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Nazarbayev Intellectual School of physics and mathematics in Kokshetau

**What are the current and future effects of Self-Driving Cars in Global Area?**

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**ABSTRACT**

Overall, this research was about the future and current opportunities or limitations of Self-Driving Cars’ implementation in the world. Several questions like “How does Self-Driving Cars work?”, “What do people think about the automotive vehicles’ implementation?” and “What are the effects of them in global area?” were investigated and answered by this research. To reach aims, there were conducted three types of methods, such as background research, survey, and interviews, with focus on the authorized sources, specific audience, and specialized professionals. Briefly, the results have shown positive correlation between people and Self-Driving Cars, indicating that it will be good innovative technology in the future.

**INTRODUCTION**

One of the most ambivalent questions in the contemporary world is the concern about is an increase of automotive vehicles (AVs henceforth) at number beneficial trend or not. There are those who say that this type of vehicle facilitates people’s lives, whereas others make an assertion that we should stop inventing them due to their unfavorable effects on the whole world and its population.

Our world is suffering a setback related to air pollution due to the traditional cars that emit greenhouse gases annihilating ecosystem. I am concerned about this environmental issue caused by fuel-based cars; thus, I want to study will self-driving cars reduce the impact of formers in future. In addition, it is to some extent believed that AVs will be safer, so I want to consider this part of these cars too, in addition to the concerns about will it has an attitude to society.

In Kazakhstan, there are different points regarding the riding of the AVs. Alternatively, only one strong perspective of country related to this type of vehicle is met in Germany who is for, and Belgium who is against the usage of SDCs. Anyway, all perspectives are considered in global area, where most of the population stick only to one side. What is this point of view and is it a right decision will be described soon.

The outcomes of this study will help world population to understand the effectiveness and ineffectiveness of automotive vehicles. To put it another way, it will explain should we be concerned about the invention of AVs because of their detrimental impact on our world, or we should bear and accept the development of automotive vehicles due to their immense influence on our environment.

**CONTEXT**

The current self-driving cars (SDCs henceforth) have gone through various changes for just one decade: it started from 1925, when New York’s electrical engineer Francis Houdini has invented the concept of an autonomous vehicle (AV henceforth) working remotely controlled and travelling over 19 kilometres between Broadway and Fifth Avenue, and its adequately working prototype has been finally implemented in 1980 by German Ernst Dickmanns, who converted a Mercedes-Benz van into a computer-guided self-driving car. This car could be ridden at 63 kilometres per hour and has travelled more than 1000 kilometres through Paris in traffic (Karla, 2021). In 1995, the European Commission under the name of Project Eureka financed this project and provided Dickmanns approximately 800 million euros to conduct a research project based on self-driving cars.

How does this type of vehicle work? AV demands the super-human vision with an absolute predictability and decision-making capability, so to sophisticate these requirements there are overlapping sensors working for AV to accurately perceive the world around it. To put it another way, there are two types of sensors having their own positive and negative sides, so if they are put together in “sensor fusion” called artificial intelligence (AI henceforth) driven process, they can access to SDC to feel the flow of data coming from outside and make manoeuvres on the road (Joann, 2023). However, these sensors are limited during the rain and fog, so there are other types of sensors, such as Radar, Lidar, and Ultrasonic sensor. Interestingly, the latter one uses the way bats feel the distances around them in the dark. Additionally, sending out pulsating radio waves, using signals that bounce back from high-speed lasers, and transmitting high-frequency sound waves help AV to paint a detailed 3D picture of an object or to gauge the distance to the objects.

