suggested that there are very few case studies related to automated transportation, there needs to be integrated research in the coming times of the automated vehicles and the environment associated with its functioning. Furthermore, there is a significant aspect of the legal framework in the context of automated public transportation. There can be ground-level research in this sector of automation. There is also a good bit of knowledge gap in terms of the occupancy of the automated system. The future lies in automation, then there should be a clear understanding of the congestion and emissions caused by automated public transportation. This type of research would yield a better and consolidated outcome if the research area could be expanded in terms of time, geography, number of people, number of survey questions, and the variety of audiences. So, it is less worthy to research only on automated cars and buses but would be important to carry out the research in the traffic, roads, life influence, and so on by the autonomous public transportation in the future

research, and the results and outcomes need to be delegated to global audiences to make everyone aware of the system, and the concept.

9. REFERENCES:

Adedjouma, M., Pedroza, G. and Bannour, B., 2018. Representative safety assessment of autonomous vehicles for public transportation. *Proceedings - 2018 IEEE 21st International Symposium on Real-Time Computing, ISORC 2018*, pp.124–129. https://doi.org/10.1109/ISORC.2018.00025.

Adnan, N., Md Nordin, S., bin Bahruddin, M.A. and Ali, M., 2018. How trust can drive forward the user acceptance to the technology? In-vehicle technology for an autonomous vehicle. *Transportation Research Part A: Policy and Practice*, 118, pp.819–836. https://doi.org/10.1016/J.TRA.2018.10.019.

Ajzen, I., 1991. The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), pp.179–211. https://doi.org/10.1016/0749-5978(91)90020-T.

Alexandria Sage, 2016. *Google makes progress on self-driving cars, hits 2 million mile mark | Reuters*. [online] Available at: <https://www.reuters.com/article/us-google-autonomous-idUSKCN1251WE> [Accessed 26 Nov. 2021].

Allgemeine Informationen, 2019. *TU Braunschweig | Blogs – Der Blog-Service des Gauß-IT-Zentrum*.

Anon 2021. *Tesla driver dies in a first fatal crash while using autopilot mode | Tesla | The Guardian*. [online] Available at: <https://www.theguardian.com/technology/2016/jun/30/tesla-autopilot-death-self-driving-car-elon-musk> [Accessed 26 Nov. 2021].

Bagloee, S.A., Tavana, M., Asadi, M. and Oliver, T., 2016a. Autonomous vehicles: challenges, opportunities, and future implications for transportation policies. *Journal of Modern Transportation 2016 24:4*, 24(4), pp.284–303. https://doi.org/10.1007/S40534-016-0117-3.

Bagloee, S.A., Tavana, M., Asadi, M. and Oliver, T., 2016b. Autonomous vehicles: challenges, opportunities, and future implications for transportation policies. *Journal of Modern Transportation*, [online] 24(4), pp.284–303. https://doi.org/10.1007/S40534-016-0117-3/FIGURES/5.

Bernard, M., Kondak, K., Maza, I. and Ollero, A., 2011. Autonomous transportation and deployment with aerial robots for search and rescue missions. *Journal of Field Robotics*, 28(6), pp.914–931. https://doi.org/10.1002/ROB.20401.

Biau, D.J., Kernéis, S. and Porcher, R., 2008. Statistics in Brief: The Importance of Sample Size in the Planning and Interpretation of Medical Research. *Clinical Orthopaedics and Related Research*, [online] 466(9), p.2282. https://doi.org/10.1007/S11999-008-0346-9.

Breathnach, P., 2000. Globalisation, information technology and the emergence of niche transnational cities: the growth of the call centre sector in Dublin. *Geoforum*, 31(4), pp.477–485. https://doi.org/10.1016/S0016-7185(00)00016-6.

Butler, L., Yigitcanlar, T. and Paz, A., 2020. How Can Smart Mobility Innovations Alleviate Transportation Disadvantage? Assembling a Conceptual Framework through a Systematic Review. *Applied Sciences 2020, Vol. 10, Page 6306*, 10(18), p.6306. https://doi.org/10.3390/APP10186306.

Cadie Thompson and Kristen Lee, 2020. *Tesla History Through the Years, Important Moments, Milestones*. [online] Available at: <https://www.businessinsider.com/most-important-moments-tesla-history-2017-2> [Accessed 26 Nov. 2021].

Choi, J.K. and Ji, Y.G., 2015. Investigating the Importance of Trust on Adopting an Autonomous Vehicle. *https://doi.org/10.1080/10447318.2015.1070549*, 31(10), pp.692–702. https://doi.org/10.1080/10447318.2015.1070549.

Christina Cogdell, 2000. *The Futurama Recontextualized: Norman Bel Geddes's Eugenic "World of Tomorrow" on JSTOR*.

Daily, M., Medasani, S., Behringer, R. and Trivedi, M., 2017. Self-Driving Cars. *Computer*, 50(12), pp.18–23. https://doi.org/10.1109/MC.2017.4451204.

DBpedia, 2021. *Eureka Prometheus Project*. [online] Available at: <https://dbpedia.org/page/Eureka_Prometheus_Project> [Accessed 26 Nov. 2021].

dpa, 2020. Germany aims to get self-driving cars on the roads in 2022 | News | DW | 22.05.2021. *Reuters*.

Edwards, J., Perrone, A. and Doyle, P.R., 2020. Transparency in Language Generation: Levels of Automation. *PervasiveHealth: Pervasive Computing Technologies for Healthcare*. https://doi.org/10.1145/3405755.3406136.

Fagnant, D.J. and Kockelman, K., 2015. Preparing a nation for autonomous vehicles: opportunities, barriers and policy recommendations. *Transportation Research Part A: Policy and Practice*, 77, pp.167–181. https://doi.org/10.1016/J.TRA.2015.04.003.

flexbus, 2021. *FLEX Admin: Daily Rider Report*.

Freie Universitat Berlin, 2011. *Autonomous car navigates the streets of Berlin*. [online] Available at: <https://phys.org/news/2011-09-autonomous-car-streets-berlin.html> [Accessed 26 Nov. 2021].

Gartner, B.Y.N.H., Messer, C. and Rathi, A.K., 2008. INTRODUCTION.

Gavanas, N., 2019. Autonomous Road Vehicles: Challenges for Urban Planning in European Cities. *Urban Science 2019, Vol. 3, Page 61*, 3(2), p.61. https://doi.org/10.3390/URBANSCI3020061.

Hancock, P.A., Nourbakhsh, I. and Stewart, J., 2019. On the future of transportation in an era of automated and autonomous vehicles. *Proceedings of the National Academy of Sciences*, 116(16), pp.7684–7691. https://doi.org/10.1073/PNAS.1805770115.

Jarratt, D. and O'Neill, G., 2002. The Effect of Organisational Culture on Business-to-Business Relationship Management Practice and Performance. *Australasian Marketing Journal (AMJ)*, 10(3), pp.21–40. https://doi.org/10.1016/S1441-3582(02)70156-0.

Jeff Sorensen, 2021. *The Self-Driving Car Series - Part 1 - SocialUnderground*. [online] Available at: <https://socialunderground.com/2015/06/self-driving-car-series-part-1/> [Accessed 26 Nov. 2021].

Johnsen, A., Strand, N., Andersson, J., Patten, C., Kraetsch, C. and Takman, J., 2017. Literature review on the acceptance and road safety, ethical, legal, social and economic implications of automated vehicles.

Joseph C., 1960. *ELECTRONIC ROADS CALLED PRACTICAL; New System of Guiding Cars Safely on Highways Is Shown at Princeton FRUIT OF 7 YEARS' STUDY R.C.A. and G.M. Jointly Conducted It -- Full Use Seen 15 Years Away - The New York Times*.

KAMIJO, S., GU, Y. and HSU, L.-T., 2015. Autonomous Vehicle Technologies :Localization and Mapping. 電子情報通信学会　基礎・境界ソサイエティ *Fundamentals Review*, 9(2), pp.131–141. https://doi.org/10.1587/ESSFR.9.2_131.

Katona, G. and Juhasz, J., 2020a. The History of the Transport System Development and Future with Sharing and Autonomous Systems. *Communications - Scientific letters of the University of Zilina*, 22(1), pp.25–34. https://doi.org/10.26552/COM.C.2020.1.25-34.