What is told in local area – in Kazakhstan? First Deputy Chairman of the Administrative Police Committee of the Ministry of Internal Affairs of the Republic of Kazakhstan told, “The driver of AV is responsible in case of violation of traffic rules, since the use of the autopilot function implies an action performed while driving the vehicle (TengriNews, 2016),” - that is, there is an administrative fine in accordance with the law of Kazakhstan. Alternatively, the lawyer Alexander Kaplan makes an assertion that government should alter the law “On Road Traffic” in order to specify and distribute responsibility for violations of traffic rules using an autopilot. As for ordinary citizens, for example, Sanzhar Altayev, the owner of SDC in Kazakhstan, said that the driver should think in advance where he or she can turn it on and where must drive themself.

On the national perspectives, there are two different points of views from Belgium and Germany related to SDC. The former country’s federal Mobility minister Georges Gilkinet believes that AV has many disadvantages: firstly, drivers can not react at the crucial situations; secondly, AV also gets stuck in traffic jams and cause pollution; finally, it is better to ride on the train for a long journey, not in this car (BelgaNewsAgency, 2023). Meanwhile, Germany’s government encourages start-ups about SDC, one of which is the ‘Vay’ service, which has collected around 100 million dollars from investors as Google Chief Financial Officer Patrick Pichette, Kinnerik and venture capital firm Atomico, and which is based on teledrivers delivering electro vehicles (EV henceforth) to client to drive themselves to their destination. Afterwards teledrivers would steer the AV to the next customer. However, despite the numerous of investments, expectations from the AV’s features have deflated. Even so, one of ‘Vay’ start-up owners Thomas von der Ohe assumes that they will work at their start-up to talk only about months, not years to develop the final version of their invention (AutomotiveNewsEurope, 2023). What about the whole world’s opinion? The topic is divided between three different points of view: only 13% of people around the world say they would never use a SDC (Germany 31%, USA 24$, China 5%); 46-63% of world population does not sure about SDC but find this idea interesting; the rest are in favor of AV, especially developing countries (India 49%, Russia 33%, USA 22%) (Naill, 2018).

In the contemporary world, there are two main failures of this type of vehicle: firstly, a pedestrian getting killed by a self-driving Uber car, secondly, a Tesla Model X an autopilot mode slammed into a highway divider before bursting into flames (Naill, 2018). Belgium also makes an assertion that SDC has several limitations to be unutilized, one of which is the fact that at crucial situations driver will be busy by unrelated to road things (BelgaNewsAgency, 2023).

Despite these negative sides, there are future pleasant outcomes having positive impact on our economy: mobility-mix; decreasing of traffic fines; expanding of job market (Andreas, 2023). That is why, the purpose of this research is, firstly, to identify are the automotive vehicles positive or negative trend at the current time, and, secondly, to specify the future feasibilities and limitations of SDC so that humanity will understand should they concern about the development of AVs at breakneck speed or not.

**AIMS AND OBJECTIVES**

The purpose of this research project was to indicate public opinion, evaluating does it coincide with experts’ points of view. The aim was to specify the current and future limitations and feasibilities of automotive vehicles.

Therefore, this research includes these main questions:

* To what extent are people aware or not of the global issue of self-driving cars?
* What are the opinions of experts on this issue of self-driving cars?
* What are the current opportunities and consequences of automotive vehicles?
* What are the future feasibilities of automotive vehicles?

The outcomes of the research were intended to increase understanding of the limitations and feasibilities of automotive vehicles so as to approach better to the problem of self-driving cars.

**METHODOLOGY**

The research design included several different methods, during the investigation of research question. It enabled the gathered data to be checked and confirmed by each method, to eliminate the potential biases and inaccuracy and to strengthen the overall quality of the research, rising the confidence in the conclusions.

First of all, the background historical research from Internet was conducted to get general overview about the topic. As the century of technologies is becoming more widely discussed, there was a lot of sources about lives-changing Self-Driving Cars. In addition, most of them were outdated that eliminated the requirements of rechecking the articles. Authorship had also been verified by RAVEN analysis before the sources were chosen. It could provide the research with more confidence.

To prevent sources from being contradicted to each other, the background research concentrated upon internationally respected sources, web magazines that had specific knowledge about the topic and recent research. To illustrate, the Automotive News Europe was the website about whole vehicles, having additional knowledge about it, and Forbes was internationally read magazine that had their readers from all over the world.

The background data about public opinion and potential responses to automotive vehicles had formed the design of the two primary research methods.

The first method was used to find out public opinion from online Google forms survey. The questionnaire was targeted upon people from 14 to 65 years old. The reason for the selection of this age group in online were:

* The topic required a wide range of opinions.
* The sample was easy and safe to get access to.
* Permission to give the survey to these individuals was obtainable.
* People could choose to participate, making the research ethical.
* People of these ages were aware of the topic as they potentially might, would or did buy a car, so this topic was familiar for them.

To make the sample representative people were chosen in different cities of Kazakhstan and in average 12 person were questioned from each of 10 big cities of country, so 154 questionnaires were completed. However, seven of these answers were spoiled or not completed properly, so the final sample size was 147. This enabled the results to be generalizable to all people from 10 cities, especially Kazakhstan.

The first part of the survey was designed to gather data about ages and genders of the respondents so that different social groups could be compared. The next section was dedicated to define the awareness of respondents about Self-Driving Cars (SDC henceforth) and, finally, the last part was presented to indicate the opinion about how SDC could affect the current and future life.

The questionnaires were completed in passing by the respondents, and each respond took approximately 3 minutes to complete.   
 The second of the two primary research methods were the interviews. This method was concentrated on finding an adequate specialist that has a specific knowledge about Self-Driving Cars.

In this method, the interviewee that has an immense knowledge about vehicles, who had been graduated with specialization in Physics field. He was invited to voice-call meeting in the platform named Zoom and had been questioned by several questions.

The first part included the questions about himself: how old he was, why he had chosen this field to work on and other questions. The next part indicated the questions relating to the different situations caused by Self-Driving Cars and how the interviewee would resolve them. To illustrate, he was asked about “who would be responsible for, if there would be attacks to Self-Driving Car from hackers”. And finally, interview had got his several opinions regarding to the implementation of the Self-Driving Cars’ utilization.

The data gathered was analyzed and applied to the research question.

**RESULTS**

The background research gathered based on 8 sources from websites and international magazines, such as Forbes and Automotive News Europe.

Analyzing overall messages from each source, it was generally identified that:

* Self-Driving Cars were considered by majority of population as benefit rather than negative trend.
* Self-Driving Cars were appeared recently and the works on them continued.
* The minority of countries had banned the utilization of Self-Driving Cars, whereas the vast majority accepted their usage.

In summary, this background research results had shown the collective mindset about Self-Driving Cars around the whole world, indicating that even if there was an immense public who was for the development and future utilization of Self-Driving Cars in the future, there were those, though they were small groups, who were against the Self-Driving Cars’ usage soon.

Then, the survey was conducted around Kazakhstani students, and there were appeared specific opinion that the majority tended to hold.

In summary, 83,4% of respondents are for or more in favor than against for the future usage of the SDC, according to the table 1.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Do you want to use SDC in the future? | Yes | More in favor than against | More against than in favor | No |
| Percentage: | 50% | 33,4% | 24,9% | 8,5% |

Table 1.

All survey results’ script was provided in the Appendices.

Further, there were provided the survey explanations of their usage:

* Two first questions indicated the age and gender of respondents, showing the high proportion of underage pupil around 92%.
* The 3rd, 4th and 5th questions demonstrated the public altitude regarding to the Self-Driving Cars that is more positive than negative.
* The next three pie charts and bar chart indicated respondents’ attitude to the different road-accident situations.
* Finally, the last question asked about high changes in the future, if there would be an implementation of SDC, demonstrating that a vast majority listed and chose the positive consequences of them.

Overall, respondents being aware of the SDC, gave a positive rate for the implementation of SDC in the future.

Afterwards, the Interview among two competent specialists in Physics and Vehicle fields were conducted.