Katona, G. and Juhasz, J., 2020b. The History of the Transport System Development and Future with Sharing and Autonomous Systems. *Communications - Scientific letters of the University of Zilina*, 22(1), pp.25–34. https://doi.org/10.26552/COM.C.2020.1.25-34.

Kaur, K. and Rampersad, G., 2018. Trust in driverless cars: Investigating key factors influencing the adoption of driverless cars. *Journal of Engineering and Technology Management - JET-M*, 48, pp.87–96. https://doi.org/10.1016/j.jengtecman.2018.04.006.

Kumar, S., Gollakota, S. and Katabi, D., 2012. A cloud-assisted design for autonomous driving. *MCC'12 - Proceedings of the 1st ACM Mobile Cloud Computing Workshop*, pp.41–46. https://doi.org/10.1145/2342509.2342519.

Lam, A.Y.S., Leung, Y.W. and Chu, X., 2014. Autonomous vehicle public transportation system. *2014 International Conference on Connected Vehicles and Expo, ICCVE 2014 - Proceedings*, pp.571–576. https://doi.org/10.1109/ICCVE.2014.7297613.

Lam, A.Y.S., Leung, Y.W. and Chu, X., 2016. Autonomous-Vehicle Public Transportation System: Scheduling and Admission Control. *IEEE Transactions on Intelligent Transportation Systems*, 17(5), pp.1210–1226. https://doi.org/10.1109/TITS.2015.2513071.

Lin, F., Wang, S., Zhao, Y. and Cai, Y., 2020. Research on autonomous vehicle path tracking control considering roll stability: *https://doi.org/10.1177/0954407020942006*, 235(1), pp.199–210. https://doi.org/10.1177/0954407020942006.

Liu, Y., Wang, X., Li, L., Cheng, S. and Chen, Z., 2019. A Novel Lane Change Decision-Making Model of Autonomous Vehicle Based on Support Vector Machine. *IEEE Access*, 7, pp.26543–26550. https://doi.org/10.1109/ACCESS.2019.2900416.

ben Lutkevich, 2021. *What is an Embedded System?* [online] Available at: <https://internetofthingsagenda.techtarget.com/definition/embedded-system> [Accessed 26 Nov. 2021].

M G, A., VAN, B., R, I. and C, S., 2016. Considering knowledge gaps for automated driving in conventional traffic. pp.102–111. https://doi.org/10.15224/978-1-63248-114-6-33.

Nordhoff, S., Van Arem, B., Merat, N., Madigan, R., Ruhrort, L., Knie, A. and Happee, R., 2017. User Acceptance of Driverless Shuttles Running in an Open and Mixed Traffic Environment. *12th ITS European Congress*, (June), pp.1–14.

Paul, M., College, C. and Thomas, M.B., 2021. A Review on Google Self Driving Car Technology. [online] Available at: <http://theoatmeal.com/blog/google_self_driving_car> [Accessed 26 Nov. 2021].

van de Poel, I. and Royakkers, L., 2006. The Ethical Cycle. *Journal of Business Ethics 2006 71:1*, 71(1), pp.1–13. https://doi.org/10.1007/S10551-006-9121-6.

ben Preston and Jeff S. Bartlett, 2021. *Automakers Are Adding Electric Vehicles to Lineups - Consumer Reports*. [online] Available at: <https://www.consumerreports.org/hybrids-evs/why-electric-cars-may-soon-flood-the-us-market-a9006292675/> [Accessed 26 Nov. 2021].

Rogers, E.M., 2003. Diffusion of Innovations, 5th Edition (Google eBook). p.576.

Ryan, M., 2019. The Future of Transportation: Ethical, Legal, Social and Economic Impacts of Self-driving Vehicles in the Year 2025. *Science and Engineering Ethics 2019 26:3*, 26(3), pp.1185–1208. https://doi.org/10.1007/S11948-019-00130-2.

Salazar, M., Rossi, F., Schiffer, M., Onder, C.H. and Pavone, M., 2018. On the Interaction between Autonomous Mobility-on-Demand and Public Transportation Systems. *IEEE Conference on Intelligent Transportation Systems, Proceedings, ITSC*, 2018-November, pp.2262–2269. https://doi.org/10.1109/ITSC.2018.8569381.