In summary, both of interviewee providers are more in favor of the implementation of the Self-Driving Cars in the future than against it.

The interviews’ scripts were provided in appendices.

Further, there were given specialists' views regarding to the SDC:

* Positive sides:

1. It reduces traffic jams in the cities due to its constructed algorithms.
2. It is eco-friendly car.

* Negative sides:

1. This type of car is still new technology, so it is not ready to be driven in some infrastructures.
2. This car may lead to the loss of jobs among the majority.

Overall, these interviews had shown that Self-Driving Cars might have more positives from interviewees’ answers.

All things considered, three types of research results were described, and what could be point out from them is that the majority of public were in favor of SDC than against.

**CONCLUSION**

The information that has been gathered from primary and secondary research has helped to develop a clear understanding of individuals' opinions regarding the implementation of Self-Driving Cars and identify possible outcomes that will occur soon if this type of vehicle is applied to the world.

In secondary research, there were points of view from all over the world relating to the implementation of Self-Driving Cars, whereas in primary research the main focus was on school students and competent specialists. There are different types of audiences: 34% of pupils out of 154 respondents and 2 interview givers who were aware in Physics and Vehicle fields, and more than 70% of world’s population were more in favor than against of the Self-Driving Cars utilization. What about opportunities which will be provided by Self-Driving Cars that was alluded in research question 9? First of all, secondary research confirms with interview givers that Self-Driving Cars are still new technologies that need further research and development in order to avoid or minimize the detrimental impact on roads. It is also worth to consider the fact that survey respondents and interview specialists share an opinion that Self-Driving Cars are ecologically friendly. That is, they might not harm the ecology that makes them prioritized due to the commitment to the Sustainable Development and may reduce traffic jams, improving the transportation system in the countries. However, it is noticeable that although Self-Driving Cars may have a beneficial impact on economy of the countries, that is what was concluded by survey results, but according to interview givers to make an assertion that this type of vehicles might lead to joblessness in countries' work markets.

To sum up, it is absolutely notable that research methods had shown the positive attitude of world's population. Although Self-Driving Cars may provoke a lack of jobs in the world and they still need the improvements to be fully safe to use, this type of autonomous vehicles can positively affect the economy, road jams decrease, and the ecology.

**EVALUATION**

Overall, the research has answered all questions and aim of the research was achieved.

The background research was helpful in order to understand the wide range of information and was conducted from respectful sources such as Forbes and Automotive News Europe, that is why they were considered as a valid and reliable. However, some caution should be utilized as approximately all companies have a vested interest in promoting research that supports their own objectives. Many of Forbes’ articles with the statistics, for example, may be gathered from government officials that can be created so that they can show their countries in the best possible circumstances.

Clear conclusions could be made from survey analysis and the findings attached to the population sampled – young people from school. The results can be generalized to all youngsters in Kazakhstan. The large sample of 147 respondents from school makes this research both reliable and representative. If repeated in different schools the same results might be obtained. However, the conclusions are not generalizable to older ones as their percentage in questionnaire was very small.

The formal interviews worked well as the interview givers provided valuable knowledge and insights about the topic. The large, allocated time allowed them to talk for a long time and share their own personal views freely. It was available also due to the informal atmosphere as they connected to the call by application at their home on holiday time. This made the data gathered valid and accurate. If there was more time more interviews could be conducted to strengthen the conclusions. For instance, interviews with car company owners would be of value. All things considered, the conclusions from the interviews confirmed the results from the previous methods, so it gives high confidence in the conclusions to this research.

**FURTHER RESEARCH**

The research was too fascinating, and I could learn a lot about the background of the issue. I was surprised that there was an essential part of people who was against of the Self-Driving Cars’ (SDC henceforth) implementation as I never met individuals who were not for the type of these cars. Despite this, there were more people who are interested in the purchase of the SDC. So, it has given me a lesson how to distinguish own personal perspective and that of world.