Salonen, A.O. and Haavisto, N., 2019a. Towards Autonomous Transportation. Passengers' Experiences, Perceptions and Feelings in a Driverless Shuttle Bus in Finland. *Sustainability 2019, Vol. 11, Page 588*, 11(3), p.588. https://doi.org/10.3390/SU11030588.

Salonen, A.O. and Haavisto, N., 2019b. Towards Autonomous Transportation. Passengers' Experiences, Perceptions and Feelings in a Driverless Shuttle Bus in Finland. *Sustainability 2019, Vol. 11, Page 588*, 11(3), p.588. https://doi.org/10.3390/SU11030588.

scitepress, 2021. *SciTePress - SCIENCE AND TECHNOLOGY PUBLICATIONS*. [online] Available at: <https://www.scitepress.org/HomePage.aspx> [Accessed 26 Nov. 2021].

Shen, Y., Zhang, H. and Zhao, J., 2018. Integrating shared autonomous vehicle in public transportation system: A supply-side simulation of the first-mile service in Singapore. *Transportation Research Part A: Policy and Practice*, 113, pp.125–136. https://doi.org/10.1016/J.TRA.2018.04.004.

Shi, X. and Li, X., 2021. Constructing a fundamental diagram for traffic flow with automated vehicles: Methodology and demonstration. *Transportation Research Part B: Methodological*, 150, pp.279–292. https://doi.org/10.1016/J.TRB.2021.06.011.

Shoemaker, C.M. and Bornstein, J.A., 2000. Overview and update of the Demo III Experimental Unmanned Vehicle Program. *https://doi.org/10.1117/12.391631*, 4024(10), pp.212–220. https://doi.org/10.1117/12.391631.

Sindelfingen, 2017. *Driver assistance systems: the next step*. [online] Available at: <https://media.mbusa.com/releases/release-3c605dffffa085cd26fc86b88f02dd3e-driver-assistance-systems-the-next-step> [Accessed 26 Nov. 2021].

Smith, B.W., 2012. Managing Autonomous Transportation Demand. *Santa Clara Law Review*, 52.

Sproule, W.J., Neumann, E.S., Lynch, S.W., American Society of Civil Engineers. Committee on Automated People Movers. and International Conference on Automated People Movers (6th : 1997 : Las Vegas, Nev.), 1998. Automated people movers VI : creative access for major activity centers : proceedings of the sixth international conference : Las Vegas, Nevada, April 9-12, 1997. p.774.

TAYLOR KUBOTA, 2019. *Stanford's robotics legacy*. [online] Available at: <https://news.stanford.edu/2019/01/16/stanfords-robotics-legacy/> [Accessed 26 Nov. 2021].

Thor Benson, 2020. *Self-driving buses to appear on public roads for the first time*.

Tom Sitton, W.D., 2001. *Metropolis in the Making: Los Angeles in the 1920s - Google Books*.

Varian, H.R., 2002. Economic Aspects of Personal Privacy. *Cyber Policy and Economics in an Internet Age*, pp.127–137. https://doi.org/10.1007/978-1-4757-3575-8_9.

Wicki, M. and Bernauer, T., 2018. Public Opinion on Route 12. *ISTP Paper Series*, 3. https://doi.org/10.3929/ETHZ-B-000282577.

Wikipedia, 2021. *History of self-driving cars - Wikiwand*. [online] Available at: <https://www.wikiwand.com/en/History_of_self-driving_cars> [Accessed 26 Nov. 2021].

Wotawa, F., Peischl, B., Klück, F. and Nica, M., 2018. Quality assurance methodologies for automated driving. *Elektrotechnik und Informationstechnik*, [online] 135(4–5), pp.322–327. https://doi.org/10.1007/S00502-018-0630-7/TABLES/1.

Yan, Z., 2015. Automobile.

Yu, J.J.Q. and Lam, A.Y.S., 2019. Core-Selecting Auctions for Autonomous Vehicle Public Transportation System. *IEEE Systems Journal*, 13(2), pp.2046–2056. https://doi.org/10.1109/JSYST.2018.2864589.

Yu, J.J.Q., Lam, A.Y.S. and Lu, Z., 2018. Double Auction-Based Pricing Mechanism for Autonomous Vehicle Public Transportation System. *IEEE Transactions on Intelligent Vehicles*, 3(2), pp.151–162. https://doi.org/10.1109/TIV.2018.2804161.