The research was successful because I found out what are the future possibilities and limitations of the implementation of this type of vehicle – surprisingly, they were evaluated by each method as a favorable trend in future. More research should be done in order to find possible ways to change the negative sides of this type of car into positive ones.

The research fully did change my own perspective on the issue – I am afraid of the utilization of this type of car in near future as they are not fully secure to ride on.

**REFERENCES**

Akhmetov, A. (2016). The use of autopilot in cars was commented on by the Ministry of Internal Affairs of the Republic of Kazakhstan. TengriNews.

Retrieved from:

<https://tengrinews.kz/autos/ispolzovanie-avtopilota-avtomobilyah-prokommentirovali-mvd-294263/amp/>

Andreas, T. How cities can benefit from automated driving. BOSCH.

Retrieved from:

<https://www.bosch.com/stories/economic-impact-of-self-driving-cars/>

Automotive News Europe. (2023). “Teledriving” tests in German city bring full self-driving closer to reality.

Retrieved from:

<https://www.europe.autonews.com/automakers/teledriving-tests-german-city-bring-full-self-driving-closer-reality>

Belga News Agency. (2023). No green lights for self-driving cars on Belgian roads.

Retrieved from:

<https://www.belganewsagency.eu/no-green-light-for-self-driving-cars-on-belgian-roads>

Joann, M. (2023). How autonomous vehicles “see” the world around them. Axios.

Retrieved from:

<https://www.axios.com/2023/03/29/how-autonomous-vehicles-see-the-world-around-them>

Karla, G. (2021). The history of autonomous vehicles, how they have evolved since the first prototypes. BBVA.

Retrieved from:

<https://www.bbva.ch/en/news/the-history-of-autonomous-vehicles-how-they-have-evolved-since-the-first-prototypes/>

McCarthy, N. (2018). Global opinion divided on self-driving cars [Infographic]. Forbes.

Retrieved from:

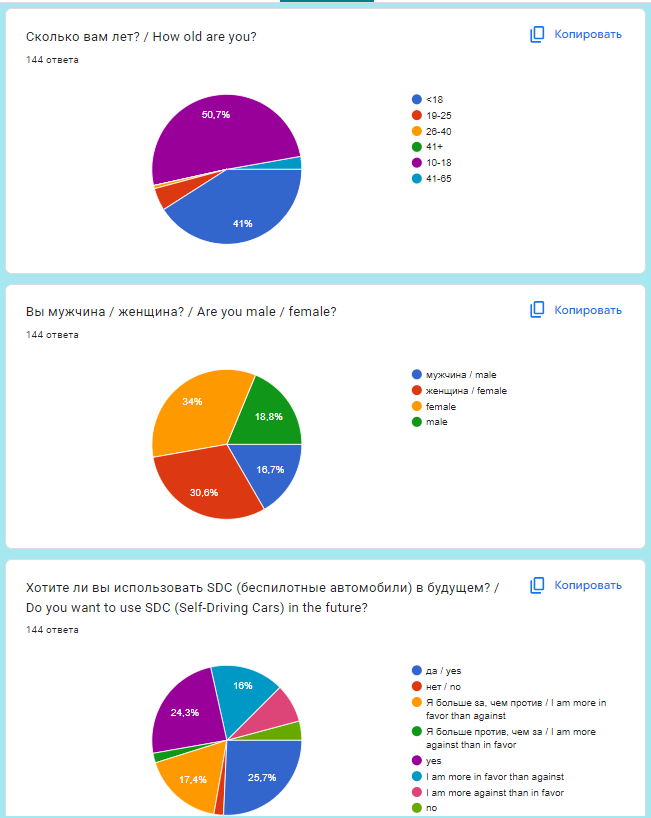
<https://www.forbes.com/sites/niallmccarthy/2018/04/13/global-opinion-divided-on-self-driving-cars-infographic/?sh=11211942110f>

Roman, Z. (2016). Self-driving cars will change cities. Regional Science and Urban Economics.

Retrieved from:

<https://www.sciencedirect.com/science/article/abs/pii/s016604621630182x>

**APPENDICIES**

Изображение выглядит как текст, снимок экрана, число, программное обеспечение

Автоматически созданное описаниеИзображение выглядит как текст, снимок экрана, Операционная система, программное обеспечение

Автоматически созданное описаниеИзображение выглядит как текст, снимок экрана, Параллельный, число

Автоматически созданное описание

**Interviewee 1:**

* Hello, my name is Altair, I am 11th grade student at NIS Kokshetau. I would like you to answer several questions regarding Self-Driving Cars. So, the first question how old are you?
* I am 39 years old.
* Are you male or female?
* I am male.
* Okay, do you want to use self-driving cars in the future?
* No, because Self-Driving Cars may not recognize some buildings so it may cause several road-accidents.
* What are the positive sides of Self-Driving Cars?
* I think it can reduce traffic jams of the cities, because SDC have better algorithms that could lead to better understanding of road situations, and they go much efficiently than human being.
* What are the negative sides?
* Electric cars are still new technology and infrastructure is not ready for SDC, because it may be harmful for people because SDC are only adaptive to US roads, so they can not ride on my country.
* Okay, the next questions will be regarding to the several situations. The first one, who will be responsible if SDC have got attack from viruses, so it lost its control?
* It depends on the model of car, firstly. The model of car is equipped with functional tools that driver can use to drive by himself, and if he will drive by himself, it is obviously his fault. But if road-accident occurred when SDC was on automate mode, so it is fault of company.
* Second question is similar to the previous. Who is responsible if there would be road accident due to the errors in SDC.
* It is fault of company, but in tesla it is fault of machine learn designer, because Tesla use graphical segmentation that allows the computer vision surrounding, and if there any problems in that it would be a fault of company.
* If child went to the road and was hit by SDC accidentally?
* It is obviously fault of parents.
* What will change in our current lives if humanity start using SDC?
* It depends on who you are. If you are driver you will lose your job. But if you are pedestrian, you may get better experience. SDC can eliminate traffic lights on the roads, because SDC can just manipulate with surrounding and could drive to one place without any unpleasant situation.

**Interviewee 2:**

- Hello, Mr. Alikhan. So, we are here to discuss the topic of self-driving cars. The first questions will be regarding to yourself. So, how old are you?

- Hello, Altair. Thank you for inviting me to this interview. I am 35 years old.

- Okay, thank you! Are you male?

- Yes, sure.

- Do you want to use self-driving cars in the future?

- Yep, of course, I already have one of them. Tesla model X is in my garage.

- In your opinion, are self-driving cars positive trend?

- Yes, sure. Nowadays, most of the SDC use electricity, so they are eco-friendly cars. Therefore, they are positive trend.

- What about negative side?

- In my opinion, there are no negative sides, because they are technological development of our century.

- Who will be responsible, if there would be road-accident in the context, where SDC were attacked by viruses?

- It is responsibility of company, because the company should make them so that they prevent such situations.

- What about situations, where self-driving cars lost their control accidentally.

- As I mentioned before, it is fault of IT-specialists and the company.

- If child went to the road and was hit by SDC accidentally.

- It is responsibility of self-driving cars, because they must prevent such kind of situations. Cars should decrease their speed, if they meet with this situation.

- Have you ever met with any kind of road-accidents?

- Not yet.

- Why?

- I drive car by myself.

- Would there be any accidents if you turn a mode of “self-driving car”?

- As I mentioned before, I try to use them by myself without this mode. I can do any kind of outcomes only after tests on SDC. So, right now, I am neutral about that.

- What could be the hugest change in the future if we start using SDC?

- I see them as a technological progression because the way they use eco-friendly energy is also emphatic for me.